Short-run dynamics and long-run effects of monetary policy on residential property prices in South Africa

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Abstract

Purpose – The study aims to estimate the short- and long-run effects of monetary policy on residential property prices in South Africa. Over the past decades, there has been a monetary policy shift, from targeting money supply and exchange rate to inflation. The shifts have affected residential property market dynamics.

Design/methodology/approach – The Johansen cointegration approach was used to estimate the effects of changes in monetary policy proxies on residential property prices using quarterly data from 1980 to 2022.

Findings – Mortgage finance and economic growth have a significant positive long-run effect on residential property prices. The consumer price index, the inflation targeting framework, interest rates and exchange rates have a significant negative long-run effect on residential property prices. The Granger causality test has depicted that exchange rate significantly influences residential property prices in the short run, and interest rates, inflation targeting framework, gross domestic product, money supply consumer price index and exchange rate can quickly return to equilibrium when they are in disequilibrium.

Originality/value – There are limited arguments whether the inflation targeting monetary policy framework in South Africa has prevented residential property market boom and bust scenarios. The study has found that the implementation of inflation targeting framework has successfully reduced booms in residential property prices in South Africa.

Keywords Residential property prices, Mortgage finance, Interest rates, Inflation targeting regime, Exchange rates, Johansen cointegration

Paper type Research paper

Introduction

The deviations of house prices from their fundamental value over the past decades due to monetary policy changes have continued to catch the attention of academics and policymakers across the globe. Over the decades, there has been an increase in massive boom–bust cycles in house prices in the USA, the UK, Spain, Ireland and China, to mention a few (Martin *et al.*, 2021). From 1996 to 2005, residential property prices have risen by more than 45% after adjusting for inflation (Baker, 2005). This unprecedented run-up in house prices generated more than US$5tn in housing bubble wealth, and the housing boom later

JEL classification – R1, E5

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bust in the 2007/2008 global financial crisis which caused more than a US$7tn fall in aggregate housing wealth (Economic Report of the President, 2012). Recently, there has been an increase in house prices during the COVID-19 lockdown period from 2020 to 2022 (Bally and Everett-Allen, 2021; Bank for International Settlement, 2022). According to Bally and Everett-Allen (2021), Knight Frank's Global House Price Index noted that 94% of 56 countries experienced residential property price inflation from the first quarter of 2020 to the first quarter of 2021, although it was uneven across economies. The Bank for International Settlement (2022) further noted that in the third quarter of 2021, global residential property prices accelerated to 5.5% yearly in real terms, the greatest since the eve of the 2007/2008 global financial crisis. The boom and bust of house prices were attributed to changes several monetary policy proxies such as interest rates (Baily *et al.*, 2008; Dieckelmann *et al.*, 2023; Jordà *et al.*, 2015; Dullien *et al.*, 2008; Shi *et al.*, 2014), conditions of obtaining mortgage finance (Karley, 2006; Koblyakova *et al.*, 2021) and other factors such as economic growth (Agnello and Sousa, 2009; Khan *et al.*, 2014; Yildirim and Yağcibaşi, 2019). Given the potential impact monetary policy variables have on residential property prices, the paper addresses the question of how the current monetary policy regime in South Africa has managed to influence residential property prices in the short and long run. Furthermore, monetary policy in South Africa does not target residential property prices, it targets consumer price index. The study provides an insight on how the inflation targeting framework has contributed to residential property price fluctuations in South Africa since its establishment in the year 2000.

Overview monetary policy and residential property prices

Over the past decades, there has been an increase in the adoption of inflation targeting by economies across the globe to control general price of goods and service within a certain target using short-term interest rates (Jahan, 2012). The implementation of inflation targeting has been mainly influenced by two theoretical breakdowns. First, in the 1970s, economies across the globe adopted monetary policy easing with the aim of promoting economic growth; however, it resulted in stagflation where there is stagnant growth associated with high inflation (South Africa Reserve Bank, 2023). Therefore, loose monetary policy's bid to promote economic growth failed as it exacerbated inflation, which negatively affected the ordinary people. After then, inflation become the enemy number of the state (Du Rand *et al.*, 2023). Second, the need for independent, transparent and accountable central banks, given their role in promoting financial viability gave rise inflation targeting (Bhalla *et al.*, 2023). The benefits inflation targeting has regarding combating inflation and promoting transparency and accountability have resulted in a number of countries, such New Zealand, Canada, the UK, Finland, Sweden, Australia and Spain and South Africa adopting inflation targeting. The inflation targeting was implemented in South Africa out of a desire for financial stability, which is a prerequisite for long-term, sustainable growth and development (Kumo, 2015). It aims to keep inflation in line with a given target through maintaining inflation rate within 3%–6% using short-term interest rates (South Africa Reserve Bank, 2023).

The use of short-term interest rates in maintaining inflation rate within the 3% to 6% target affects residential property prices through different monetary policy transmission mechanisms such as the savings and investment channel, exchange rate channel, inflation expectation channel and the wealth channel (Berg *et al.*, 2013; Gumata *et al.*, 2013; Miyajima, 2021; Sethi *et al.*, 2019; Smal *et al.*, 2001; Van Hai and Trang, 2015). Through the savings and investment channel, increase in interest rates increases costs for borrowers with flexible interest rate debt such as the interest rate on residential property loans (Atkin and Cava,

2017). Increasing cost of borrowing discourages borrowing and promote saving. Increased savings and reduced borrowing weaken demand and reduce price pressures in the economy. Monetary policy can also affect short- and long-run dynamics in the economy through exchange rate channel (Borio and Zhu, 2008; Chanda, 2021; Gumata *et al.*, 2013; Ouchchikh, 2018), a higher interest rate will tend to strengthen the rand's exchange rate. An appreciating exchange rate improves returns on rand-based investments, which includes returns in real estate investments. Furthermore, increasing interest rates signals a commitment to reduce inflation, and households, firms and investors will factor in their expectations on price and wage when making their decisions (Akinlo, 2021; Haldane and Haldane, 1994; Patrick *et al.*, 2017). Monetary policy can affect the residential property market using the wealth channel, increase in interest rates reduces the prices of properties hence housing wealth (Goeltom, 2006; Ndubuisi, 2015). Therefore, it is undisputable that monetary policy significantly influences residential property price dynamics in the short and long run. The inflation targeting contributes to South Africa's overall financial stability through addressing uncertainties that increases risk in financial markets and institutions (Mandeya and Ho, 2021).

Before the inflation targeting was implemented, tracing back to when the South African Reserve Bank was established on December 17, 1920, the value of its currency was based on the gold standard (Feingold *et al.*, 2021). In 1932, South Africa decided to end the use of the gold standard and replace it with a monetary policy that tied the value of its currency to the British pound (Swanepoel and Fliers, 2021). In 1944, the Currency and Banking Act of 1920 was replaced with the South African Reserve Act 29 of 1944. The South African Reserve Act 29 of 1944 was enacted to regulate the monetary system in South Africa and extend the issuing of bank notes, which was by then one of the mandates of the South African Reserve Bank (Vermeulen, 2020). In 1961, South Africa gained independence, and on February 14, 1961, the South African Reserve Bank abandoned the pound and introduced the rand. In 1985, South Africa introduced the dual rand system with two exchanges rates. The dual rand system was enacted as an exchange control in response to significant capital outflows resulting from debt default and economic sanctions (South African Reserve Bank, 2011). The dual rand system was abolished in 1995. In 1989, the South African Reserve Bank Act 90 of 1989 was enacted, and it replaced the SARB Act 1944 (South African Reserve Bank, 2011). The main objective of the Act was to protect the internal and external value of the rand (Honohan and Orphanides, 2022). In 2000, South Africa became the 13th country to adopt an inflation-targeting monetary policy framework (Kumo, 2015). The SARB targets an inflation band between 3% and 6% for consumer inflation (Miyajima, 2021). The development of the monetary policies significantly influenced residential property prices. Figure 1 demonstrates the monetary policy events between 1980 and 2022 and the real residential property index trend in the same period.

Figure 1 demonstrates that real residential properties responded to different monetary policy regimes and decisions implemented by the South African Reserve Bank. The figure has demonstrated that there is a relationship that exists between changes in monetary policy in line with empirical studies. From 1980 to 1984, there was an increase in mortgage interest rates. However, the same period was characterized by increased house prices. Therefore, factors other than changes in interest rates influenced the trend, as a substantial increase in interest rates is associated with a decline in residential property prices (Dieckelmann *et al.*, 2023; Jordà *et al.*, 2015; Shi *et al.*, 2014; Trimbath and Montoya, 2005). Since 1985, there have been significant policy changes in the monetary policy framework in South Africa. In 1985, the South African Reserve Bank introduced the dual rand system to bust the economic sanctions imposed on apartheid South Africa, and it was associated with

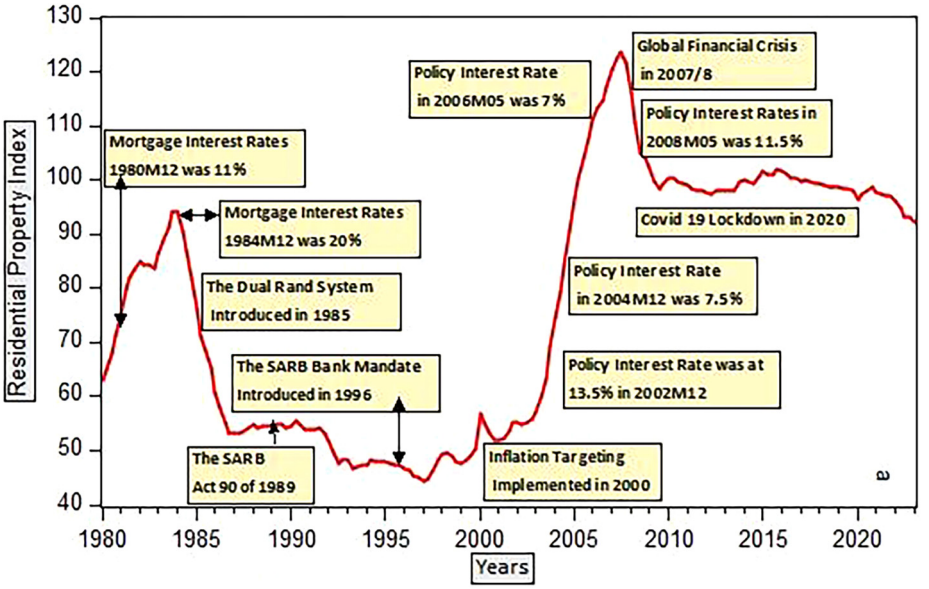

Figure 1.
Residential property prices for South Africa from 1980 to 2022 and monetary policy events

Notes: Figure 1 shows real residential property prices for South Africa index 2010-100 quarterly, Not seasonally adjusted. The data was obtained from Federal Reserve Economic Data. The residential property prices are matched with monetary policy changes that occurred from 1980 to 2022
Source: Authors' own creation

declining residential property prices. In 2000, the inflation targeting framework was implemented, and times leading the implementation of the inflation targeting were characterized by declining policy interest rates, and increasing house prices, leading to the housing bubble, which caused the 2007/2008 global financial crisis after the housing market bust. After the bust of house prices in 2008, the South African Bank increased the policy interest rate by 650 basis points between 2008 and 2010, associated with a decline in house prices. During the COVID-19 lockdown, the South African Reserve Bank reduced the policy rate by 225 basis points in the first four months of the year. The reduction in policy rate was associated with an increase in residential property prices but was lower than the increase from 2003 to 2007. Due to the lessons learned from the 2008 global financial crisis, the monetary policy easing during the COVID-19 lockdown had a less significant impact when compared to the effect of monetary policy easing during the times leading the 2008 global financial crisis.

Theoretical framework

The user cost framework and the Taylor's Rule is discussed as the framework of monetary policy and residential property prices. The user cost model has been used to establish the relationship between interest rates and prices of residential real estate. The framework states that cost of owning a residential property is a summation of maintenance cost, property taxes, transactions cost, opportunity costs such as the returns to property equity and the cost of servicing the mortgage (interest rates) (Kuttner, 2012). According to

Poterba (1984) for housing to be considered optimal, the rental income (R) from one unit of housing service must equal the net cost of keeping the asset, less the anticipated capital gain. The user cost equation 1 is depicted as follows:

$$R_t/P_t = \left(i_t + \tau_t^p\right) + \left(i_t + \tau_t^y\right) + \sigma_t + \delta - \dot{P}_t^e/P_t$$

where R_t/P_t is the rent-to-price ratio, i is the nominal interest rate, δ is the depreciation, σ is the risk premium, $\dot{P}_t^e/P_t$ is expected nominal property price appreciation, τ_t^p is the property tax rate and τ_t^y is income tax rate. Equivalently, subtracting the expected rate of inflation yields an expression in terms of the real interest rate and the rate of real house price appreciation. The model after adjusting for inflation is expressed as follows:

$$R_t/P_t = \left[\left(i_t + \tau_t^p\right) + \left(i_t + \tau_t^y\right) + \sigma_t + \delta - \pi_t^e\right] - \left(\dot{P}_t^e/P_t - \pi_t^e\right)$$

where the term in square brackets represents the real user cost, excluding expected real residential property price appreciation. Based on the user cost framework as defined by Poterba (1984), interest rates play a significant role in determining residential property prices. The effects of changes in interest rate are further demonstrated by differentiating equation (1) or (2). After differentiating equation (1) and 2, equation (3) was obtained.

$$\frac{1}{P}\frac{\partial P}{\partial i} = -\frac{(1-\tau^y)}{UC}$$

It implies that there is a negative relationship between interest rates and residential property prices and the sensitivity of house prices to interest rates is determined by risk premium and the level of expected inflation (Yiu, 2023). According to Kuttner (2012), a reduction in risk premium and increase in expected rate of inflation, all things being equal, significantly increases price of residential properties and reduces the rent to price ratio, hence increasing the sensitivity of house prices to interest rates. The user cost framework discussed how the relationship between interest rates and house prices emerge and concluded that there is an inverse relationship and the sensitivity of house prices to interest rate can be directly influenced by risk premium and the level of expected inflation.

Furthermore, the role of monetary policy in explaining the deviation of assets prices from their fundamental value has been discussed using the Taylor Rule. The Taylor Rule states that central banks aim at stabilizing inflation around its target level and output around its potential (Ambrose *et al.*, 2018; Bunzel and Enders, 2010; Hofmann and Bogdanova, 2012; Orphanides, 2007), and whenever there is a positive or negative deviation of the two variables from their target or potential level, it would be associated with a tightening or loosening of monetary policy to address the imbalance, respectively (Okoye, 2018). The Taylor Rule argues that if there is a deviation of price from their target level and output from its potential and the central banks do not intervene to stabilize the inflation and output, the prevailing interest will have a detrimental effect on house prices as the level of interest rates will not be in line with the Taylor Rule. Interest rates that are below the Taylor's Rule are likely to result in housing bubbles where residential property values are beyond their fundamental values and interest rates above the Taylor's Rule are likely to reduce housing wealth as property values fall below their fundamental value (Taylor, 2009). The conclusions by Taylor manifested during the periods preceding the 2008 global financial

crisis. Years leading to the 2008 global financial crisis were characterized by low interest rates, rising prices of goods and services and output fluctuations (Taylor, 2007). As the inflation was rising, central banks were supposed to hike interest rates; however, this did not happen, interest rates were kept at a very low rate, which was in violation of the Taylor's Rule. Accordingly, interest rates that prevailed in the market since 2003, particularly in the USA, were below the Taylor's Rule. This led to a housing bubble, which later bust in 2008. Taylor (2007) argues that an interest rate that keeps the inflation rate within the target and output within its potential can prevent bubbles and busts in the housing market.

Empirical literature

There is a plethora of studies that have investigated the effects of monetary policy proxies on residential property prices. Despite long and vast literature on monetary policy on house prices, there is a growing consensus that central banks' influence on monetary policy has contributed significantly to the residential property prices fluctuations. The boom and bust of house prices were attributed to changes in several monetary policy proxies such as interest rates (Baily *et al.*, 2008; Dullien *et al.*, 2008; Dieckelmann *et al.*, 2023; Jordà *et al.*, 2015; Shi *et al.*, 2014), conditions of obtaining mortgage finance, (Karley, 2006; Koblyakova *et al.*, 2021) and other factors such as economic growth (Agnello and Sousa, 2009; Khan *et al.*, 2014; Yildirim and Yağcibaşi, 2019). The study discussed literature with regard to the impact on interest rates on house prices, the impact of mortgage finance on residential property prices and finally, the impact of other monetary policy factors such as economic growth, inflation, inflation and exchange rate.

Interest rates and residential property prices

Monetary policy transmits into the economy through changes in official interest rates. Changes in official interest rates have a significant impact on money market interest rates, bank lending rates, expectations on future interest rates, investment and savings decisions and supply of credit and loanable funds, yet these aspects significantly influence asset prices such as residential property prices (Asgharpur, 2019; Chanda, 2021). According to Mishkin (1996, 2001), the interest rates channel holds that if central banks execute an expansionary monetary policy (either by expanding the money supply or by lowering short-term interest rates), long-term interest rates decline. According to the expectations theory of terms structure, long-term nominal interest rates are a weighted average of short-term interest rates. A decline in short-term interest rates reduces borrowing costs. A decline in borrowing cost implies a decline in the cost of production. A decline in the cost of production should be associated with a decline in prices. However, prices are sticky; they remain steady or move slowly (Head *et al.*, 2012). The excess money supply that prices and wages have not yet absorbed causes a decline in nominal long-term interest rates. Changes in long-term interest rates affect real estate prices using the income and wealth channels (Berlemann and Freese, 2013). The income channel examines the impact of household interest payment (Simons, 2005). A continuous reduction in interest rates results in lower interest payments for households, leading to more discretionary income; hence, demand and residential property prices increase (Simo-Kengne *et al.*, 2012). The wealth channel is associated with the attractiveness of residential properties as an investment (Ndubuisi, 2015). A reduction in interest rates lowered the relative cost of housing, making residential investments more attractive and increasing residential property prices due to the rising demand and constrained short- to medium-term supply (Sutton *et al.*, 2017).

Empirically, in a study conducted by Williams (2016), a one percentage point increase in the short-term interest rate resulted in actual house prices declining by over 6%, considering

a sample of 17 countries over the past 140 years. Calza and Stracca (2009) studied 19 emerging and advanced economies and concluded that a 1% increase in interest rate reduced residential property prices by 2.3%. Goodhart and Hofmann (2008) concluded that a 1% increase in interest rates led to a 7.2% decline in house prices in a study conducted in 17 countries. So, changes in the short- and long-term interest rates significantly affect house prices. Yusuf *et al.* (2023) investigated the relationship between mortgage rates and house prices in Turkey considering the subsidized mortgage program that reduced the mortgage rates of state-owned banks in the summer of 2020 as an exogenous shock to provide causal estimates of a decrease in the cost of credit on mortgage demand and house prices. The study found out that a one percentage point decline in annual mortgage rates led to an increase in individual mortgage loans by 3.3% and an increase in house prices by 1.6%. Hanck and Prüser (2016) conducted an empirical analysis, which revealed that interest rates play an important role in the recent development of house prices in Germany, as a large part of the variation in house prices was explained by shocks to interest rates. Furthermore, Hanck and Prüser (2016) noted that the persistent negative response of house prices to interest rate shocks indicated that falling interest rates had a substantially contribution to the sudden increase in house prices. According to LaCour-Little *et al.* (2020), decline in house prices was associated with higher mortgage rates. Okey (2023)'s findings revealed that real interest rates had a negative and significant relationship with house prices. The relationship between interest rates and residential property prices has been discussed, and an inverse relationship exists.

Mortgage finance and residential property prices

The bank lending channel demonstrates the significance of financial intermediaries in transmitting monetary policy into the economy (Mathenge, 2017). The lending channel significantly influences residential property prices through the money creation process, which increases the money supply. Theoretically, changes in the money supply (monetary quantity) are transmitted into the economy through changes in the interest rate (monetary price) and bank credit (lending channel) (Yan, 2019). There are mixed findings regarding the effect of mortgage finance (the bank lending channel) on residential property prices. The effect of the bank lending channel on residential properties has been primarily influenced by institutional arrangements, loan products available, the degree to which the market is regulated and the level of securitizations (Farag, 2015). Due to the heterogeneity of institutions and differences in macro and micro-prudential supervision within economies, empirical studies on the lending channel's role in residential property prices have been diverse. According to Favara and Imbs (2015), bank lending channels will significantly impact house prices if the credit markets are deregulated. Carbo-Valverde and Rodríguez-Fernández (2011) concluded that mortgage loans have a significant influence on house prices in Spain. Sutton *et al.* (2017) conducted a study investigating the response of house prices to changes in mortgage loans in 47 advanced and emerging market economies. They concluded that mortgage loans drive house prices, especially in countries where securitization of home mortgages is less prevalent.

Given the incident that triggered the 2007/2008 global financial crisis, it can be concluded that deregulation, which promotes easy access to mortgages, significantly contributes to residential property price fluctuations. Dajcman (2020) explored the determinants of demand for residential mortgage loans for 13 euro area countries, with a focus on the house prices, covering the period 2003Q1–2016Q3. The results demonstrated that the growth of house prices was positively associated with changes in demand for residential mortgage loans. According to Okey (2023), increase in mortgage finance pushed up house prices by 5% in

the short run; however, no long-run effects were found, suggesting that most Nigerians depend on their money income rather than credits in securing residential properties. Empirical studies conclude that there is a positive relationship that exists between residential property prices and mortgage finance. However, the effect is mainly determined by the monetary policy stance, how the central banks operate, how they are regulated and the degree of innovations.

Other macroeconomics factors on residential property prices

Changes in residential properties have also been attributed to the volatility in the foreign exchange markets. Many investors consider the exchange rate to be a crucial factor in the assessment of the residential property market, and any change in the exchange rate influences investors' decisions on the purchase of real estate, which affects residential property prices. Akkay (2021) demonstrated that an increase in the value of the US$ relative to the Turkish Lira over the 2010–2020 period had an enormous and escalating impact on residential properties in Turkey. Sumer and Özorhon (2020) found no evidence of a significant impact of the US$ to Turkish Lira exchange rate on Turkish housing prices. Based on the findings by Tripathi (2019), the real exchange rate has a positive and statistically significant effect on accurate house prices. According to Mahalik and Mallick (2011), a rise in the real effective exchange rate was linked to a drop in residential property prices in India. . Liu and Zhang (2013) discovered that rising housing prices were associated with a rise in the value of the US$ relative to the Chinese yen. There is also supporting literature on the impact of economic growth, a control variable in the study on residential property prices (Miller *et al.*, 2011). Demand for residential properties is mainly influenced by the level of income (Tita and Opperman, 2021). So, as the economy grows, the demand for housing increases. With an increase in demand for housing without the corresponding increase in supply, residential property prices will increase (Ka Yui Leung, 2005).

Data and methods

The Johansen cointegration technique was used to estimate the long-run effects of changes in macroeconomic variables on residential property prices. The Johansen cointegration technique is commended compared to other estimation techniques, such as the ARDL and Engle-Granger, because it discovers more than one integration equation and examines multivariate estimation techniques (Inglesi-Lotz and Gupta, 2013). Most time-series data are not stationary at levels and are stationary at the first difference. The Johansen cointegration technique supports data that is stationary at first difference I(1) (Brooks, 2008). Previous studies used Johansen to estimate the relationship between monetary policy and house prices (Carbo-Valverde and Rodríguez-Fernández, 2011; McQuinn and O'Reilly, 2006; Molin, 2020; Okey, 2023). Despite the sensitivity of the Johansen cointegration estimates to the number of lags used, the model has gained momentum, and it has been widely used in various fields of studies in economics. To make sure that the model used does not suffer from spurious results, the variables used were stationary at the first difference using the augmented Dickey–Fuller test and the Phillips–Perron test and different lag length criteria such as the LR – sequential modified LR test statistic; FPE – final prediction error; AIC – Akaike information criterion; SC – Schwarz information criterion were used to determine to desirable lag length.

According to Hjalmarsson and Österholm (2010) and Johansen (1991, 2004), VAR-based cointegration tests are performed using an estimated VAR object. The VAR object of order p is as depicted in equation (4):

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + \beta x_t + \varepsilon_t$$

Where y_t is a k vector of non-stationary I(1) variables, x_t is a d-vector of deterministic variables and ε_t is a vector of innovations. The equation can be further estimated as shown on equation (5):

$$\Delta y_t = \prod y_{t-1} + \sum \Gamma_i \, \Delta y_{t-1} + \beta x_t + \varepsilon_t$$

where

$$\prod = \sum_{i=1}^{p} A_i - 1$$

and

$$\Gamma_i = -\sum_{j=i+1}^{p} A_j$$

Click or tap here to enter text. Johansen (1991) asserted that if the coefficient matrix has reduced rank, $r < k$, then there exist $K \, x \, r$ matrices α and β each with rank r such that $\prod = \alpha\beta'$ and $\beta' y_t$ is I(0). r is the number of cointegrating relations, and each column of β is the cointegrating vector, where α is the adjustment parameters in the VEC model. Johansen's method then estimate $\prod$ of matrix from an unrestricted VAR and to test whether the restrictions implied by the reduced rank of $\prod$ can be rejected. According to Kapingura and Alagidede (2016), assuming that X_t is the $n \times 1$ vector of variables, the intra-impulse transmission process to be captured by the study, where X_t is the number of explanatory variables in the model can be defined as shown in equation (6):

$$BX_t = \mu + \Gamma X_{t-1} + e_t$$

where B is the matrix of variable coefficients. X_t is the number of explanatory variables $\times$ 1 vector of observations at time t of the variables. μ is the vector of constants, Γ is a matrix polynomial of appropriate dimension and e_t is a diagonal matrix of structural innovations with zero means and constant variance. The regression model that was estimated is defined as shown in equation (7):

$$HPI_t = \beta_0 + \beta_1 \ \mathrm{IR}_t + \beta_2 \mathrm{M3}_t + \beta_3 \mathrm{LOGHML}_t + \beta_4 GDP_t + \beta_5 \mathrm{LOGCPI}_t + \beta_6 LOGEXCH_t + \beta_7 \mathrm{ITF} + \hat{e}_t$$

where HPI_t is for house price index; IR_t is for interest rates; LOGHML_t is for housing mortgage loans; LOGCPI_t is for consumer price index; GDP_t is for gross domestic product; $LOGEXCH_t$ is for real effective exchange; ITF is a dummy variable for policy shift to inflation targeting framework from 2001 to 2021; $\hat{e}_t$ is for the error term and the β_0 is the constant and β_1 to β_7 are the coefficients. where HPI_t. The data is described in Table 1.

The trace and eigenvalue test have confirmed the existence of cointegration equation(s). The vector error correction mechanism established the long-run relationship and short-term

Variable	Symbol	Description	Source
Residential property prices	HPI	Real residential property prices for South Africa, Index 2010 = 100, quarterly, not seasonally adjusted from 1980Q1 to 2022Q4	Federal Reserve Economic Data https://fred.stlouisfed.org
Gross domestic product	GDP	Leading indicators OECD: Reference series: gross domestic product (GDP): normalized for South Africa, index, quarterly, seasonally adjusted from 1980Q1 to 2022Q4	Federal Reserve Economic Data https://fred.stlouisfed.org
Money supply	M3	Monetary aggregates/money supply: M3 from 1980 to 2022	South African Reserve Bank https://www.resbank.co.za/
Housing mortgage loans	HML	New mortgage loans and re-advances granted for residential dwellings and flats from 1980 to 2022	South African Reserve Bank https://www.resbank.co.za/
Consumer price index	CPI	Consumer price index: all items: total for South Africa, index 2015 = 100, quarterly, not seasonally adjusted	Federal Reserve Economic Data https://fred.stlouisfed.org
Exchange rate	EXCH	Nominal effective exchange rate normalized for South Africa, index, quarterly, seasonally adjusted from 1980Q1 to 2022Q4	Federal Reserve Economic Data https://fred.stlouisfed.org
Inflation targeting framework		Dummy variable: 0 – from 1980 to 2000 and 1 from 2001 to 2022	Own computation

Source: Authors' own creation

Table 1.
Data sources

dynamics between house prices and the explanatory variables under consideration. After estimating the vector error correction model, the study further estimated the Granger causality test between the residential property prices and explanatory variables to determine the direction of causality between variables. These estimations seek to answer the questions of the effects of monetary policy on residential property prices.

Results of the study

The study estimated the descriptive statistics and correlation analysis and tested the stationarity of variables using the augmented Dickey–Fuller test and the Phillips–Perron test. The study further determined the lag length using different lag length criteria such as the LR – sequential modified LR test statistic, FPE, AIC, SIC and HQ – Hannan-Quinn information criterion. After the lag length was established, the study determined whether a long-run relationship existed using the trace and maximum eigenvalue tests. The trace test and the maximum eigenvalue test rejected the null hypothesis of no integration, the vector error correction model and the Granger causality test was further estimated. Lastly, the variance decomposition established how the shock of each explanatory variable influences residential property prices.

Descriptive statistics

Descriptive statistics are essential to econometric analysis as they give a foundational understanding of the data for more sophisticated statistical analyses such as regressions and other conclusions (Brooks, 2008). When data is described effectively, it enables the study to demonstrate the nature of the data, whether it has outliers, skewness, kurtosis,

distribution, and other measures of central tendencies. The descriptive statistics obtained as depicted in Table 2.

The descriptive statistics have shown that house prices, money supply and interest rates are highly volatile since the wide range between the minimum and maximum values associated with high standard deviation exceeds the recommended parameter that ranges between –2 and 2. The variables are within the skewness of –3 and 3, indicating that the data is not highly skewed. Byrne (2010) argued that data is standard if skewness is between –2 to +2 and kurtosis is between –7 and +7. The descriptive statistics have demonstrated that all the variables are within Byrne's (2010) range except for gross domestic product, with a kurtosis value exceeding +7. However, it is argued that a lower standard deviation accompanies a higher kurtosis. The kurtosis value might be of limited use.

Correlation analysis

The study performed the Pearson correlational analysis to establish the relationship between residential property prices and explanatory variables. The Pearson correlation is crucial as it predicts the relationship between dependent and explanatory variables before estimating the regression model. Correlational analysis can further be used to check for multicollinearity. If the relationship between two explanatory variables is high, above 0.8, it implies that the variables included in the regression model are likely to suffer from multicollinearity. The results obtained after testing the relationship between variables are displayed in Table 3.

The results show a positive relationship between the gross domestic product and the house price index. An increase in output, all things being equal, is associated with increased residential property prices. The study has shown a negative relationship between interest rates and house prices. All things being equal, a rise in interest rates will reduce house prices. Low interest rates increase the demand for housing mortgage loan resulting in an increase in prices. Correlational analysis has further shown that implementing the inflationary targeting framework in 2000 increased the residential property prices. The inflationary targeting framework uses monetary policy instruments to keep the consumer price index from 3% to 6%. The analysis elaborated that consumer price inflation is associated with a positive impact on residential property prices. Exchange rate appreciation is negatively associated with high house prices. There is a positive association between house mortgage loans and house prices. Lastly, an increase in money supply (M3) is negatively correlated with house prices. The relationship will be further ascertained using the vector error correction model. The analysis has further noted that some of the explanatory variables are highly colinear, and including such variables enables the model to suffer the problem of multicollinearity. However, the existence of multicollinearity doesn't not affect the unbiasness of coefficients.

Unit root test

Unit root tests that can be used to check for the stationarity of data include the Augmented Dickey-Fuller (ADF) test, Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test, and Phillips-Perron (PP) test (Ahmad *et al.*, 2023). The ADF test is the most widely used in applied econometrics for identifying the presence of unit roots. This technique enables examining slightly more complex time series processes than the original theory's simple random walk models, which are a suitable description of the underlying data generation process (Gianfreda *et al.*, 2023). Stationarity testing is necessary to avoid spurious regressions and to assist in choosing the best estimation procedures for the research. There Augmented Dick Fuller Test and the Phillips Perron were used to check for data stationarity. The outcomes are shown in Table 4 and 5.

Table 2.
Descriptive of the study

	Descriptive statistics							
	HPI	GDP	IR	ITF	LOGCPI	LOGEXCH	LOGHML	M3
Mean	77.1108	100.0262	4.212425	0.502959	3.638559	4.776676	10.82437	12.75793
Median	81.7581	100.0402	3.934154	1.000000	3.869900	4.770685	11.21720	12.27000
Maximum	123.539	103.8535	12.69103	1.000000	4.915108	5.141664	12.90775	27.30000
Minimum	44.2677	88.66101	–11.00901	0.000000	1.545656	4.510860	7.294377	1.790000
SD	23.8653	1.592132	3.375877	0.501477	0.942646	0.135222	1.691128	5.674681
Skewness	0.04714	–2.089613	–0.387534	–0.011835	–0.629923	0.551061	–0.535900	0.374090
Kurtosis	1.43764	17.46243	6.062152	1.000140	2.295774	2.869114	1.891490	2.216936
Sum	13031.7	16904.42	711.8997	85.00000	614.9164	807.2582	1829.318	2156.090
Sum sq. dev.	95685.1	425.8605	1914.620	42.24852	149.2818	3.071876	480.4656	5409.936

Notes: The table shows descriptive statistics of the of the house price index (HPI); gross domestic product index (LOGGDP); interest rates (IR); inflation targeting framework (ITF); consumer price index (LOGCPI); exchange rate (LOGEXCH); housing mortgage loans (LOGHML) and money supply (M3) using quarterly data from 1980Q1 to 2022Q4
Source: Authors' own creation

Correlational analysis								
	HPIII	GDP	INCPI	INEXCH	INHML	IR	ITF	M3
HPIII	1	0.023764	0.467158	–0.292702	0.551404	–0.148566	0.746033	–0.277912
GDP	0.0237	1	–0.226656	0.157947	–0.232381	0.213668	–0.144852	0.330178
INCPI	0.4671	–0.226656	1	–0.784672	0.966754	0.274260	0.811653	–0.555031
INEXCH	–0.2927	0.157947	–0.784672	1	–0.730751	–0.103547	–0.670620	0.399409
INHML	0.5514	–0.232381	0.966754	–0.730751	1	0.210152	0.865988	–0.437769
IR	–0.1485	0.213668	0.274260	–0.103547	0.210152	1	–0.027486	–0.051343
ITF	0.7460	–0.144852	0.811653	–0.670620	0.865988	–0.027486	1	–0.375938
M3	–0.2779	0.330178	–0.555031	0.399409	–0.437769	–0.051343	–0.375938	1

Notes: The table shows the Pearson correlation of the house price index (HPI), gross domestic product index (LOGGDP), interest rates (IR), inflation targeting framework (ITF), consumer price index (LOGCPI), exchange rate (LOGEXCH), housing mortgage loans (LOGHML) and money supply (M3) using quarterly data from 1980Q1 to 2022Q4
Source: Authors' own creation

Table 3.
Correlation analysis

Levels						
	Augmented Dickey–Fuller test			Phillips–Perron test		
Variable	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None
HPI	–1.673751	–2.305142	–0.268037	–1.275769	–1.712557	0.122452
LOGGDP	–4.574718***	–4.694863***	–0.109497	–4.745462***	–4.876664***	–0.106338
ITF	–1.000000	–1.993940	0.000000	–1.000000	–2.026102	0.000000
LOGCPI	–5.632881***	–2.777684	1.689341	–7.764103***	–2.657212	4.712376
LOGEXCH	–3.240371**	–4.460348***	–0.604007	–2.121041	–2.806941	–0.672606
LOGHML	–1.582806	–2.149918	1.661918	–0.946978	–1.457627	2.235514
LOGM3	–3.220032**	–3.982510**	–0.880859	–2.782790*	–3.339640**	–0.921269

Notes: The table reports the unit root tests using the augmented Dickey–Fuller test (ADF) and the Phillips–Perron (PP) test at levels. House price index (HPI), gross domestic product index (LOGGDP), interest rates (IR), inflation targeting framework (ITF), consumer price index (LOGCPI), exchange rate (LOGEXCH), housing mortgage loans (LOGHML) and money supply (M3) were tested at intercept, trend and intercept and none using automatic selection based on the SIC for ADF and Bartlett Kernel for the PP. The results show the test statistic and its level of significance: *** (0.01 level of significance), ** (0.05 level of significance) and *(0.1 level of significance)
Source: Authors' own creation

Table 4.
Unit root test for stationarity at levels

The results obtained after testing the unit root at levels shows that the variables are not stationary. The level of stationarity is inconsistent as one variable can be stationary at intercept and non-stationary at trend and intercept and none. Since the variables are not stationary at levels, the study further tested for stationarity at 1st Difference to conclude the stationarity of variables. The results for 1st Difference are shown in Table 5.

After checking for stationarity at 1st difference, all the variables were stationary. All the variables were stationary at a 1% significance level except for Consumer Price Index (LOGCPI), which was significant at 5%. The Johansen cointegration can establish long-run estimation if the variables are significant at the same level and 1st Difference. Testing for stationary is important since correlation may persist in a non-stationary series, leading to spurious regressions (Bilgili, 1998). The macroeconomic theory assumes that there should be a stable long-run relationship among variables, implying that variables cannot move too far

	First difference					
	Augmented Dickey–Fuller test			Phillips–Perron test		
Variable	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None
HPI	–4.325736***	–4.318129***	–4.335000***	–4.325736***	–4.318129***	–4.335000***
LOGGDP	–12.87395***	–12.83426***	–12.91205***	–14.03005***	–13.97020***	–14.07298***
ITF	–12.92285***	–12.88365***	–12.88410***	–12.92285***	–12.88364***	–12.88410***
LOGCPI	–3.215659**	–7.490735***	–1.954071**	–5.169329***	–7.737622***	–2.511038**
LOGEXCH	–4.723587***	–4.737865***	–4.706713***	–4.655871***	–4.651986***	–4.649619***
LOGHML	–5.294745***	–5.340937***	–4.888225***	–5.313637***	–5.246311***	–4.942099***
LOGM3	–7.962652***	–7.943128***	–7.980688***	–7.719405***	–7.777157***	–7.817764***

Notes: The table reports the unit root tests using the augmented Dickey–Fuller test (ADF) and the Phillips–Perron test (PP) at the first difference. House price index (HPI), gross domestic product index (LOGGDP), interest rates (IR), inflation targeting framework (ITF), consumer price index (LOGCPI), exchange rate (LOGEXCH), housing mortgage loans (LOGHML) and money supply (M3) were tested at intercept, trend and intercept and none using automatic selection based on the SIC for ADF and Bartlett Kernel for the PP. The results show the test statistic and its level of significance: *** (0.01 level of significance), ** (0.05 level of significance) and *(0.1 level of significance)
Source: Authors' own creation

Table 5.
Unit root test for stationarity at the first difference

from each other. If individual time series are not stationary, they can wander too far from each other, and results become unreliable (Sørensen, 2020).

Lag length determination

The selection of the lag order is an essential component of empirical research based on the vector autoregressive (VAR) model, as all inferences in the VAR model are predicated on the correct model specification (Brooks, 2008; Kapingura and Alagidede, 2016; Liu and Zhang, 2013; Molin, 2020). When executing the Johannsen cointegration test, selecting the appropriate lag length is crucial. Several studies have demonstrated the importance of lag length determination by showing that impulse response functions and variance decompositions generated from estimated VARs are incoherent when the predicted VAR's lag length differs from the actual lag length (Enrique Gutiérrez, 2007; Inoue and Kilian, 2002; Ozcicek and McMillin, 1999). Since underfitting the lag length typically leads to autocorrelated errors, adopting a greater order lag length than the actual lag length causes overfitting, which raises the mean-square forecast errors of the VAR. The correct lag length needs to be used. The criteria for determining the number of lags are the LR – Sequential modified LR test statistic, FPE – Final prediction error, AIC – Akaike information criterion, SC – Schwarz information criterion and HQ. According to Khim-Sen Liew *et al.* (2004), in the case of small samples, AIC and FPE outperform the other study criteria in a way that minimizes the likelihood of underestimation while maximizing the likelihood of recovering the proper lag length. The results of the lag length determination are displayed in Table 6.

The sequential modified LR test statistic, FPE and AIC have identified six lags to establish the Johansen cointegration and perform the vector error correction.

Cointegrating equations

The trace test and the maximum eigenvalue test were used to establish whether the long-run relationship exists between monetary policy and house prices. The results obtained are in Table 7.

Lag length determination

Lag	LogL	LR	FPE	AIC	SC	HQ
0	–1,866.019	NA	1.780187	23.27973	23.43285	23.34190
1	556.4557	4574.113	3.37e–13	–6.018084	–4.640064	–5.458552
2	888.4049	593.7973	1.21e–14	–9.346645	–6.743720*	–8.289752*
3	916.2155	46.98435	1.93e–14	–8.897087	–5.069256	–7.342832
4	957.6255	65.84445	2.62e–14	–8.616466	–3.563728	–6.564849
5	1,066.403	162.1525	1.57e–14	–9.172705	–2.895062	–6.623727
6	1,211.748	202.2195*	6.12e–15*	–10.18321*	–2.680656	–7.136866
7	1,261.610	64.41811	8.04e–15	–10.00758	–1.280124	–6.463878
8	1,321.540	71.46918	9.67e–15	–9.957019	–0.004657	–5.915956

Notes: The table shows various criteria used to determine the appropriate lag length; *indicates the number of lags determined by each criterion at the 5% level. The criteria used are LR – sequential modified LR test statistic; FPE; AIC; SIC; and HQ. These criteria were determined using data from 1980Q1 to 2022Q4
Source: Authors' own creation

Table 6. Lag length determination

The study has found eight cointegration results based on the trace statistic and five cointegrations based on the maximum eigenvalue test. The results reject the null hypothesis that no cointegration exists and conclude that long-run relationships exist between residential property prices and the variables under study. The study has concluded that long-run relationships exist and further estimated the vector error correction model.

Error correctional model

The study estimated the vector error correction model to establish short- and long-term relationships between residential property prices and selected macroeconomic factors. The results obtained from the estimation are shown in Table 8. The estimates showed a positive long-run relationship between the growth of the output and house prices. As the economy grows, so does growth in income because there will be more economic activities. Income is one of the main contributing factors to housing affordability. With constrained income, households cannot afford housing mortgages and improve their savings habits (Squires and Webber, 2019; Tita and Opperman, 2021; Voith and Wachter, 2009). However, employment opportunities and income rise as the economy grows, increasing affordability. As affordability increases, the demand for residential properties rises, so does the house prices. The study has further noted a significant long-run negative relationship between interest rates and residential property prices. Interest rates determine mortgage servicing costs; the cost of acquiring a housing mortgage rises as interest rates rise (Dieckelmann *et al.*, 2023; Jordà *et al.*, 2015). Increasing the cost of servicing mortgages reduces the demand for residential properties and hence prices (Chanda, 2021; McQuinn and O'Reilly, 2006; Shi *et al.*, 2014; Sutton *et al.*, 2017; Trimbath and Montoya, 2005). The study has found a negative relationship between the consumer price index and residential property prices. As prices of goods and services increase, residential properties' prices fall. From an income point of view, as prices of goods and services rise, the purchasing power of income declines, and households need more income to meet their day-to-day consumption levels. This implies that the level of savings will decline, given the income constraints. The decline in savings reduces the demand for assets, hence the price of residential properties.

The study has found a positive relationship between housing mortgage loans and residential properties. The study posits that residential property prices will increase as the demand for housing mortgage finance increases. Mortgage finance is one of the primary

Table 7.
Determination of whether long-run relationships exist or not

Unrestricted cointegration rank test (Trace)					Unrestricted cointegration rank test (maximum eigenvalue)				
Hypothesized no. of CE(s)	Eigenvalue	Trace statistic	0.05 critical value	Prob.**	Hypothesized no. of CE(s)	Max-Eigen eigenvalue	Statistic	0.05 critical value	Prob.**
None *	0.325478	264.2117	159.5297	0.0000	None *	0.325478	63.78758	52.36261	0.0023
At most 1 *	0.275984	200.4242	125.6154	0.0000	At most 1 *	0.275984	52.31667	46.23142	0.0100
At most 2 *	0.253551	148.1075	95.75366	0.0000	At most 2 *	0.253551	47.37331	40.07757	0.0064
At most 3 *	0.192433	100.7342	69.81889	0.0000	At most 3 *	0.192433	34.62407	33.87687	0.0407
At most 4 *	0.171762	66.11010	47.85613	0.0004	At most 4 *	0.171762	30.52964	27.58434	0.0203
At most 5 *	0.105413	35.58046	29.79707	0.0096	At most 5	0.105413	18.04568	21.13162	0.1282
At most 6 *	0.071699	17.53478	15.49471	0.0243	At most 6	0.071699	12.05274	14.26460	0.1087
At most 7 *	0.033274	5.482043	3.841466	0.0192	At most 7 *	0.033274	5.482043	3.841466	0.0192

Notes: The table shows the Johansen test results for cointegration using the trace test and the maximum eigenvalue test. The trace test indicates eight cointegrating equations (s) at 0.05. The Max-eigenvalue test indicates five cointegrating equations (s) at the 0.05 level on the house price index (HPI), gross domestic product index (LOGGDP), interest rates (IR), inflation targeting framework (ITF), consumer price index (LOGCPI), exchange rate (LOGEXCH), housing mortgage loans (LOGHML) and money supply (M3). *denotes rejection of the null hypothesis of no cointegration at the 0.05 level; **MacKinnon–Haug–Michelis (1999) *p*-values
Source: Authors' own creation

Table 8. Vector error correctional model

Vector error correction model							
	Short-run results				Long-run results		
Variable	Coefficient	Standard error	*t*-statistic	Variable	Coefficient	Standard error	*t*-statistic
D(HPI)	0.001420	(0.00083)	[1.70853]	HPI(–1)	1.000000		
D(IR)	–0.000600	(0.00026)	[–2.30708]	IR(–1)	92.62571	(14.0634)	[6.58628]
D(ITF)	–0.000151	(3.4E–05)	[–4.38416]	ITF(–1)	748.9817	(137.955)	[5.42916]
D(LOGCPI)	–1.86E–05	(4.9E–06)	[–3.81097]	LOGCPI(–1)	619.5899	(192.702)	[3.21527]
D(LOGEXCH)	–6.62E–06	(7.5E–06)	[–0.88389]	LOGEXCH(–1)	1440.512	(431.032)	[3.34201]
D(LOGHML)	4.82E–05	(3.0E–05)	[1.62139]	LOGHML(–1)	–242.1674	(91.9314)	[–2.63422]
D(M3)	–8.28E–06	(0.00045)	[–0.01822]	M3(–1)	6.133604	(8.92725)	[0.68707]
D(GDP)	–0.000384	(0.00073)	[–0.52928]	GDP(–1)	–124.2636	(27.8438)	[–4.46288]

Notes: The table shows the vector error corrections. The vector error corrections show the short- and long-run results using six lags as determined by the LR – sequential modified LR test statistic, FPE and AIC after determining the lag length used in the study. The coefficients of the long-run relationship will be multiplied by a negative when interpreting the model. *Significant [*t*-statistic > 1.96]: Insignificant [*t*-statistic < 1.96]
Source: Authors' own creation

sources of financing the acquisition of residential properties in South Africa. An increase in access to credit increases the demand for properties, and when demand increases, so do the prices holding the supply of residential properties constant (Favara and Imbs, 2015; Koblyakova *et al.*, 2021). The study has further shown that an appreciation in the rand's value negatively impacts residential property prices. Given that the appreciation of a currency makes domestic assets and commodities more expensive in the eyes of the international community, foreign investors are likely to reduce their demand for properties in South Africa. On another note, an appreciating exchange rate strengthens the value of local currency in relation to other currencies (Adu *et al.*, 2019; Sumer and Özorhon, 2020). Finally, the study found that the inflation targeting framework, implemented in 2001, significantly reduced residential property prices. The inflation targeting framework uses interest rates and other monetary policy tools to control the general price level of goods and services in South Africa.

The short-run results have shown that interest rates, consumer price index, the inflation targeting framework, exchange rate, money supply, gross domestic product adjust to their long-run equilibrium at an average speed of 0.01% when they are in disequilibrium. The study has further noted that house prices and housing mortgage loans take longer to return to equilibrium when they are in disequilibrium. To explore more on the short-run relationships, the vector error Granger causality was estimated. The estimated coefficients are unbiased as the model was free from serial correlation and the model was homoscedastic. Using the VEC residual heteroskedasticity tests (levels and squares), the chi-square estimate was 3,444.230, with a probability value of (0.0535); therefore, we fail to reject the null hypothesis of constant variance. The VEC residual serial correlation LM test was used to test for serial correlation. The results demonstrated that the model residuals are not correlated with the error term on all the lags, thus failing to reject the null hypothesis of no serial correlation.

Vector error Granger causality estimates

The study further estimated the vector error Granger causality test to explore the short-run dynamics. The results obtained are shown in Table 9.

The study has revealed that exchange rate Granger cause residential property prices and other variables such as inflation targeting, economic growth, consumer price index, money

Dependent variable: D(HPI)

Variables	Chi-sq	df	Prob.
D(GDP)	1.244120	6	0.9746
D(INCPI)	6.764847	6	0.3431
D(INEXCH)	19.47462	6	0.0034
D(INHML)	2.334425	6	0.8865
D(IR)	6.979894	6	0.3227
D(ITF)	2.787670	6	0.8350
D(M3)	9.901518	6	0.1289
All	50.93986	42	0.1622

Table 9.
The vector error Granger causality test

Notes: The table reports the direction of causality between house price index (HPI) and gross domestic product index (LOGGDP), interest rates (IR), inflation targeting framework (ITF), consumer price index (LOGCPI), exchange rate (LOGEXCH), housing mortgage loans (LOGHML) and money supply (M3).
Source: Authors' own creation

supply and interest rates do not Granger cause residential property prices. Jointly, the variables do not Granger cause residential property prices. Therefore, the study postulates that in the short run, changes in exchange rate significantly affect residential properties.

Variance decomposition

To examine the relative effect of mortgage finance, economic growth, interest rates, general price level and money supply on house prices, ten periods of variance decomposition have been estimated. The results are shown in Table 10.

The model depicts that a shock in the exchange rate, inflation targeting framework, money supply, consumer price index, housing mortgage loans, gross domestic product and interest rates influence residential property prices. Among these shocks, exchange rate shock has the most significant impact, whereas interest rates has the most negligible impact on economic growth.

Discussion of results

The effect of monetary policy factors on residential has been documented in the literature under different circumstances, and there is overwhelming evidence that the prevailing monetary policy environment influences the fluctuations in residential property prices. First, the hypothesis on whether interest rates influence house prices has been tested across economies, and the results supported a significant relationship in the short and long run. Findings from the study have noted that interest rates significantly influence residential property prices in South Africa. The result from the study concurs with existing literature which posited that interest rates have a significant impact on house prices (Dieckelmann *et al.*, 2023; Jordà *et al.*, 2015; McQuinn and O'Reilly, 2006; Shi *et al.*, 2014; Sutton *et al.*, 2017; Trimbath and Montoya, 2005). Based on the findings by Dieckelmann *et al.* (2023), non-linearities in the residential property price reaction to interest rate fluctuations are significant in a low-interest rate environment, and residential property prices might experience downward pressure that is three to eight times more than what other studies predict if real interest rates rise from their current ultra-low levels.

Variance decomposition

Period	SE	HPIII	GDP	INCPI	INEXCH	INHML	IR	ITF	M3
1	1.262611	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	2.377385	99.19836	0.057800	0.001014	0.039579	0.042733	1.76E-05	0.437080	0.223413
3	3.423270	95.27330	0.482561	0.221901	0.667067	0.208559	0.013315	1.692256	1.441044
4	4.574731	87.69488	0.707264	0.727476	3.111315	0.698265	0.008594	3.547015	3.505192
5	5.845593	78.68133	0.905531	1.275076	7.363900	1.033391	0.033002	5.282958	5.424814
6	7.184359	70.30407	1.114839	1.829194	12.09987	1.284542	0.176675	6.645963	6.544847
7	8.586319	63.30225	1.287126	2.039758	16.75415	1.566119	0.321057	7.529996	7.199547
8	10.05694	58.29157	1.397130	2.192211	20.68124	1.821940	0.416158	8.070514	7.129232
9	11.53373	54.70070	1.438517	2.468754	23.60780	2.086137	0.453622	8.584979	6.659492

Notes: The table reports variance decompositions for the house price index (HPI) to gross domestic product index (LOGGDP), interest rates (IR), inflation targeting framework (ITF), consumer price index (LOGCPI), exchange rate (LOGEXCH), housing mortgage loans (LOGHML) and money supply (M3) on ten periods using data from 1980Q1 to 2022Q4

Source: Authors' own creation

Table 10. Variance decomposition

The findings by Dieckelmann *et al.* (2023) posit an increase of real interest rates by that 0.1 percentage points could lead to downward pressure on residential property prices in the range of –2.4% and –1.2%, which is about four- to eight-fold the magnitude the literature would predict. The study supports these findings as a negative relationship between residential property prices and interest rates was established, and a unit increase in interest rates was associated with a 2.4-unit decline in residential property prices. According to Sutton *et al.* (2017), in the USA, data from the period from 1970 to the end of 1999 indicates that a 100 basis-point decline in the nominal short-term rate was coupled with a corresponding decline in the real short-term rate led to a three-year increase in residential property price by 5% relative to the baseline, if data until the end of 2015 was considered, more significant influence was noticed. Sutton *et al.* (2017) further noted that in advanced and emerging markets economies, a 100 basis-point decline in domestic short-term interest rates and a corresponding decline in real interest rates resulted in a three-year increase in housing prices of up to 3.5% relative to the baseline. Therefore, both short-term policy rates and long-term interest rates significantly influence residential property prices.

Findings on the relationship between mortgage finance and house prices remain mixed and unexplained across economies. Different macro and micro-prudential regulations and monetary policy regimes across economies have explained the mixed results. The study established a positive, significant long-term relationship between residential mortgage loans and house prices. Favara and Imbs (2015) supported the study findings, who concluded that mortgage finance positively influenced residential property prices. Carbo-Valverde and Rodríguez-Fernández (2011) concluded that mortgage loans positively influence house prices. However, according to Favara and Imbs (2015), mortgage finance will significantly impact residential property prices if the credit markets are deregulated. In 2000, the South African government implemented the inflation targeting regime to target inflation between 3% and 6%. The study has demonstrated that implementing the inflation targeting framework was associated with declining house prices. Therefore, using short-term interest rates and other monetary policy instruments to target inflation significantly contributed to the decline in house prices. Williams (2016) noted that implementing an inflation targeting framework is likely to change the monetary policy transmission mechanism on macroeconomic variables to the economy. The study also noted that residential property prices significantly respond to economic growth. As the economy grows, individuals experience increasing income, and income plays a significant role in housing affordability (Chen, 2012; Grum and Govekar, 2016; Tita and Opperman, 2021). Increased affordability increases the demand for housing, leading to an increase in house prices. According to Muthee (2012), economic growth leads to an increase in the middle class of society. The middle-class society pushes up the demand for housing, residential property prices increase. Leung *et al.* (2020) concluded that the constant GDP growth rate was traced as one of the causes of house price growth in Hong Kong. Economic growth significantly contributes to the rising house prices in several economies across the globe.

The study has further noted that the exchange rate appreciation significantly reduces house prices. Adu *et al.* (2019) also investigated the impact of exchange rate volatility in Ghana and found that the appreciation exchange rate significantly influences residential properties. The findings of Adu *et al.* (2019) were also in line with the study's findings regarding the consumer price index. The study found a negative relationship between residential property prices and the consumer price index. During inflation, purchasing power declines, affecting mortgage affordability and savings. The negative impact of inflation savings and mortgage affordability reduces the demand for mortgage finance, one

of the primary sources of financing residential properties in South Africa, negatively affecting the demand for properties.

Conclusion

This study used quarterly data from 1980Q1 to 2022Q4 to estimate the effects of consumer price index, exchange rates, money supply, interest rates, housing mortgage loans, economic and the inflation targeting framework on residential property prices. The study used the Johansen cointegration and the Granger causality test to establish long-run estimates and short-run dynamics. In the long run, the studies concluded a significant positive long-run relationship between economic growth and mortgage finance with residential property prices. Furthermore, increases in general price level, local currency appreciation and interest rates have a significant negative relationship with residential property prices. The study has further established that the implementation of the inflation targeting in the year 2000 by the South Africa Reserve Bank is associated with a decline in residential property prices in South Africa. In the short run, only exchange rate significantly Granger causes residential property prices. The study concludes that monetary policy changes significantly influence residential property prices in South Africa. The study recommends that policymakers continue to pursue macro and micro-prudential supervision and enforce the inflation targeting framework as it prevents housing market booms that negatively affect affordability and may later bust.

References

Adu, J.K., Okyere, F. and Amoah, E.K.S. (2019), "Effects of exchange rate volatility on real estate prices in developing economies, a case of Ghana", *Advances in Social Sciences Research Journal*, Vol. 6 No. 11, pp. 268-287, doi: 10.14738/assrj.611.7392.

Agnello, L. and Sousa, R.M. (2009), "Fiscal policy and asset prices", *Bulletin of Economic Research*, Vol. 65 No. 2, pp. 154-177.

Ahmad, Y., Check, A. and Lo, M.C. (2023), "Unit roots in macroeconomic time series: a comparison of classical, Bayesian and machine learning approaches", *Computational Economics*, doi: 10.1007/s10614-023-10397-0.

Akkay, R.C. (2021). "The macroeconomic determinants of the housing prices in Turkey", *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, Vol. 58, pp. 241-264. doi: 10.18070/erciyesiibd.801319.

Akinlo, A.E. (2021), "Effectiveness of monetary policy transmission mechanism in an implicit inflation targeting regime: the case of Nigeria", *African Journal of Economic Review*, Vol. 10, pp. 85-109.

Ambrose, B.W., Coulson, N.E. and Yoshida, J. (2018), "Reassessing Taylor rules using improved housing rent data $", *Journal of Macroeconomics*, Vol. 56, pp. 243-257.

Asgharpur, H.A.K.K. (2019), "The relationships between interest rates and inflation changes: an analysis of long-term interest rate dynamics in developing countries", pp. 1-8.

Atkin, T. and Cava, G.L. (2017), "The transmission of monetary policy: how does it work".

Baker, D. (2005), "The housing bubble fact sheet", *Issue Brief July, CEPR Washington DC, July*.

Berg, A., Charry, L., Portillo, R.A. and Vlcek, J. (2013), "The monetary transmission mechanism in the tropics: a narrative approach", *IMF Working Papers*, Vol. 13 No. 197, p. 1, doi: 10.5089/9781484398135.001.

Baily, M.N., Litan, R.E. and Johnson, M.S. (2008), "The origins of the financial crisis".

Bally, L. and Everett-Allen, K. (2021), "Global house price index", pp. 1-2.

Bank for International Settlement (2022), "Statistical release: BIS residential property price statistics in Q1 2021", *August 1–8*.

Bilgili, F. (1998), "Munich personal RePEc archive stationarity and cointegration tests: comparison of Engle-Granger and Johansen methodologies", *MPRA Paper, 75967*.

Brooks, C. (2008), *Introductory Econometrics for Finance*, 2nd ed., Cambridge University Press, Cambridge.

Berlemann, M. and Freese, J. (2013), "Monetary policy and real estate prices: a disaggregated analysis for Switzerland", *International Economics and Economic Policy*, Vol. 10 No. 4, pp. 469-490, doi: 10.1007/s10368-012-0222-7.

Bhalla, S.S., Bhasin, K. and Loungani, P. (2023), "Macro effects of formal adoption of inflation targeting", WP/23/7, January 2023.

Borio, C. and Zhu, H. (2008), "Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism?", *Journal of Financial Stability*, Vol. 8 No. 4, pp. 236-251.

Bunzel, H. and Enders, W. (2010), "The Taylor rule and 'opportunistic' monetary policy", *Journal of Money, Credit and Banking*, Vol. 42 No. 5, pp. 931-949, doi: 10.1111/j.1538-4616.2010.00313.

Byrne, B.M. (2010), *Structural Equation Modelling with AMOS: Basic Concepts, Applications, and Programming*, Routledge, New York, NY.

Calza, A. and Stracca, L. (2009), "Working paper series. Housing finance and monetary policy", *Social Science Research*.

Carbo-Valverde, S. and Rodríguez-Fernández, F. (2011), "The relationship between mortgage markets and house prices: does financial instability make the difference?", *SSRN Electronic Journal*, doi: 10.2139/ssrn.1547247.

Chanda, C.N.C. (2021), "Monetary policy transmission in Zambia: pass-through from the bank of Zambia policy rate to commercial banks market interest rates cleopatra ngoma* and Cosam Chanda * bank of Zambia".

Chen, D.R. (2012), "An empirical analysis of house price bubble: a case study of Beijing housing market", A thesis submitted in partial fulfilment of the requirements for the Degree of Master of Commerce and Management at Lincoln University by Dong (Ryan) Chen Lincoln Univ.

Dajcman, S. (2020), "demand for residential mortgage loans and house prices in the Euro area", *Sociology*, Vol. 13 No. 1, doi: 10.14254/2071.

Du Rand, G., Hollander, H. and Van Lill, D. (2023), "A deep learning approach to estimation of the Phillips curve in South Africa".

Dullien, S., Detlef, J.K., Márquez, A. and Priewe, J. (2008), "United Nations: the financial and economics crisis and developing countries".

Economic Report of the President (2012), "Chapter 4: Stabilization and healing of the housing market".

Enrique Gutiérrez, C.C. (2007), "Selection of optimal lag length in cointegrated VAR models with common cyclical features".

Farag, I.A. (2015), "The role of asset securitization in 2008 financial crisis university of Birmingham the role of asset securitization in 2008 financial crisis prepared by: Ibrahim Farag to: Prof. Laetitia Lepetit", *January*.

Favara, G. and Imbs, J. (2015), "Credit supply and the price of housing", *American Economic Review*, Vol. 105 No. 3, pp. 958-992, doi: 10.1257/aer.20121416.

Gianfreda, A., Maranzano, P., Parisio, L. and Pelagatti, M. (2023), "Testing for integration and cointegration when time series are observed with noise", *Economic Modelling*, Vol. 125, doi: 10.1016/j.econmod.2023.106352.

Goeltom, M.S. (2006), "The transmission mechanisms of monetary policy in Indonesia the objective of monetary policy", *BIS Paper*, Vol. 35 No. 35, pp. 309-332.

Goodhart, C. and Hofmann, B. (2008), "House prices, money, credit and the macroeconomy", *Oxford Review of Economic Policy*, Vol. 24 No. 1, pp. 180-205.

Gumata, N., Kabundi, A. and Ndou, E. (2013), "Important channels of transmission monetary policy shock in South Africa".

Grum, B. and Govekar, D.K. (2016), "Influence of macroeconomic factors on prices of real estate in various cultural environments: case of Slovenia, Greece, France, Poland, and Norway", *Procedia Economics and Finance*, Vol. 39, pp. 597-604, doi: 10.1016/s2212-5671(16)30304-5.

Haldane, A.G. and Haldane, A.G. (1994), "The interest rate transmission mechanism: sectoral estimates for Spain José Luis Escrivá for Spain".

Hanck, C. and Prüser, J. (2016), "House prices and interest rates – Bayesian evidence from Germany", *Applied Economics*, Vol. 52 No. 28, pp. 3073-3089.

Head, A., Liu, L.Q., Menzio, G. and Wright, R. (2012), "Sticky prices: a new monetarist approach", *Journal of the European Economic Association*, Vol. 10 No. 5, pp. 939-973, doi: 10.1111/j.1542-4774.2012.01081.x.

Hjalmarsson, E. and Österholm, P. (2010), "Testing for cointegration using the Johansen methodology when variables are near-integrated: size distortions and partial remedies", *Empirical Economics*, Vol. 39 No. 1, pp. 51-76, doi: 10.1007/s00181-009-0294-6.

Hofmann, B. and Bogdanova, B. (2012), "Taylor rules and monetary policy: a global 'great deviation'?", *BIS Quarterly Review*.

Honohan, P. and Orphanides, A. (2022), "Monetary policy in South Africa, 2007-21".

Inglesi-Lotz, R. and Gupta, R. (2013), "The long-run relationship between house prices and inflation in South Africa: an ARDL approach", *International Journal of Strategic Property Management*, Vol. 17 No. 2, pp. 188-198, doi: 10.3846/1648715X.2013.807400.

Inoue, A. and Kilian, L. (2002), "Bootstrapping smooth functions of slope parameters and innovation variances in VAR(1) models", *International Economic Review*, Vol. 43 No. 2, pp. 309-331.

Jahan, S. (2012), "Inflation targeting: holding the line – back to basics: economics concepts explained – Finance and Development".

Johansen, S. (1991), "Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models", *Econometrica*, Vol. 59 No. 6, available at: https://about.jstor.org/terms

Johansen, S. (2004), "Cointegration; An overview", Unpublished Manuscript, University of Copenhagen, available at: https://web.math.ku.dk/~susanne/Klimamode/OverviewCointegration.pdf

Jordà, Ò., Schularick, M. and Taylor, A.M. (2015), "Interest rates and house prices: pill or poison?", *FRBSF Economic Letter*, pp. 1-5.

Ka Yui Leung, C.Y. (2005), "Economic growth and increasing housing prices", *SSRN Electronic Journal*, doi: 10.2139/ssrn.406100.

Kapingura, F.M. and Alagidede, P. (2016), "The relationship between financial sector development and savings mobilization in South Africa: an empirical study", *Development Southern Africa*, Vol. 33 No. 5, pp. 703-718, doi: 10.1080/0376835X.2016.1203760.

Karley, N.K. (2006), "Challenges in mortgage lending for the Underserved in South Africa", *Housing Finance International, September 2003*, pp. 27-33, available at: www.housingfinance.org/uploads/Publicationsmanager/0309_Cha.pdf

Khan, H.U., Reza, A. and Khan, H. (2014), "House prices and government spending shocks house prices and government spending shocks *".

Khim-Sen Liew, V., Khim, V. and Liew, S. (2004), "Which lag length selection criteria should We employ?", *Economics Bulletin*, Vol. 3 No. 33.

Koblyakova, A., Fleishman, L. and Furman, O. (2021), "Accuracy of households' dwelling valuations, housing demand and mortgage decisions: Israeli case", *Journal of Real Estate Finance and Economics*, doi: 10.1007/s11146-021-09823-7.

Kumo, W.L. (2015), "Inflation targeting monetary policy, inflation volatility and economic growth in South Africa", available at: www.afdb.org/

Kuttner, K.N. (2012), "Low interest rates and housing bubbles: Still no smoking gun".

LaCour-Little, M., Lin, Z. and Yu, W. (2020), "Assumable financing redux: a new challenge for appraisal?", *The Journal of Real Estate Finance and Economics*, Vol. 60 Nos 1/2, pp. 3-39, doi: 10.1007/s11146-019-09710-2.

Leung, C.K.Y., Ng, J.C.Y. and Tang, E.C.H. (2020), "Why is the Hong Kong housing market unaffordable? Some stylized facts and estimations", *Federal Reserve Bank of Dallas, Globalization Institute Working Papers*, Vol. 2020 No. 380, doi: 10.24149/gwp380.

Liu, C. and Zhang, S. (2013), "Econometric analysis on the relationship between RMB exchange rate and real estate price by VAR model", available at: www.stats.gov.cn

Mandeya, S.M.T. and Ho, S.Y. (2021), "Inflation, inflation uncertainty and the economic growth nexus: an impact study of South Africa", *MethodsX*, Vol. 8, doi: 10.1016/j.mex.2021.101501.

Martin, A., Moral-Benito, E. and Schmitz, T. (2021), "The financial transmission of housing bubbles: evidence from Spain", *SSRN Electronic Journal*, Vol. 2245, doi: 10.2139/ssrn.3341198.

Mathenge, R.W. (2017), "Effects of money supply on residential real estate pricing in Nairobi county", pp. 1-67.

McQuinn, K. and O'Reilly, G. (2006), "Assessing the role of income and interest rates in determining house prices", *December*.

Mahalik, M.K. and Mallick, H. (2011), "What causes an asset price bubble in an emerging economy? Some empirical evidence in the housing sector of India", *International Economic Journal*, Vol. 25 No. 2, pp. 215-237, doi: 10.1080/10168737.2011.586806.

Miyajima, K. (2021), "Monetary policy, inflation, and distributional impact: South Africa's case", *WP/21/78, March 2021*.

Miller, N., Peng, L. and Sklarz, M. (2011), "House prices and economic growth", *The Journal of Real Estate Finance and Economics*, Vol. 42 No. 4, pp. 522-541, doi: 10.1007/s11146-009-9197-8.

Mishkin, F. (1996), "The channels of monetary transmission: lessons for monetary policy", *NBER Working Paper Series*, pp. 1-29, available at: www.nber.org/papers/w5464.pdf?new_window=1%5Cnpapers2://publication/uuid/E7FD0848-77D9-4893-A4F5-579BFFF16DE9

Mishkin, F.S. (2001), "The transmission mechanism and the role of asset prices in monetary policy", *Monetary Policy Strategy*, doi: 10.7551/mitpress/7412.003.0006.

Molin, S. (2020), "House price dynamics in Sweden".

Muthee, K.M. (2012), "Relationship between economic growth and real estate prices in Kenya", *November*, pp. 1-53, available at: http://erepository.uonbi.ac.ke:8080/xmlui/handle/123456789/13065%0Ahttp://erepository.uonbi.ac.ke/handle/11295/13065

Ndubuisi, G.O. (2015), "Interest rate channel of monetary policy transmission mechanisms: what do we know about it?", *SSRN Electronic Journal*, doi: 10.2139/ssrn.2623036.

Ozcicek, O. and McMillin, W. (1999), "Lag length selection in vector autoregressive models: symmetric and asymmetric lags", *Applied Economics*, Vol. 31 No. 4, pp. 517-524, doi: 10.1080/000368499324237.

Okey, P.C. (2023), "Drivers of Nigeria's real house prices: long-run analysis and short-run dynamics", *International Journal of Housing Markets and Analysis*, doi: 10.1108/IJHMA-07-2023-0093.

Okoye, U.H. (2018), "2008 Financial crisis and the deviation from the Taylor rule", available at: https://digitalcommons.georgiasouthern.edu/honors-theses

Orphanides, A. (2007), "Taylor rules", *Finance and Economics Discussion Series*, Vol. 2007 No. 18, pp. 1-13, doi: 10.17016/feds.2007.18.

Ouchchikh, R.A. (2018), "Monetary policy transmission mechanism in a small open economy under fixed exchange rate: an SVAR approach for Morocco international", *International Journal of Business and Economic Sciences Applied Research (IJBESAR)*, Vol. 11, pp. 42-51.

Patrick, C., Akanbi, O.A., Chileshe, M. and Olusegun, A. (2017), "The relative importance of the channels of monetary policy transmission in a developing country: the case of Zambia", *African Journal of Economic Review*, Vol. 5 No. 2, pp. 149-174.

Poterba, J.M. (1984), "Tax subsidies to owner-occupied housing: an asset-market approach", available at: www.archive.org/details/taxsubsidiestoowOOpote

Sethi, M., Baby, S. and Dar, V. (2019), "Monetary policy transmission during multiple indicator regime: a case of India", *The Journal of Asian Finance, Economics and Business*, Vol. 6 No. 3, pp. 103-113, doi: 10.13106/jafeb.2019.vol6.no3.103.

Simo-Kengne, B.D., Balcilar, M., Gupta, R., Reid, M. and Aye, G.C. (2012), "Is the relationship between monetary policy and house prices asymmetric across bull and bear markets in South Africa? Evidence from a Markov-switching vector autoregressive model", *Economic Modelling*, Vol. 32 No. 1, pp. 161-171, doi: 10.1016/j.econmod.2013.02.006.

Simons, R.A. (2005), "Chapter 3: Real estate theory", *When Bad Things Happen to Good Property*, Environmental Law Institute, Washington DC, Vol. 48, pp. 31-62.

Smal, M.M. and De Jager, S. and South African Reserve Bank (2001), "The monetary transmission mechanism in South Africa. South African reserve bank".

South African Reserve Bank (2011), "South African reserve bank history, functions, and institutional structure", available at: www.reservebank.co.za

Shi, S., Jou, J.B. and Tripe, D. (2014), "Can interest rates control house prices? Effectiveness and implications for macroprudential policy", *Journal of Banking and Finance*, Vol. 47 No. 1, pp. 15-28, doi: 10.1016/j.jbankfin.2014.06.012.

Sørensen, B.E. (2020), "Cointegration", *Time Series Analysis*, Vol. 1, pp. 571-629, doi: 10.2307/j.ctv14jx6sm.22.

South Africa Reserve Bank (2023), *Monetary Policy Review*; available at: www.resbank.co.za

Squires, G. and Webber, D.J. (2019), "House price affordability, the global financial crisis and mortgage rates' (Ir)relevance", *Regional Studies, Regional Science*, Vol. 6 No. 1, pp. 405-420, doi: 10.1080/21681376.2019.1643777.

Sumer, L. and Özorhon, B. (2020), "The exchange rate effect on the housing price index and REIT index returns rates", *Finansal Araştırmalar ve Çalışmalar Dergisi*, doi: 10.14784/marufacd.688468.

Sutton, G., Mihaljek, D. and Subelytė, A. (2017), "Interest rates and house prices in the United States and around the world", *Bank for International Settlements*, Vol. 665, pp. 1-53, available at: www.bis.org/publ/work665.htm

Swanepoel, C. and Fliers, P. (2021). The fuel of unparalleled recovery: Monetary policy in South Africa between 1925 and 1936. *Economic History of Developing Regions*. Vol. 36. pp. 213-244, doi: 10.1080/20780389.2021.1945436

Taylor, J.B. (2007), "NBER working paper series housing and monetary policy", available at: www.nber.org/papers/w13682

Taylor, J.B. (2009), "Economic policy and the financial crisis: an empirical analysis of what went wrong", *Critical Review*, Vol. 21 Nos 2/3, pp. 341-364, doi: 10.1080/08913810902974865.

Tita, A.F. and Opperman, P. (2021), "Understanding the behaviour of house prices and household income per capita in South Africa: application of the asymmetric autoregressive distributed lag model", *International Journal of Housing Markets and Analysis*, doi: 10.1108/IJHMA-02-2021-0018.

Trimbath, S. and Montoya, J. (2005), "Housing affordability in three dimensions: price, income, and interest rates", *SSRN Electronic Journal*, Vol. 31, doi: 10.2139/ssrn.349681.

Tripathi, S. (2019), "Macroeconomic determinants of housing prices: a cross country level analysis".

Van Hai, B. and Trang, T.T.M. (2015), "The transmission mechanism of monetary policy in Vietnam: a VAR approach", *Working Paper Series, N IHEIDWP1*, pp. 1-36.

Vermeulen, C. (2020), "On the mandate, ownership, and independence of the South African reserve bank", *South African Journal of Economic and Management Sciences*, Vol. 23 No. 1, pp. 1-11, doi: 10.4102/sajems.v23i1.3416.

Voith, R.P. and Wachter, S.M. (2009), "Urban growth and housing affordability: the conflict", *The ANNALS of the American Academy of Political and Social Science*, Vol. 626 No. 1, pp. 112-131, doi: 10.1177/0002716209344839.

Williams, J. (2016), "Measuring the effects of monetary policy on house prices and the economy", *Bank for International Settlements*, Vol. 88 No. 88, pp. 7-16.

Yildirim, M.O. and Yağcibaşi, Ö.F. (2019), "The dynamics of house prices and fiscal policy shocks in Turkey", *Economic Annals*, Vol. 64 No. 220, pp. 39-59, doi: 10.2298/EKA1920039O.

Yan, N. (2019), "Study on the influence of monetary policy on real estate price in China", *Journal of Service Science and Management*, Vol. 12 No. 2, pp. 152-171, doi: 10.4236/jssm.2019.122011.

Yiu, C.Y. (2023), "Are Central banks' monetary policies the future of housing affordability solutions", *Urban Science*, Vol. 7 No. 1, doi: 10.3390/urbansci7010018.

Yusuf, E.A., Ozlem, D.N., Yavuz, S.H. and Fatih, Y. (2023), "Cost of credit, mortgage demand and house prices".

Further reading

Adrian, T. and Shin, H.S. (2011), "Prices and quantities in the monetary policy transmission mechanism", *SSRN Electronic Journal*, pp. 131-142, doi: 10.2139/ssrn.1483825.

Agha, A.I., Ahmed, N., Mubarik, Y.A. and Shah, H. (2005), *Transmission Mechanism of Monetary Policy*, Vol. 1 No. 1.

Anari, A. and Kolari, J. (2002), "House prices and inflation", *Real Estate Economics*, Vol. 30 No. 1, pp. 67-84, doi: 10.1111/1540-6229.00030.

Barran, F. and Virginie Coudert, B. (1998), "The transmission of monetary policy in Israel", *IMF Working Papers*, Vol. 98 No. 114, p. 1, doi: 10.5089/9781451943504.001.

Brandao-Marques, L., Gelos, R., Harjes, T., Sahay, R. and Xue, Y. (2020), "Monetary policy transmission in emerging markets and developing economies", *IMF Working Papers*, Vol. 20 No. 35, doi: 10.5089/9781513529738.001.

Chu, Z., Chen, X., Cheng, M., Zhao, X. and Wang, Z. (2023), "Booming house prices: friend or foe of innovative firms?", *The Journal of Technology Transfer*, doi: 10.1007/s10961-023-10005-1.

Gelain, P., Lansing, K.J. and Mendicino, C. (2013), "House prices, credit growth, and excess volatility: implications for monetary and macroprudential policy", *Federal Reserve Bank of San Francisco, Working Paper Series*, Vol. 9 No. 2, pp. 219-276, doi: 10.24148/wp2012-11.

Huh, I. and Lee, Y. (2021), "Monetary policy transmission mechanism of Bangladesh", *December 30*.

Reserve Bank of Australia (1996), "The transmission of monetary policy in Canada", *Canadian Public Policy/Analyse de Politiques*, Vol. 22 No. 4, p. 418, doi: 10.2307/3551475.

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