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The impact of interest rates on the South African real estate market

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THIS RESEARCH PROJECT IS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF MANAGEMENT IN FINANCE AND INVESTMENTS, WITS BUSINESS SCHOOL.

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DECLARATION

This research project is my original work and has not been submitted for the award of a degree in any university.

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This research project has been submitted for examination purposes with my approval as the University Supervisor.

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Supervisor

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DEDICATION

To my mother, Thandi, who always motivates and guides me, this one is for you. Thank you for never ever giving up and for your unwavering support. I will continue to make you and myself proud. You are love- and greatness personified!

ABSTRACT

Real estate not only represents a big part of individual and business investments, but also forms an important part of people's livelihoods by providing shelter, alleviating poverty, and boosting income distribution. The real estate sector in South Africa is lagging in fulfilling this fundamental role. South Africa inherits most of its housing issues from an unpredictable economy and from the past and present governing and administrative systems. Housing and economic policies are intended to handle the housing backlog and issues which are a legacy of the period of inequality and segregation when access to housing and land was regulated based on race and ancestral tenure.

To understand the dynamics in the residential real estate market better, this study sought to establish the impact of interest rates on the South African real estate market, using quarterly time series data from 1993Q2 to 2017Q4. Encompassed within the real estate market, this paper will focus on housing price indices and the market size which is represented by construction activity. These dependent variables are analysed against interest rates and moderated by inflation rates, gross domestic product (GDP), exchange rates, tax rates and the interaction term between interest rates and tax rates. A multiple linear regression model with OLS estimation method is used to determine the relationship between the variables.

The dependent variables are evaluated individually against the explanatory variables. Overall, the obtained results show that interest rates have an indirect and significant relationship with housing prices; and a direct yet insignificant relationship with construction activity. As such, this suggests that interest rates are deemed adequate in explaining the movements in the house prices but not the movements in the entire real estate market. The insignificant relationship between interest rates and construction activity are surprising considering the theoretical and practical expectations. The results are largely attributed to shortcomings encompassed within the economy.

Thus, it is believed that addressing the current economic shortfalls, along with additional research into the real estate market in South Africa should aid in both addressing problems and in further expanding the knowledge needed to effectively correct short falls within the economy and the real estate sector.

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LIST OF ABBREVIATIONS

ABSA	**Amalgamated Banks of South Africa**
CAPM	**Capital asset pricing model**
CEIC	**Census and Economic Information Centre**
CPI	**Consumer price index**
FRED	**Federal reserve bank of St. Louis**
GDP	**Gross domestic product**
REIT	**Real Estate Investment Fund**
OECD	**Organization for Economic Cooperation and Development**
OLS	**Ordinary Least squares**
REIT	**Real estate investment trust**
RDP	**Reconstruction and Development Programme**
StatsSA	**Statistics South Africa**
VECM	**Vector error correction model**
VIF	**Variance Inflation Factor**

Chapter 1 - Introduction

1.1 Background and motivation

Although the interaction between the housing sector and the real estate economy has been extensively studied in developed economies (Simo-Kengne, 2013), housing and housing related issues are yet to be widely explored in developing countries (Simo-Kengne, 2013). Published literature on real estate has suggested several housing market characteristics to explain house prices (Zietz *et al.*, 2007). Unlike developed nations, investment in residential real estate in developing countries faces critical challenges including, but not limited to; uncertain economic environments, poverty, the lack of capacity of the construction sector, poor infrastructure, and lack of integrated research (Simo-Kengne, 2013).

The real estate market is influenced by ever-changing factors which are inter-linked (Zietz *et al*., 2007). These factors include, but are not limited to; interest rates, Gross Domestic Product (GDP) and disposable incomes of individual investors. Moreover, the performance of other industries impacts the demand and supply of real estate assets and hence the prices at which they can trade in the marketplace. In addition, changing political, regulatory, and environmental factors affect the supply of and demand for assets in the real estate sector.

There have been many definitions of housing market that have been put forward. As such, Royuela & Vargas (2007) defined the housing market as the collection of alternative locations that are considered as location substitutes by households. This is based on the theory that a residential location depends on the distance that individuals face in their commute (Royuela & Vargas, 2007).

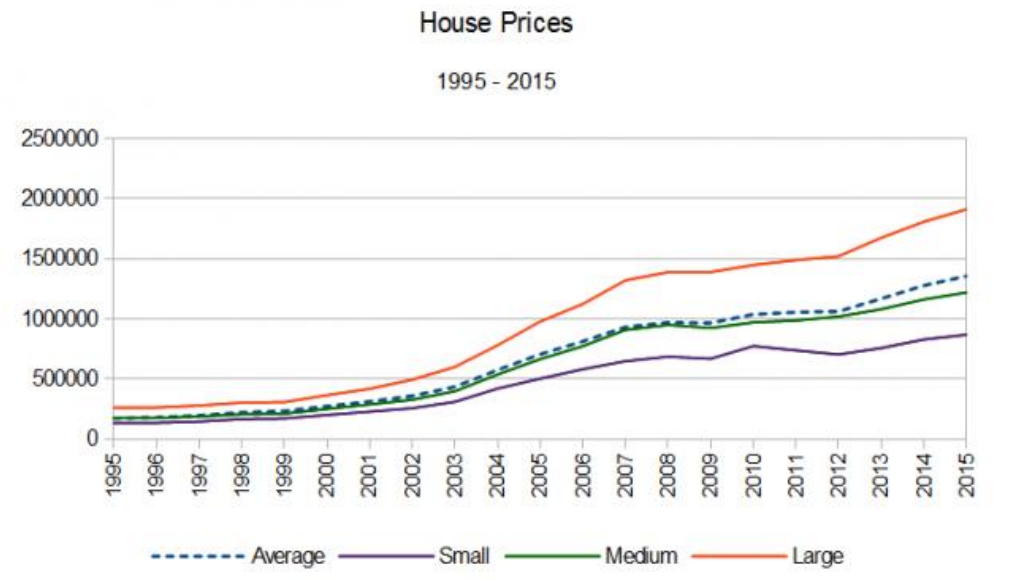
The real estate market can be defined based on the theory of demand and supply (Akumu, 2014). This means that the dynamics exhibited by the market are driven by the mechanisms of demand and supply (Akumu, 2014). Real estate market could also be defined in the context of subsuming the real estate prices and to some degree, the sizes of the real estate market, the extent of the construction activity and the volume of transactions. Fundamentally, the real estate market is defined by factors that impact it.

Real estate investment involves the purchase, ownership, management, rental or sale of real estate assets for profit (Nzalu, 2013). Developed countries predominantly use bonds

and stocks as a channel to invest in the real estate market, whereas in developing countries like Kenya and South Africa, financing of real estate is predominantly through mortgage financing (Muriuki, 2013; Iossifov *et al*., 2008). Therefore, this results in the real estate industry being dominated by institutional investors such as insurance and mutual funds, investment banks and corporations who generally have more funds to invest.

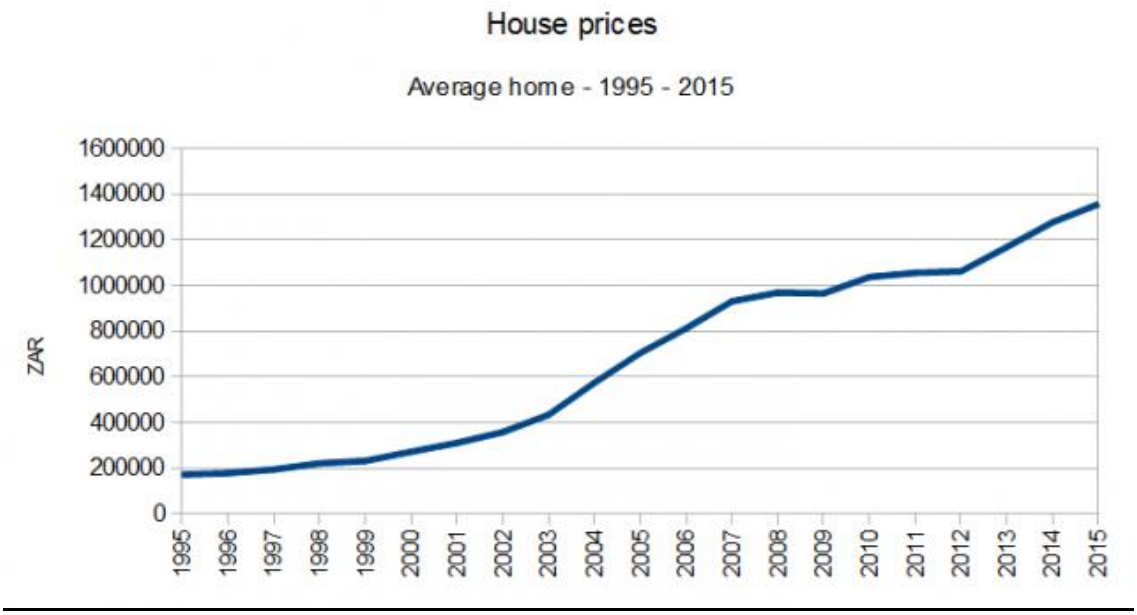
Real estate is influenced by several dynamic factors. This study will focus on interest rates as a factor. Interest rates, together with money supply, are regulated through the monetary policy, and interest rates are integral when dealing with variables such as investments, employment, and inflation (Muriuki, 2013).

The residential real estate industry in South Africa has experienced some growth in the 20 years between 1995 & 2015; as shown in figures 1.1 and 1.2 below. According to the Census and Economic Information Centre (CEIC) database, the average year on year house price growth between 1967 and 2016 rate is 10.5% p.a. It is important to also note that growth patterns have fluctuated widely in direct response to exogenous events (Clark & Daniel, 2006). Clark and Daniel (2006) reported a strong domestic currency as an exogenous event in 1980 which influenced the real estate market.



Source: BusinessTech, Available at: http://businesstech.co.za/news/general/120187/average-house-prices-in-south-africa-1995-2005/

Figure 1.1: Nominal house prices (in ZAR) for different housing sizes (small-80-140m^2, medium-141-220m^2 and large- 221-400m^2) from 1995 to 2015.



Source: BusinessTech, Available at: http://businesstech.co.za/news/general/120187/average-house-prices-in-south-africa-1995-2005/

Figure 1.2: Average nominal house prices (in ZAR) for small, medium and large homes from 1995 to 2015.

Residential real estate analysts have limited tools at their disposal to evaluate the role that certain factors have played in shaping the pricing of assets in the country's real estate market (Clark & Daniel, 2006). Analyses are generally based on events in international property markets (Clark & Daniel, 2006) which do not always fit the South African context. In addition, limited data and knowledge limits the evaluation of real estate sector dynamics. The purpose of this study, therefore, is to ascertain the impact interest rates have on real estate market growth in South Africa. Furthermore, construction output is a key indicator of the health of an economy and yet in theory there is a lack of empirical evidence on the influence of monetary instruments, including lending rates on construction output (Mbusi *et al.,* 2017).

To acquire additional understanding of the context of the real estate market in South Africa, and how interest rates influence it, it is also necessary to understand the history of the South African real estate market and how it has changed and evolved.

1.2 Real estate context in South Africa

Given the history of South Africa which had many policies relating to governance, property ownership was regulated on a racial basis. As a result, considerable disparities in

development, income, and urbanisation within South Africa induced segmentation in the housing markets (Simo-Kengne, 2013).

Access to land in most sub-Saharan African countries, such as South Africa, has been determined by indigenous systems of land tenure that have evolved over time under local and colonial influences (Chimhowu & Woodhouse, 2006). The land policy, which included partially the parts on customary ownership of land, has a colonial basis which was introduced by the colonial administration (Chimhowu & Woodhouse, 2006).

The political history of South Africa contributed to the housing backlog and inequality. The physical segregation that permeated the nation created inequalities in housing supply, housing types, residential setting types and land ownership policies, which Burger and Janse van Rensburg (2008) suggests resulted in a dual mortgage market. Burger and Janse van Rensburg (2008) argue these disparities using the theory of the law of one price which suggests that products that belong in the same market must have absolute prices that converge. The middle- and upper income market performs well while a significant part of the population faces housing delivery backlog in the low-income market (Burger & Janse van Rensburg, 2008). Considering significant differences in average house prices between the two markets, an important development goal is to reduce housing inequalities (Simo-Kengne, 2013).

It is therefore inevitable that people who moved to urban areas in search of greener pastures became backyard dwellers or building shacks which resulted in growing illegal informal settlements on the periphery of major cities.[1]

South Africa continues to experience large scale migration from rural areas to urban areas, where most migrants end up in low-cost housing and informal settlements and slums (Shackleton, 2013). As a result, the government introduced the Reconstruction and Development Programme (RDP) which aimed to service the housing gap for South Africa's impoverished majority (Midgley, 2001). However, the RDP's proposals soon created expectations that could not be met with the country's economy as government was unable to mobilise sufficient funds to meet the RDP's objectives (Midgley, 2001). Government is faced with a high demand for housing and other social services making the turnaround for

the provision of these services long, and government is struggling to balance the social and economic objectives (Midgley, 2001).

Developing countries like South Africa face critical challenges such as an uncertain economic environment, low capacity of the construction sector (Simo-Kengne, 2013), which impact the amount of investment into the real estate market. As a result, South Africa and other developing nations are faced with severe and urgent housing problems but lack adequate resources and/or the economic and political stability to utilise the resources they currently have.

The country's experience on upgrading the informal settlements shows that there are several challenges in relation to maintenance and the protection of the right to access to adequate housing, health, school, basic services and ensuring the effective participation of communities in housing development (SERI, 2018) [1].

At the dawn of democracy, the country introduced new policies which were mandated to promote economic growth and at the same time, raise the standards of living of the country's impoverished majority (Midgley, 2001). These policies are aimed at inclusion of people who were previously disadvantaged into the economy. Legislation pertaining to building construction was also progressively amended over years (Simo-Kengne, 2013). According to PwC (2015), rapid urbanisation and shifts in population dynamics will drive changes in demand for real estate. This will result in the infrastructure shortages which will create opportunities for investment and an increase in construction activity (PwC, 2015).

In South Africa, over the past 30 years there has been an approach to private capital to promote inclusive social housing using private capital and government subsidy for this purpose. However, this attempt has not been successful due to lack of institutionalization of the process (Soares da Motta, 2019).

The housing and land subject in South Africa are more than just a political mandate, but also a social concern. The spatial mismatch in which the unemployed and poor are located far from employment opportunities is a typical poverty trap (SERI, 2018). Research should

[1] https://www.southafricanmi.com/south-africas-gdp.html

therefore gear towards looking how, if at all, certain factors like interest rates influence the real estate sector of developing countries to help alleviate these issues.

1.3 Interest rate dynamics

To be able to delve deep into the context of this paper, it is worthwhile to explore the concept of interest rates. Broadly, interest rates are thought to affect the cost of capital which is the interest expenses and hence affects property values.

Akumu (2014) reported that the nominal and real interest rates usually reflect the status of current and future business environments and investment opportunities. Akumu (2014) further stated that real interest rates indicate the cost of financing investments which implies that the supply and demand of residential properties will be depressed when interest rates are high. When interest rates are higher, supply is strangled because higher interest rates reduce the capital available to expand businesses (Muriuki, 2013). It is evident therefore, that interest rates are a cost to real estate developers as much as they are to real estate investors (Muriuki, 2013).

Muriuki (2013) defined interest rates as the amount of money which is charged or paid for the use of an amount borrowed over a defined period as percentage of principal. The interest rate that the lender charges is a percentage of the total amount loaned (Muriuki, 2013).

In monetary policy, when interest rates are low, people have more disposable income which then allows them to invest more in the economy and increases consumption. The opposite is true, when interest rates are high, investment and consumption in the economy tends to decrease (Muriuki, 2013). These relationships also influence the supply and demand of real estate commodities (Muriuki, 2013).

Majority of average South Africans who wish to invest in residential real estate market are dependent on banking systems to finance their real estate transaction(s); therefore, it is crucial to evaluate factors like interest rates. The cost of borrowing from banks is driven primarily by real interest rates, which are driven by inflation (Muriuki, 2013).

Soares de Motta (2019) argues that, unlike other nations, the reason for including banks in housing finance in South Africa was not with the aim of increasing housing availability, but strongly linked to the intention of reducing inequalities generated by apartheid.

The real estate sector in South Africa is one of the contributors to the economy, and it is important to understand the dynamics in the sector, as it is thought to be influenced largely by interest rates. Therefore, the purpose of this study is primarily to discern the impact of changing interest rates on the growth of the real estate market and how this in turn impacts the benefit (if any) of investing in the real estate market by ordinary South Africans. This research sought to investigate the patterns of real estate prices based on interest rates and whether it is worth it to invest considering these patterns.

Muriuki (2013) stated that generally, investors such as individual homeowners usually have limited information on factors influencing housing prices. As indicated in the dynamics of the monetary policy, interest rate levels impact the availability of capital and thus investment into the real estate industry which in turn also influences the demand for mortgage bonds. The capital flows influence the supply and demand for property and, as a result, they affect property prices. Interest rates are also thought to influence construction activity. Thus, it is worth exploring whether base lending rate can be used as an effective policy instrument to influence construction output (Mbusi *et al*., 2017) which forms a large part of the economy and addresses the real estate demands and supply structure.

Interest rates also affect returns on real estate investments, and because of the inherent risk in real estate investments, the price changes will correspond to the changes in the inherent risk (Muriuki, 2013). These changes in required rates of return for real estate also vary during periods of destabilisation in the credit markets (Muriuki, 2013). As investors foresee increased variability in future rates or an increase in risk, risk premiums widen, putting increased downward pressure on property prices (Muriuki, 2013).

1.4 Problem statement

Housing supply is determined not only by the production decisions of builders of new units but also by the decisions made by investors (and their agents) concerning purchasing which determines the trajectory that the housing market takes (Dipasquale, 1999). Thus, it is crucial to understand factors that influence housing prices.

Juma (2014) describes the crucial role that real estate plays in economies by providing employment opportunities, offering shelter to households, and enhancing income distribution and poverty alleviation. When determining what factors motivate investors to

invest in the real estate sector, Muriuki (2013) suggests that investors tend to intensively study rising real estate prices as a motivating factor to invest in real estate. However, Muriuki (2013) argues that interest rates can also be a good proxy to motivate for the investment in real estate.

Not only do interest rates influence real estate returns but they also influence the cost of borrowing to invest in real estate (Muriuki, 2013). Interest rates are less predictable than real estate values, as they fluctuate more often. The real estate sector, being one of the major sectors of the South African economy, together with finance and business contributed 22% towards the country's GDP in 2018[1].

The performance of the real estate sector is believed to be largely affected by fluctuating interest rates (Chaney & Hoesli, 2010). In a study by Akbari and Aydede (2012), the researchers concluded that even though an increase in the real estate prices are caused by interest rates, low interest rates will also stimulate investment into real estate. His premise is also illustrated by Jordaan (2013), who states that, generally, when interest rates increase there is a decrease in aggregate demand for investments especially with investments are sensitive to changes in interest rates. However, there is no clear understanding, in the South African context, of the nature of the relationship between interest rates and performance of real estate investments. This has limited investors' decision-making and undermined their portfolio construction efficiency. Therefore, this study seeks to establish the nature of the relationship between real estate growth and interest rates in South Africa.

In the context of the real estate market, there is increasingly higher desire for people to be able to afford and to ultimately own their own residential properties. There is also an interest to pursue the real estate market as a business venture. Therefore, this study will enable investors to make better-informed decisions pertaining to their real estate portfolios.

1.5 Research objectives

The broad objective of this study is to understand the impact that interest rates, as a factor, has on the real estate market in South Africa. Specifically, the study seeks to:

- Examine the relationship between interest rates and growth of South Africa's real estate sector

- Examine the effect of interest rates on housing prices in South Africa's real estate market
- Evaluate the extent of construction activity and its impact on real estate market in South Africa

1.6 Significance of study

Real estate is an important sector because it plays a dual role in economic development and fulfilling people's fundamental housing needs (Wang *et al*., 2013). It is therefore imperative to research and find more compelling information and evidence on the factors that influence the real estate market. Although many people acquire residential property through mortgage loans, mortgages are generally expensive, and the average person cannot afford them (Muriuki, 2013).

Therefore, the value that this study is three-fold. First, the factors influencing real estate sector growth are to be considered as real estate plays a significant role in the economy and PwC (2015) forecasts a substantial expansion in the global investable real estate universe. This appears to be supported by recent data, which suggests that the real estate sector (together with finance) was one of the only four sectors that experienced positive quarter-on-quarter growth in South Africa between quarter 1 and quarter 2 of 2019[1]. The growth for real estate and finance was 4.1% and the second highest was trade at 3.9% contribution to GDP[1]. Another example is the real estate market in the United States of America which accounts for a large share of wealth.

Secondly, although not being the primary goal of this paper, this paper sheds light into the effect of financial policy guidelines such as regulating interest rates on the real estate sector. Controlling interest rates can potentially increase the demand for real estate commodities therefore there will be more investment into the sector. This is expected to have a significant impact on various parts of the economy and addressing social issues like the lack of adequate housing.

Lastly, the results of this study are expected to yield guidance to financial institutions, financial advisors, spatial planners, and brokers on potential advice to their clients on plausible portfolio responses to changing interest rates. This enables them to advise on the

real estate patterns that clients can look at to determine the trajectory of their investments and to plan their portfolios (Muriuki, 2013).

The remainder of this paper is organized as follows. Chapter 2 describes the literature review of the historical and current research in the field of study. Chapter 3 describes the methodology and data analysis methods. Finally, results are discussed in Chapter 4, and this paper ends with concluding remarks and recommendations in Chapter 5.

Chapter 2 - Literature review

This section deals with the historic and current state of research in the field of study (Muriuki, 2013). Most importantly, it reviews the evidence of studies that have been conducted that are similar to the research focus of this paper. This section also outlines the research gap that this study intends to contribute to.

2.1 Theoretical literature review

There are several theories that attempt to explain how interest rates affect economies and how they can be used to forecast future changes within the real estate industry/ real estate dynamics (Muriuki, 2013).

Heinrich & Schreck (2018) in their study on the sensitivity of institutional real estate investments on interest rates argued that there are some justified reasons to assume that there exists a strong relationship between interest rate and real estate prices. Firstly, from a capital market perspective, real estate as an investment competes with bonds (Heinrich & Schreck, 2018). This means that the trends in the respective yields of the two investment classes relate to each other; that is, the expected yield on real estate decreases (increases) whenever the expected yields on bonds decrease (increase). Secondly, real estate investments are often highly leveraged. Therefore, whenever credit costs decrease, investing in real estate therefore becomes more profitable and prices rise for any given yield expectation. And finally, in real estate, rent is often linked to inflation, which in turn is empirically correlated to the market interest levels (Heinrich & Schreck, 2018).

Heinrich and Schreck (2018) measured the interest rate sensitivity of an asset by the "modified duration", which follows the concept that interest rates and bond prices move in opposite directions. Duration is defined by Macaulay (1938) as the weighted average of the time for a bond to reach maturity. A bond is a fixed-income security whose yield is determined by the interest rate at which the present value of the payment stream equals its price. Macaulay (1938) argues that this makes duration a very suitable measure to calculate the interest-rate sensitivity of a bond's market value. Chaney & Hoesli (2010) states that interest rate sensitivity of financial instruments indicates the relative change of

the instrument's value following a unit change in interest rates which is parallel to the duration.

Harris (1989) states that there are certain expectations in the real estate market based on the overall economy, however, the behaviour of the markets can be different from what is expected. Harris (1989) looked at how inflation and interest rates play a role in the returns dynamics in real estate versus bonds and stocks. Further, when nominal interest rates begin to rise sharply after a period of relative stability, expectations of further increase intensify which increases demand for real estate assets (Harris, 1989). Buyers who are most sensitive to interest rates are first-time buyers and those with moderate income, therefore a rise in nominal interest rates could introduce a downward bias in sales prices. Harris (1989) also highlighted the effect of interest rates on loans when these investors wish to invest in real estate assets.

To expand on this, Muriuki (2013) argues the state of interest rates in the obtaining of loans. Muriuki (2013) states that the interest rates that banks charge make loans more expensive which then means fewer people and businesses can afford to borrow. This lowers the amount of credit available to fund purchases, slowing consumer demand (Muriuki, 2013). In contrast, lower interest rates allow more people to be able to qualify to purchase a home, thus more people can afford to purchase servicing the supply. Muriuki (2013) based this on the 'Post-Keynesian theory' of debt deflation which takes a demand-side view, arguing that real estate property owners not only feel richer, but borrow against the increased value of their property, or borrow money to speculate in real estate property, therefore buying property with borrowed money in the expectation that it will rise in value and they can profit from that.

The Keynesian Economic theory views that aggregate demand in the market does not necessarily equal the productive capacity of the economy, but it is influenced by a host of factors and sometimes behaves erratically, affecting production, employment, and inflation (Juma, 2014). Keynesian economists often argue that private sector decisions sometimes lead to inefficient macroeconomic outcomes which require active policy responses by the public sector, in particular, monetary policy actions by the central bank and fiscal policy

actions by the government, in order to stabilise output over the business cycle (Juma, 2014). In a study by Chen and Tzang (1988), the capital asset pricing model (CAPM) was used as a base to decipher the sensitivity of real estate investment trusts (REITs) to interest rates and inflation and used a multiple regression model to model the relationship. They argue that regressing interest-rate changes on equity REIT price changes provides an analysis of the effects interest rates may have on the real estate investment funds (Chen and Tzang, 1988).

In a study by McKinnon (1973), the author describes domestic capital markets as a conduit to stimulate economic performance. The process of economic development is described as the reduction of dispersion of social rates of return on different investments, as described by McKinnon (1973), where an extreme state of repression is where no lending takes place. In his theory, McKinnon (1973) was able to explain the failure of some region's attempts at economic growth, stating the policies set in place as playing a vital role. McKinnon (1973) used an example of countries with larger economies, whose central banks raised the interest rates above the rate of inflation which increased the demand for real money, the size of the financial sector and the quantity and quality of investment. Likewise, Shaw (1973) looked at the prominent factors that influence lagging economies and stated that there is no shortage of investment opportunities but there is a shortage of savings for their finance. Shaw (1973) posits his analysis on financial repression and liberalisation, which describes in essence the state in which interest rates are prevented or permitted to play a role in the demand or supply of money, providing some guidelines for financial policies.

Juma (2014) proposes in their study of the effect of macro-economic variables on the Kenyan real estate market, a theory that posits that the nominal interest rate should be administratively fixed. Juma (2014) echoes McKinnon and Shaw's theory that there is a greater likelihood of having investments that are less productive in emerging markets because emerging economies are fragmented.

In a study on the effects of interest rates on housing prices in Sweden, Demewez (2011) argued that there are two basic determinants of house price dynamics, long-term and short-term determinants. They stated that long-term house price determinants included growth in disposable income, average level of interest rates (related to long run inflation) and existing

house stock, whereas short-term determinants included provision of financing for house purchasing, liquidity of house, taxes, and price expectations (Demewez, 2011). These factors are thought to shape the trajectory of the Swedish housing market.

Kohn and Bryant (2008) evaluated research by Mints (2007) where the impact of several factors, including mortgage rates, on the Russian housing market was studied. They uncovered that a housing bubble is what essentially caused the trajectory of the housing market in Russia which they found to be similar also what the housing market in the United States (Kohn & Bryant, 2008), and the analysis of data lent support to this. However, in another study, He *et al*. (2003) indicated that returns on REITs are highly correlated with stock market returns and returns on mortgage REITs, are also related to changes in interest rates.

Literature studies show therefore that multiple factors contribute to the real estate market. The exact variable and extent of the variable's impact is dependent on various other factors that are related to the economy, the country and/or period.

CHAPTER 3 - Research methodology

The research methodology section outlines the approach taken to establish the relationship based on the research question. This section will cover the research design, sampling method, data collection methods and data analysis techniques.

3.1 Research design

Research methodology is a vital component of research. It is concerned with the general and specific approaches used by a researcher in obtaining knowledge for their study (Warburton, 2016). The choice of the method is context-dependent and has its limitations, but inherent weaknesses of any one method can potentially be offset by situating them within a broader research strategy (Warburton, 2016). Quantitative methodology seeks to obtain accurate and reliable measurements that allow a statistical analysis of data and information (Queirós *et al*., 2017).

Warburton (2016) describes quantitative research as that which relates to the collection of numerical data that allows for statistical based methods to isolate specific variables for analysis. Based on the literature on the effect of interest rates on real estate markets and the transaction process, a quantitative approach is thus the most appropriate in this research.

The relationship between changing interest rates and real estate growth will be evaluated using a regression model. The findings from the models are discussed in the data findings and analysis section.

3.2 Data and data collection

This study uses data from the local housing markets in South Africa obtained from sources including OECD, Stats SA, Trading Economics, Federal Reserve Bank of St. Louis and World Bank. The housing markets include residential housing markets in South Africa. To fully capture the context in the South African housing market, there needs to be customised set of data reflective of the country's housing market. Housing price data will be proxied by housing price indices and construction activity represents the change in supply of real estate and is proxied by the number of residential permits passed. The data series consists of quarterly data from 1993 until 2017, used to observe changes/ trends over the period and when impacted by different economic events. The relationship between interest rates and

real estate was moderated by macroeconomic aggregates namely GDP, inflation rate, exchange rates and tax rates as control variables.

The type of data collected is related to the methodology to be used. For this thesis, quantitative data are collected in the form of lending interest rates, housing price indices, construction activity growth, inflation rates, GDP, exchange rates and tax rate. Quantitative assessment of growth of the real estate market is the change in investments in the residential housing segment of the real estate sector (Muriuki, 2013).

GDP measures the output of final goods and services and incomes within an economy in a specified period. Inflation is a general increase in prices of goods and services. Inflation is measured using the consumer price index (CPI) based on a representative basket of goods and services, which measures the proportion of the typical consumer's overall spending is spent on specific goods and services (Muriuki, 2013). The rate that one currency is exchanged in relation to another currency is the exchange rate and the tax rate is the proportion at which an individual is taxed. These variables are also proved by literature to impact the residential real estate markets (Grum & Grovekar, 2015; Kohn & Bryant, 2008).

3.3 Econometric methodology

Brooks (2014) describes regression analysis as one of the most important tools at the disposal of a researcher. Regression is defined as an attempt to explain movements in a variable by reference to movements in one or more other variables (Brooks, 2014). The regression is analysed through usage of the statistical tool EViews to properly review the characteristics of the dataset and the strength of the relationship between the dependent and independent variables.

The multiple regression equation takes the below form:

$$y_{it} = \beta_0 + \beta_1 x_{t,1} + \beta_2 x_{t,2} + \beta_3 x_{t,3} + \beta_4 x_{t,4} + \beta_5 x_{t,5} + +\beta_6 x_{t,6} + \varepsilon_{it}$$

Where y_{it} represents the variable representing performance of the real estate sector (house prices and construction activity). The β_0 represents the regression constant and $\beta_1 \; to \; \beta_6$ represents the regression coefficients (change in y for every unit change in X for the different periods). $x_{t,1} \; to \; x_{t,6}$ represent the observed values of interest rates, GDP growth,

inflation rates, exchange rates and the tax rates respectively at time t and ε_{it} is the error term.

The choice of the predictor variables is based on the literature. Following literature and adapted methodologies of Muriuki (2013); Juma (2014); Grum & Grovekar (2015) and Harris (1989), we conduct our empirical study by using multiple linear regression analysis.

Grum and Grovekar (2015) argue the use of multiple linear regression to evaluate the influence of various observed macroeconomic factors on residential real estate prices and argued that the choice of variables is because the variables describe characteristics of real estate over periods of time, which reflects the consensus in the reviewed literature. The choice of variables and models is further substantiated by Kohn and Bryant (2008); and Demewez (2011) who argues that there was a relationship between house price with real GDP, prime lending rate and private house price.

There are many econometric models available that can be used to estimate relationship between variables (Kelly, n.d). Unlike traditional approaches, the use of regression analysis provides unbiased comparable properties, and the process can be performed repeatedly with great accuracy (Robey *et al.,* 2019). Kelly (n.d) proposed the ordinary least squares (OLS) estimation method, which will yield a relationship between the variables by estimating the size and the sign of the β's. This is motivated further by He *et al.* (2003) who studied the sensitivity of mortgage REITs to interest rates. Akumu (2014) adapted the use of multiple linear regression in their study as guided by Ngugi (2001) who used regression analysis in a study on the empirical analysis of interest rates spread in Kenya.

3.4 The macroeconomic variables

3.4.1 Interest rates

Interest rates are described by Muriuki (2013) as the rate at which interest is paid by borrowers for the use of money that they borrow from a lender. It is a portion of the principal amount that must be paid over and above the initial principal over a period.

Demewez (2011) stated the relationship between interest rates and real estate in the pricing and mortgage financing. Demewez (2011) also mentions that most households having variable mortgages are found to be very sensitive with small changes in interest rates because of the impact on their incomes and asset prices.

3.4.2 Inflation rates

Inflation rates are a measure of the general increase in prices of commodities. Inflation rates are measured using the consumer price index (CPI) based on a representative basket of goods and services (Muriuki, 2013). Muriuki (2013) explains that the CPI determine what proportion of the typical consumer's overall spending is spent on specific goods and services, and then weights the average prices of those items accordingly.

3.4.3 Gross domestic product (GDP)

GDP is defined as a variable which measures the monetary value of final goods and services (those that are bought by the final user) produced in a country in any given period (Callen, 2008).

3.4.4 Real effective exchange rates

The rate that one currency is exchanged in relation to another currency

3.4.5 Tax rates

The proportion at which an individual is taxed

3.5 Meaning and measurement of variables

The following table shows a brief definition or proxy of the independent and dependent variables, and the units of measurement for each of the variables.

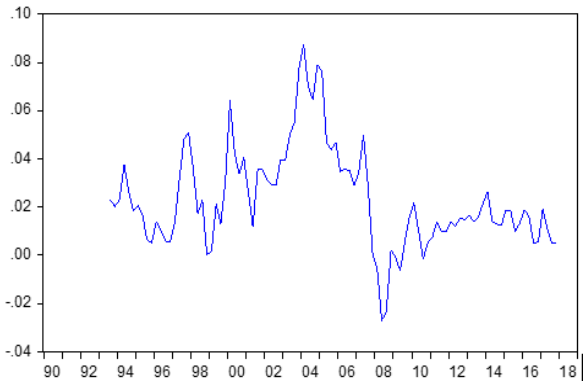
Table 3.1 Definitions and units of measurement for the variables

Variable	**Definition**	**Measurement**
Dependent variable		
House Prices	Cost of buying property	House price index
Construction activity	Residential permits passed for construction	Quarterly growth rate (%)
Independent variables		
Interest rates	Lending interest rate	Quarterly lending rates (%)
GDP	Real GDP growth rate	Quarterly growth rate (%)
Inflation rate	Inflation growth rate	Quarterly change in Consumer price index (CPI) (%)
Exchange rate	Real effective exchange rate	Real effective exchange rates
Tax rate	Represent the fiscal policy (tax policy)	Year-on-year change for each quarter (%)

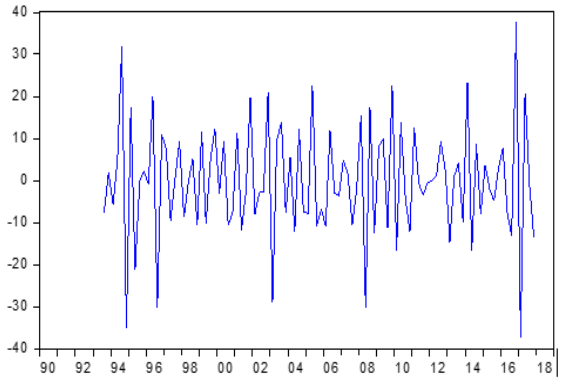
3.6 Data plots

The line graphs represent the differenced time series data. The x-asis represents the quarterly duration that the study covers and the y-axis represents the measure of the variable.

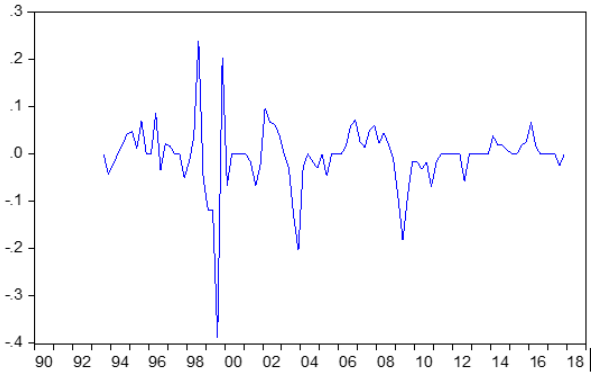
House price



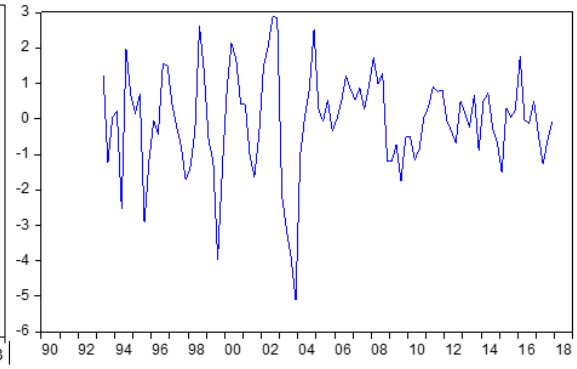
Construction activity



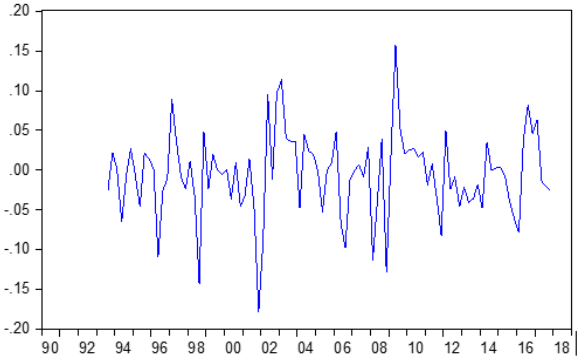
Interest rates



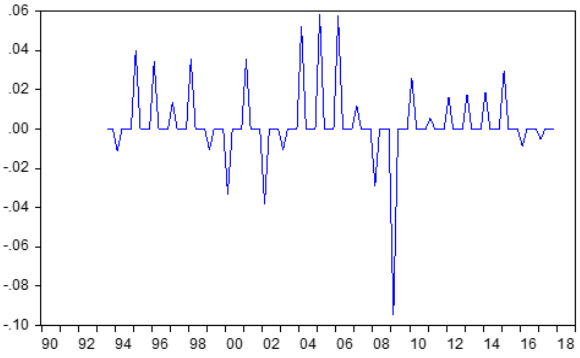
Inflation



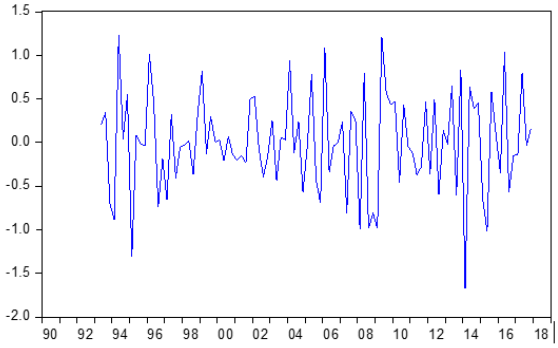
Exchange rate



Tax rate



GDP



3.7 Unit root analysis

The Augmented Dickey-Fuller (ADF) test was employed to test the stationarity of the variables used in the model. For this unit root analysis, a statistical significance at the 5% level will be used to reject the null hypothesis, indicating that the data being tested is stationary (i.e. devoid of a unit root). Generally, a p-value of more than 5% means the null hypothesis cannot be rejected and that there is no unit root. The test was conducted on the E-Views software.

Table 3.2.1: Results of the Augmented Dickey-Fuller (ADF) tests

Variable	**ADF-statistic**	**Critical value**	**Order of integration**	**P-value**
House Prices	-9.7106	-3.4999*	I(2)	0.0000
Construction Permits	-3.8916	-3.4992***	I(0)	0.0030
Interest Rates	-8.3733	-3.4984**	I(1)	0.0000
Inflation	-4.7799	-3.5014**	I(1)	0.0001
GDP	-5.4010	-3.4977***	I(0)	0.0000
Tax Rates	-9.9435	-3.4984**	I(1)	0.0000
Exchange Rates	-8.2786	-3.4984**	I(1)	0.0000

***Significant at the 1% level

**Significant at the 5% level

*Significant at 10% level

The above unit root test results indicate that the variable house price was stationary after second differencing I(2) with a probability value of 0.0000. However, construction permits and gross domestic product (GDP) were stationary at level I(0) with probability values 0.0030 and 0.0000 respectively. The variables interest rate, inflation, tax rate and exchange rates were all stationary after first differencing I(1) with probability values of 0.0000, 0.0001, 0.0000 and 0.0000 respectively. All the Augmented Dickey Fuller tests were considered using the intercept type of test.

CHAPTER 4 - Data findings and analysis

This chapter will discuss the analysis of the data pertaining to the impact of interest rates on the South African real estate market. The relationship was moderated by the macro-economic variables namely, real gross domestic product (GDP), inflation rates, exchange rates and tax rates. The quarterly data are collected from 1993 to 2017.

This section of the paper comprises of different sub-sections. The first sub-section consists of the descriptive statistics of the data. The analysis of the correlation between the dependent variables (housing price index and construction activity) and interest rates employing multicollinearity test are presented in the next sub-section, together with the cointegration test. The results of the regression analysis, empirical test rests are presented next and the multicollinearity (VIF) tests and vector error correction model (VECM) are then presented next, with the summary of the findings presented last.

4.1 Descriptive Analysis

The results in Table 4.1 show the descriptive statistics of the variables included in the study.

Table 4.1: Descriptive statistics of the data

	Mean	Median	SD	Min	Max	Jarque-Bera (p-values)
House Price Indices	53.43	56.96	33.55	11.17	111.1	0.009**
Construction Permits (%)	1.31	0.61	9.09	-23.69	33.49	0.010*
Lending int. rates (%)	13.38	12.65	3.95	8.5	24.9	0.018*
Inflation (%)	6.09	6.19	2.87	-1.76	13.57	0.31
GDP (%)	0.71	0.74	0.59	-1.56	1.87	0.003**
Tax rates (%)	24.86	24.4	1.77	21.53	27.6	0.084
Exchange rates	96.62	96.59	16.66	64.84	131.34	0.211

***Significant at the 1% level

** Significant at the 5% level

*Significant at 10% level

The table shows the average lending interest rate over the period to be 13.38% p.a. with a standard deviation of 3.95% p.a. The minimum and maximum lending interest rates are 8.5% and 24.90% reflecting observations for 2012Q1 and 1998Q3 respectively. The former,

low interest rates in 2012, are attributed to the good performance of sectors such as manufacturing and finance which boosted the economy and GDP in 2012. The maximum value is attributed to the effects of the Asian financial crisis, which resulted in a rise in interest rates in many emerging markets.

Furthermore, the house price index presented a minimum value of 11.17 in 1993Q2 which is the beginning of the period covered in this study, maximum value of 111.10 in 2017Q4 and an average of 53.43. The periodic percentage change in permits passed for construction of residential properties, which proxies the construction activity in the real estate market, presented a mean of 1.31%. The minimum and maximum values are -23.69% and 33.49% which are observed in 2008Q2 and 1994Q3 respectively, with a median value of 0.61%. The maximum value can be attributed to the rise and plethora of construction projects as a response to changes in policies which are aimed to reverse the effects of the segregation system (Soares de Motta, 2019; Pottie, 2004). The minimum value in 2008 can be attributed to the global financial crisis which impacted sectors and economies at large.

Figure 4.1 below shows the variability (standard deviation, SD) in interest rates, construction activity and house prices indices for the period 1993-2017. The figure shows that the interest rates are quite erratic. There are three visible spikes in the pattern (shown by red dots). The first is around 1998-1999 which can be attributed to some extent to the Asian financial crisis, which then had an influence on emerging markets. The other peak is in 2003-2005 and the last spike in 2008-2009 which could be attributed to the uncertainty presented by the global financial crisis, as discussed by Soares de Motta (2019). The interest rate levels are almost constant from the period between 2010 onwards. The variability in interest rates is an evidence of instability in financial markets (Wambui, 2013). Construction activity is very erratic, and the absolute value of house price index grows gradually over time.

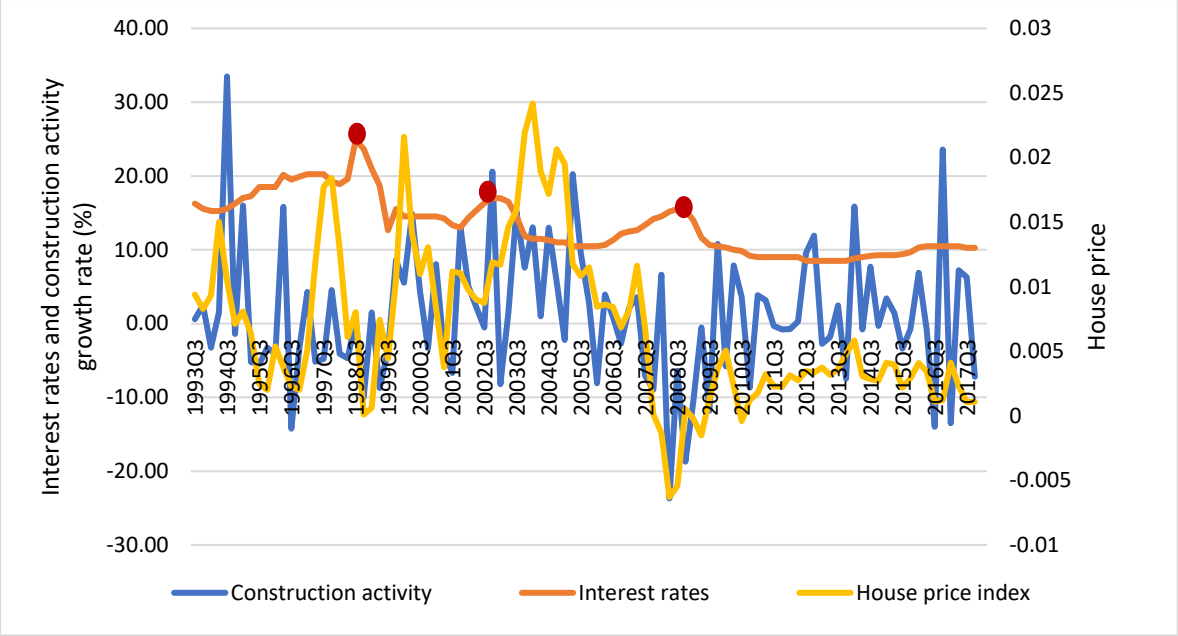


Figure 4.1: Housing price index, lending interest rates and percentage change in construction activity pattern from 1993 to 2017.

4.2 Correlation analysis

It is essential to quantify and define the relationship between interest rates and the real estate market. The study employs in part the Pearson correlation analysis to achieve this at a 95% confidence level (α=0.05).

Correlation analysis is used as an indicator of the linear association and strength of association between the dependant and independent variables. The Pearson correlation co-efficient is denote by 'r' and takes value between -1 and 1. A positive association between the variables is indicated by a value higher than 0 and no association between the variables is depicted by a r value of 0. A positive association simply means that as one variable increases, so does the other. This is the existence of a perfect linear relationship among some exogenous (explanatory) variables in an econometric model (Gujarati, 2004). The test considers the validity of the R-squared at its heart and this econometric problem is also reflected by very few ratios which are statistically significant and have a remarkably high R-squared. The econometric problem of serial correlation or multicollinearity is deemed present in an econometric model if any value in the correlation matrix is greater than 0.8.

Table 4.2.1 Correlation Matrix of explanatory variables

Variables	Interest Rates	Inflation	GDP	Tax Rate	Exchange Rate
Interest Rates	1.000000	0.527263	-0.032667	-0.600967	0.527331
Inflation	0.527263	1.000000	-0.315016	-0.320884	0.099620
GDP	-0.032667	-0.315016	1.000000	-0.104367	0.270102
Tax Rate	-0.600967	-0.320884	-0.104367	1.000000	-0.711070
Exchange Rate	0.527331	0.099620	0.270102	-0.711070	1.000000

Source: Research findings

Gujarati (2004) states severe correlation among explanatory variables exists when any value in the correlation matrix table is greater than 0.8. Considering the above table, the regression model does not suffer from the econometric problem of severe multicollinearity amongst its explanatory variables.

Co-integration Analysis

In this study, the Johansen Co-integration method is employed to test for co-integration. This is a procedural test that can be used to test for co-integration of several time series. This procedure is generally more accepted as it permits more than one cointegration relationship unlike the Engle-Granger approach which makes use of the Augmented Dickey Fuller test for unit roots. The two tests (Trace and Max-Eigen value) of co-integration under the Johansen Co-integration test shall be considered. Table 4.2.2 represents the results of the performed cointegration test using house prices as the dependent variable.

Table 4.2.2 Co-integration analysis

Lags	Trace Statistic	Critical Value	Prob**
At most 1*	95.91	79. 34	0.0017
At most 2*	64.87	55.25	0.0056
At most 3*	40.76	35.01	0.0109
At most 4*	18.70	18.40	0.0454
At most 5*	8.72	3.84	0.0031

Lags	**Max-Eigen Statistic**	**Critical Value**	**Prob****
At most 5*	8.72	3.84	0.0031

If the Trace statistic or Max-Eigen statistic is greater than the critical value at 5% level of significance and if the probability value is less than 5% (as a rule of thumb), that demonstrates and detects the presence of co-integration amongst variables. In respect to the Table 4.2.2 considering both the cointegration Trace test and Max-Eigen test, the variables are considered to be cointegrated as they have met mentioned rules of thumb. When variables are cointegrated, it therefore implies that a Vector Error Correction Model (VECM) should be considered and run.

4.3 Regression analysis

The regression analysis provides the relationship between two or more quantitative variables i.e. the value that is being predicted (dependent) and the predictor (independent) variables. To discern the goodness of fit of the regression equation, correlation coefficient is determined between the dependent and independent variables. The tables 4.3.1 and 4.3.2 below show the summary and the fit statistics for the multiple linear regression.

The regressions are run with the independent variables house prices and construction activity against the independent variables interest rates, GDP, inflation rates, exchange rates, tax rates and the interaction term between interest rates and tax rates. The tests are run with the dependent variable against interest rates, GDP and inflation rates in the second column, then the dependent variable against interest rates, GDP, inflation rates and exchange rates in the third column and the dependent variable against interest rates, GDP, inflation rates, exchange rates, tax rates and the interaction term between interest rates ad tax rates in the last column, yielding the below results.

Regression model

Table 4.3.1: Dependant variable: House prices

$$House\ price\ index = \beta_0 + \beta_1 interest\ rate + \beta_2 inflation\ rate + \beta_3 GDP + \beta_4 exchange\ rate + \beta_5 Tax\ rate + \beta_6 int\ rate * tax\ rate + \varepsilon$$

	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
c	152.312	0.0000***	197.930	0.0000***	-135,440	0.0000***
Interest rates	-7.542	0.0000***	-5.599	0.0000***	-4.604	0.0000***
GDP	-11.578	0.0007***	-6.378	0.0302	-6.337	0.0007***
Inflation	1.643	0.0424	1.005	0.1405	1.956	0.0000***
Exchange rate		-	-0.737	0.0000***	-0.110	0.2127
Tax rate		-		-	10.205	0.0000***
Interest rate*Tax rate		-		-	0.700	0.0000***
Adjusted R-squared	0.708		0.796		0.920	
Probability (F-statistic)	81.189		97.291		229.127	
Durbin-Watson (DW) statistic	0.297		0.200		0.469	

***Significant at the 1% level
** Significant at the 5% level
*Significant at 10% level

Table 4.3.2: Dependant variable: Construction activity

$$Construction\ activity = \beta_0 + \beta_1 interest\ rate + \beta_2 inflation\ rate + \beta_3 GDP + \beta_4 exchange\ rate + \beta_5 Tax\ rate + \beta_6 int\ rate * tax\ rate + \varepsilon$$

	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
c	4.264	0.2289	64.583	0.0006***	-33.780	0.6683
Interest rates	-0.131	0.6335	1.020	0.1790	6.556	0.2494
GDP	1.897	0.2520	1.020	0.5205	0.983	0.5344
Inflation rates	-0.418	0.2943	-0.403	0.2918	-0.5116	0.1803
Exchange rate		-	-26.347	0.1176	-25.840	0.1236
Tax rate		-		-	-2.100	0.0010
Interest rate*Tax rate		-		-	-0.293	0.2016
Adjusted R-squared	0.025		0.113		0.130	
Probability (F-statistic)	0.147		0.004		0.004	
Durbin-Watson (DW) statistic	2.421		2.601		0.654	

*** Significant at the 1% level
** Significant at the 5% level
*Significant at 10% level

4.4 Empirical tests results

Table 4.3.1 represents the dependent variable house prices against the independent variable. The second column presents the dependant variable against the independent variables interest rates, GDP and inflation rates considered, which resulted in an adjusted R-squared of 0.708. The probability (F-statistic) is 81.189 and the Durbin-Watson statistic is 0.297. The p-values for the constant, interest rates and GDP are highly significant with p-values of 0.0000, 0.0000 and 0.0007 respectively, and the probability GDP of 0.0424 is moderately significant.

When the independent variables interest rates, GDP, inflation rates and exchange rates are considered in column three, the resultant adjusted R-squared value is 0.796. The probability (F-statistic) is 97.291 and the Durbin-Watson value is 0.200. The p-values for the constant term, interest rates, GDP and exchange rates are significant with values of 0.0000, 0.0000, 0.0302 and 0.0000 respectively. Inflation rates was not significant with a probability value of 0.1405.

When the independent variables namely interest rates, GDP, inflation rates, exchange rates, tax rates and the interaction term (interest rates*tax rates) are considered against the dependant variable in the fourth column, the adjusted R-squared is 0.416 and the probability (F-statistic) is 0.000 and the Durbin-Watson statistic is 0.654. The probability values are 0.0000, 0.0007, 0.0000, 0.2127, 0.0000 and 0.0000 respectively for the independent variables. The probabilities of all independent variable show a highly significant relationship with real estate prices except for exchange rates which is insignificant.

When interest rates are considered, Chin (2003) reported a significant result between the variables from their study conducted in Southeast Asia and argued that the result is because these markets are linked to developed markets. The significant result is further consistent with He *et al.* (2003) and Iossofiv *et al*. (2008) who studied the effect of interest rate proxies on the returns of REITs, where the proxies presented are statistically significant. Xu and Tang (2014) argue that the significance of the relationship between interest rates to house price is attributed to generally lower interest rates in the United Kingdom, which are just

above 0%. This indicates that individuals can invest in real estate and interest rates are strongly tied to their buying decisions (Xu & Tang, 2014). Akbari and Aydede (2012) concluded that although low interest rates cause an increase in real estate prices, the low interest rates stimulate investment into real estate. Jordaan (2013) echoes this, that generally when interest rates increase, there is a decrease in aggregate demand for investments especially when the investments are significantly sensitive to changes in interest rates. The significant result of these studies is consistent to the findings presented in table 4.3.1, which represents that for the South African real estate market, interest rates have a significant role in influencing house prises, and thus the real estate market.

In Malaysia, however, there is no significant relationship between interest rates and housing prices (Ong, 2013). This finding stems from the theory that the housing market is controlled by the demand of housing because if housing is sought after by everyone then investors will not care about the interest rate charged by financial institutions, as housing demand and supply would be unbalanced (Ong, 2013). This is consistent with Lean and Smyth (2014), who found no statistically significant relationship between house prices and interest rates and attributed this to the wealth effect where on average housing is expensive and real estate tends to be an investment vehicle for the wealthy and others leveraging the market.

The finding by Lean and Smyth (2014) seems to be consistent with the wide-ranging case in South Africa with real estate investment being out of reach for majority of South Africans. Many markets which are considered affordable by average values are not affordable when local incomes are used to measure housing affordability (CAHF, n.d). Despite attempts to engage financial institutions through providing guarantees such as the Finance Linked Individual Subsidy (FLISP) which is a subsidy for households with a certain lower income level, very few households have successfully accessed private mortgage funding to acquire housing in the affordable market (CAHF, n.d).

It is important to note that most of the papers cited did not look at the interaction term between interest rates and tax rates. The interaction term between interest rates and tax rates shows the relationship that tax rates have on interest rates. Interaction effects occur when the effect of one variable depends on the value of another variable. In this paper, the interaction term between interest rates and tax rates describes the effect of interest rates on tax rates and vice versa. When the interaction term was considered in table 4.3.1 the

results are consistent with literature stating a significant relationship between interest rates and house prices, and tax rates and house prices. This is an important aspect as there is a historic relationship between tax rates and interest rates, which affects how interest rates are perceived in the market (Balzarich, 2017).

When considering inflation rates, Wambui (2013) states that interest rates are used to control inflation rates and that interest rates are strongly linked to inflation rates. The result of the probability of inflation rate shows that overall inflation rate has a statistically significant relationship with house price index. Inflation could be considered a good predictor at a 99% confidence level. The result is consistent with the findings from Demewez (2011) and Chen and Tzang (1988). Chen and Tzang (1988) explained that a higher-than-expected inflation rate would generally result in a present value for existing mortgages to be lower and would thus reduce the mortgage REIT stock price. This is consistent with what happened in South Africa during the financial crisis where inflation rates were relatively high and falling housing prices were recorded, according to ABSA, after a housing boom between 2000 and 2006 was recorded (house price growth of approximately 32% per annum during the boom and a fall of approximately -16% during inflationary periods 2007 to 2009). This aligns with Harris (1989) who argues that house prices follow inflation patterns. However, expectations in interest rates are viewed by the home buyer as the primary mechanism affecting change in housing price levels and these interest rates are boosted by the dynamics in the inflation rates (Harris, 1989). However, when the exchange rate was considered together with the inflation rates, the significance reported above by Harris (1989) did not hold, meaning there is an effect of exchange rates interact with the other variables.

GDP is statistically significant in this study. This is consistent with theory according to Valadez (2010) who reported a statistically significant relationship between the housing price index and GDP, although they do not substantiate the cause for this trend. Ping-Ma (2010) used an empirical analysis to research the influence of movement of real estate prices on the economy of China and China's GDP. The researcher proved that an increase in investments into real estate significantly influenced the increase in GDP and that there was a significant relationship between GDP and real estate (Ping-Ma, 2010). Ping-Ma (2010) stated that in their opinion, what they had observed from theory was understandable and

expected as at that point, and more than 11% of the country's GDP are investments into real estate. In 2017, PwC (2015) forecasted a real estate contribution to the total GDP of South Africa of 1.64% following an average of 1.62% in 2014 and 2015 which is relatively lower than developed economies, however, it is still a growth in investment.

When exchange rates are considered in addition to the other explanatory variables, Jack (2019) reports that volatility in the exchange rates does not predict changes in real estate prices and does not cause any changes to the real estate prices in the short and long run (Jack, 2019). This is consistent to the findings in table 4.3.1 when exchange rates are considered with tax rates. The findings by Jack (2019) are supported by the findings by Diala *et al*. (2016) who reported an insignificant relationship between commercial property returns and Naira/US Dollar exchange rate movement in Nigeria. The authors reported a persistent volatility in the exchange rates which implies that the current exchange rate is highly likely to influence the forecasted future exchange rate (Diala *et al*., 2016). South Africa has also experienced its share of volatile exchange rates with the record low exchange rates being experienced during the COVID-19 pandemic. The South African currency compared to major currencies like the Euro, Pound and United States Dollar has dropped drastically, meaning that South African would need more Rands in order to purchase these currencies, meaning the Rand would have less purchasing power. Jack (2019) attributes the findings of the results to the fact that movement in exchange rates affect the price of goods in both local and international markets. This is important as some of the building materials are imported (Jack, 2019). The findings from Jack (2019) and Diala *et al*. (2016) being consistent with this study could be attributed because of the similarities in socio-economical context.

Some literature concludes that there is a statistically significant relationship between exchange rate movements and the real estate market (Juma, 2014; Otwoma, 2012). Benson *et al*. (1999) also reported a significant relationship between these variables, but the impact is lagged meaning the impact of the variable in one period only presents in subsequent period, which could explain the results in this paper and the South African economy (when exchange rates are considered without tax rates). Benson *et al*. (1999) states that therefore, a period of rising (falling) exchange rates will overestimate (underestimate) the current exchange rate for sales in the first half of the quarter, and underestimate (overestimate) the

current exchange rate for sales in the second half of the quarter (Benson *et al*., 1999). Furthermore, Benson *et al*. (1999) stated that for both theoretical and practical reasons it is probable that the impact of the exchange rate will occur with a lag of one or more quarters. These theories are more aligned with more developed economies, in which South Africa does not fit.

Table 4.3.2 looks at the dependent variable construction activity against the independent variables. When the independent variables interest rates, GDP and inflation rates are considered, the adjusted R-squared is 0.025. The probability (F-statistic) is 0.147 and the Durbin-Watson statistic is 2.421. The significance diagnostics of the constant, interest rates, inflation and GDP show that the variables are not significant, with probability values of 0.2289, 0.6335, 0.2920 and 0.2943 respectively. Mbusi *et al*. (2017) suggests that there is no significant relationship between changes in lending rates and the annual change in construction output, in a study in Kenya. This finding is consistent with the findings of this paper in table 4.3.2. This finding is against what Jiang (2013) reported in their study in China and the United Kingdom where the relationship between GDP and construction was significant, which are more developed economies than South Africa.

When the dependent variable construction activity is considered against the independent variables interest rates, GDP, inflation rates and exchange rates, the adjusted R-squared is 0.113. The probability (F-statistic) is 0.004 and the Durbin-Watson statistic is 2.601. The resulting probability values for all the independent variables are not significant. The result of the insignificant relationship between the independent variables to construction activity is not expected according to literature (Salama *et al*., n.d; Adegbembo & Adeniyi, 2015; Oladipo & Oni, 2012). Practically, changes in the exchange rate would influence the purchasing power of a local currency. This influences the construction industry as most of the equipment needed in construction is imported (CIBD, n.d; Salama *et al*., n.d) and influences investment outlook.

When all the independent variables are considered together with the interaction term (interest rates*tax rates), the adjusted R-squared is 0.130. The probability (F-statistic) is 0.004 and the Durbin-Watson statistic is 0.654. The resulting probabilities for the independent variables are all statistically insignificant. This goes against theory stated by Salama *et al*., (n.d) and Calitz *et al*. (2013). Lastly, when the interaction term between tax

rates and interest rates is considered together with the explanatory variables, the resulting probabilities are not significant. Poterba (1991) describes the housing market as one where there is stock of already existing housing and another with a flow of new construction, which determines the level of new investment. This is thought to be impacted by rates of taxes as property is tax-deductible (Poterba, 1991).

The following is a summary of the output of the regression models in the form of regression equations. The regression models are developed according to the respective dependent variables which represent the real estate (housing) market and construction activity. The predictor variables are interest rates, GDP, inflation rates, exchange rates, tax rates and the interaction term interest rates*tax rates.

It was established from the regression equation,

$$(i) Real\ estate\ prices = -135.44 - 4.604 interest\ rate + 1.956 inflation\ rate - 6.337 GDP + 0.110 exchange\ rate + 10.205 Tax\ rate + 0.700 int\ rate * tax\ rate + \varepsilon$$

Considering equation (i), when holding other independent variables (inflation rate, GDP, exchange rate and tax rate) constant, a percentage increase in interest rates will cause a 4.604-unit decrease in house prices. This inference is made because of the negative relationship between real estate prices and interest rates. According to theory, the findings that the interest rates and house prices are negatively correlated is in line with what is expected (Xu & Tang, 2014). According to Xu & Tang (2014), the negative relationship between interest rates and housing prices in their study confirms that interest rate has a significant impact on the house prices. Barot and Yang (2002) state that theoretically, it is expected that housing prices would be caused by these independent variables as they reported a negative relationship too.

When holding interest rates, GDP, exchange rate and tax rate constant, a percentage increase in inflation rates will cause a 1.956-unit increase in house prices. This depicts a positive relationship between the dependent variable and inflation rate. This result is not consistent with findings from Jack (2019), Juma (2014), Muriuki (2013), Chen and Tzang (1988) and Harris (1989). Consumer price index captures overall inflation effects according to Kohn and Bryant (2008), who found different relationships between inflation and housing prices. Kohn and Bryant (2008) reported a negative relationship between the variables in

the pre-bubble period and a positive relationship between the variables in during the housing bubble (Kohn & Bryant, 2008). They also theorised that during the pre-boom period markets are more stable and fewer variables would impact housing prices (Kohn and Bryant, 2008). During the boom period, however, more complex forces would influence housing prices (Kohn & Bryant, 2008). This means that if a housing market boom occurred, the models would be different between the two periods (Kohn & Bryant, 2008). South Africa experienced boom periods in the property market and South Africa did have a period of quick rise in property price around 2000-2006 compared to steady growth in other periods, which could be used to explain the result in this paper. Therefore, when looking at just inflation solely, periods might need to be considered to explain house price movements.

A one unit increase in GDP will cause a 6.337-unit decrease in house prices when the other independent factors interest rates, inflation rates, exchange rates, tax rates and interaction term are held constant. This means there is a negative/inverse relationship between the variables. This finding is not constant with findings from literature. In the study by Ong (2013) on the impact of factors on the price of housing in Malaysia, GDP is found to be significantly and positively correlated with the housing prices (Ong, 2013; Wambui, 2013). The increase in GDP is attributed to an increase in investment and personal consumption (Ong, 2013). This increase in consumption will lead to an increase in demand and therefore an increase in the prices of housing (Ong, 2013). There is a causal relationship between GDP, which is a measure of economic growth, and the growth in house prices which result from growth in consumer expenditure (Chioma, 2009). Valadez (2010) also reported that there exists a positive relationship between GDP and house price index. Vadalez (2010) states that the correlation measures provide evidence that is convincing that a strong positive relationship exists between the quarterly changes in housing price indices and gross domestic product.

Increasing exchange rates by one unit will cause a 0.110-unit increase in housing prices when interest rates, GDP, inflation, tax rates and the effect of interaction term between tax rates and interest rates are held constant. This finding of the positive relationship between exchange rates and housing prices is inconsistent with what was evident in literature, according to Akumu (2014) who presented indirect effects between the variables. This is because a weaker local currency (the Rand) against major currencies will mean investors will

need more Rands to buy the other major currency. This will prompt foreign investors to leverage the local market and invest in opportunities locally including real estate (Akumu, 2014). An appreciating Rand will likely cause the opposite effect. Both scenarios describe an indirect effect. Clarke and Daniel (2006) state that the stability or instability of a country's currency also contributes to the level of business confidence and therefore affects residential house prices. In contrast, Jack (2019) argues that there is no relationship (neither positive nor negative) between exchange rates and real estate prices and exchange rates do not predict changes in real estate prices according to the findings in their study, a reason is not stated.

Tax rate is found to have a positive relation to housing price index in equation (i). Holding all the other explanatory variables constant, a one percent increase in tax rate will cause a 10.205-unit increase in house price index. The interaction term between interest rates and tax rates shows a one percent increase in both these will cause a 0.700-unit increase in house prices. This relationship is not consistent with literature as concluded by Barot and Yang (2002) that tax rates and housing prices have a negative relationship. The interaction term between interest rates and tax rates results in speculation that these two factors move in the same direction with each other and housing prices. According to Balzarich (2017), tax reform will likely lead to interest rates which are lower and thus will provide a more favourable outlook for markets; as wealth effects are triggered by changes in interest rates (Barot & Yang, 2002). Further, the tax-deductible nature of mortgage interest payments is an underlying factor influencing residential property demand (Iossifov *et al.,* 2008; Swank *et al*., 2002; Harris, 1989), which is influenced by the rates of taxation.

The construction activity which is a determinant of market size, has a regression equation: $(ii)\ Construction\ activity = -33.78 + 6.556 interest\ rate - 0.983 inflation\ rate - 0.512 GDP - 25.840 exchange\ rate - 2.100 Tax\ rate - 0.293 int\ rate * tax\ rates + \varepsilon.$

Considering the above equation, when holding all other independent variables namely inflation rate, GDP, exchange rate and tax rate constant, a one percent increase in interest rates will cause a 6.556-unit increase in construction activity and thus the market size. This shows a direct relationship between interest rates and the construction activity. The finding in equation (ii) is not consistent with what is concluded from theory, which Poterba (1991) states that an increase in construction costs which negatively impact construction activity,

cause a decrease the housing market activity. Poterba (1991) reported an inverse relationship but did not expand on the causality of this relationship and encouraged further exploration of this relationship. The findings by Berger-Thompson and Ellis (2004) reports the negative relationship between interest rates and housing construction as interest rates are considered demand shifters. An increase in interest rates causes a decrease in the consumption demand for housing through intertemporal substitution and the demand for investment because the return on alternative assets rises (Berger-Thompson & Ellis, 2004). Mbusi *et al*. (2017) states that interest rates have no significant impact on the changes in construction output and an increase in interest rates does not influence movement of construction activity as the demand for construction activity was driven by manipulation of interest rates instead of real projects.

The result of the regression equation (ii) show that a percentage increase of inflation rate will cause a 0.983-unit decrease in the construction activity when holding interest rates, GDP, exchange rates and the interaction term with tax and interest rates constant. This shows a negative relationship between the variables, which is not consistent with theory (Gambo & Ashen, 2012). Gambo and Ashen (2012) posit that increasing inflation and other attributes of the economy have severe consequences on the construction industry. The reasoning behind this is that as inflation increases, building material price escalates causing projects to not be completed at their initial contract pricing and investors can hardly depend upon initial contract pricing (Gambo & Ashen, 2012). The result found in this study is inconsistent with what is expected from theory, as Adegbembo and Adeniyi (2015) reported a positive relationship between the inflation and building materials prices and thus a positive relationship between inflation and construction activity.

When considering GDP, a unit increase in GDP will cause a 0.512-unit decrease in construction activity when the other independent variables are held constant. This result goes against what is expected from literature as this theory stated a direct relationship between the variables reported by Jiang (2013) and Oladinrin (2012) who state that construction activity is influenced largely by GDP. Jiang (2013) conducted a study in the United Kingdom and China and the positive association makes it clear that the construction development is highly dependent on the national economy in the countries. The United

Kingdom and China have large economies when compared to South Africa, which could be reason for the observed variances in the results.

An increase in the exchange rate is defined in this context as the increase in the rate at which the Rand (local currency) is exchanged for another currency, and not necessarily an appreciation of local currency. In equation (ii), a unit increase in exchange rates renders a 25.840-unit decrease in construction activity. This negative relationship is consistent with what is evident from theory (Oladipo & Oni, 2012; Ughamadu, 1993; Salama *et al*., n.d). Oladipo and Oni (2012) state that high prices of building materials had formed a crucial constraint to improving construction procurement in Nigeria. This alludes to the rationale that increasing costs of construction hinders the activity/growth in construction. Ughamadu (1993) asserts that local currency devaluation was one of the factors that sky-push the cost of construction. Salama *et al*. (n.d) theorised that the resulting relationship between the variables in Egypt is due to the local currency being strongly related to the United States Dollar, just as South Africa.

A one percent increase in tax rate will cause a 2.100-unit decrease in the construction activity, when holding all the other explanatory variables constant. A one percent increase in the interaction term between interest rates and tax rates will cause a 0.293-unit decrease in the construction activity. This result is consistent with the finding from Calitz *et al*. (2013) and PwC (2019) which agrees with Balzarich (2017)'s theory on the dynamics of tax reform, which have an impact on interest rates and thus construction activity. This is relevant particularly in South Africa where property is tax-deductible.

4.5 Multicollinearity test- Variance Inflation factor

Table 4.4.1: Variance Inflation Factor (VIF) for House price

Variable	**Interest Rates**	**GDP**	**Inflation Rates**	**Exchange Rates**	**Tax Rates**
Centred VIF	2.136557	1.236542	1.668668	2.429130	2.448270

Under this criterion for an econometric model to be declared safe from the problem of multicollinearity, the Variance Inflation Factor (VIF) should be less than 5. The above model variables have a centred VIF of 2.136557, 1.236542, 1.668668, 2.429130 and 2.448270 for

interest rates, GDP, Inflation, exchange rates and tax rates, respectively. Therefore, in respect to the above model, it can be concluded that the model does not suffer from the problem of multicollinearity.

Table 4.4.2: Variance Inflation Factor for Construction activity

Variable	**Interest Rates**	**GDP**	**Inflation Rates**	**Exchange Rates**	**Tax Rates**
Centred VIF	2.136557	1.236542	1.668668	2.429130	2.448270

For a model to be considered safe from the econometric problem of multicollinearity, the centred VIF should be less than 5 as a rule of thumb. The above model variables have a centred VIF of 2.136557, 1.236542, 1.668668, 2.429130 and 2.448270 for interest rates, GDP, Inflation, exchange rates and tax rates respectively. Therefore, these variables can be considered not to suffer from the problem of severe multicollinearity as they have met the rule of thumb. It follows that no variable can be deleted from the model.

Vector Error Correction Model

Table 4.4.3: Error Correction Coefficients for house prices

Variable	**House Price**	**Exchange Rates**	**GDP**	**Inflation**	**Interest Rates**	**Tax Rates**	**Interest Rates*Tax Rates**
Error Coefficients	-0.0024	0.0155	-0.0013	-0.0093	-0.0027	-0.0010	-0.0778
t-ratio	-2.4963	2.0063	-1.4039	-5.1814	-1.4159	-1.3812	-1.5970

The Error Correction Coefficients determines the speed upon which the model will regain its equilibrium after some disturbances. In respect to table 4.4.3, the dependent variable house prices (HP), and inflation variable are negative and statistically significant demonstrating that there is a convergence from short term dynamics towards long run equilibrium. The adjustment coefficients of these variables are 0.0024 and 0.0093 respectively and moving

towards the long run equilibrium in case of a disequilibrium condition. Exchange rates have a positive adjustment coefficient and statistically significant which in a similar way reflected significant adjustments coefficients towards the long run equilibrium considering any disequilibrium condition. The variables GDP, interest rate, tax rate and the interaction term (interest rate*tax rate) are declared statistically insignificant as their t-values are less than 2 (rule of thumb), Gujarati (2004).

The result of the relationship between house prices and inflation is analogous to the findings of Wambui (2013) who also found a statistical relationship between the two mentioned variables. Demewez (2011), and Chen and Tzang (1988) had similar set of results with Wambui (2013). According to Harris (1989), house prices were noted to follow inflation patterns.

Although GDP is statistically insignificant, the study however posted an inverse relationship between GDP and house prices. This did not find much support from the body of literature and knowledge. Ong (2013) in Malaysia found a positive relationship between house prices and GDP. The researcher's argument was based on two components and causation of investment and consumption which was then argued to have an effect on house prices. In a similar manner, Chioma, (2009) and Valadez (2010) findings were not in line with this study's findings just like Ong (2013). Chioma (2009) and Valadez (2010) found a positive relationship between GDP and house prices.

The study found exchange rates and house prices to be positively correlated. This was not consistent with the findings of Akumu (2014) who postulated an indirect relationship between exchange rates and house prices. The positive relationship found by this study was supported by Clarke and Daniel (2006). Interest rate and tax rate had an inverse association with house prices, this result was supported by Barot (2002) who postulated the same findings. Iossifov *et al*. (2008), Swank *et al*. (2002) and Harris (1989) also postulated that tax rates influenced house prices.

Table 4.4.4: Short Run and Long Run Coefficients for House Prices

Variable	C(1)	C(2)	C(3)	C(4)	C(5)	C(6)	C(7)	C(8)	C(9)
Coeff	-0.002	0.714	0.033	0.127	0.012	-0.833	-0.472	0.034	0.315
P-Value	0.014	0.000	0.010	0.211	0.804	0.359	0.372	0.359	0.001

Considering Table 4.4.4, C(1) represents the model's long run coefficient. A negative long run coefficient of -0.002 demonstrates the long run causality between the model variables. In essence, the coefficient must be negative in order to prove the ability to bounce back to the equilibrium. However, a positive long run coefficient reflects a movement away from the equilibrium. The variables C(2) to C(8) reflects the short run coefficients while C(9) is the model constant. C(2) is the dependent variable (house prices) meaning a 1% increase in the house prices itself will lead to a 0.002% decrease in house prices. C(3) implies a 1% increase in exchange rates will lead to a 0.7% increase in house prices. C(4) forwards that a 1% increase in GDP will lead to a 0.12% increase in house prices. C(5) means that a 1% increase in inflation will lead to a 0.012% increase in house prices. C(6) and C(7) implies that a 1% increase in interest rate and tax rate will lead to a 0.8% and 0.47% decrease in house prices respectively. The interaction term represents C(8) which forwards that a 1% increase in it will lead to a 0.034% increase in house prices. Variables C(2) and C(3) are statistically significant with probability values less than 0.05. The overall model was declared statistically significant as it had an adjusted R^2 of 0.72, F-statistic of 32.36 and a Durbin-Watson statistic of 1.64.

Table 4.4.5: Error Correction Coefficients for construction activity

Variable	Construction Activity	Exchange Rates	GDP	Inflation	Interest Rates	Tax Rates	Interest Rates*Tax Rates
EC Coeff	-1.4885	0.0101	0.0080	0.0104	-0.0019	-0.013	-0.1997
t-ratio	-7.9285	0.0994	0.6322	0.3907	-0.0767	-1.333	-0.3061

Considering Table 4.4.5, the variables exchange rates, GDP, Inflation, Interest rate, Tax rate and the interaction term are considered statistically insignificant as there is a demonstration of the lack of significant adjustments of the coefficients towards the long run equilibrium

taking into consideration any disequilibrium conditions. The dependent variable CP is statistically significant as its t-ratio was greater than 2 with a negative coefficient. This means that there was convergence from short term dynamics towards the long run equilibrium.

Exchange rates and construction activity have a direct relationship. This inverse relationship is inconsistent with the findings of Ughamadu (1993) and Oladipo and Oni, (2011) in Nigeria. The findings supported the fact that an increase in the cost of construction material jeopardizes the growth of the construction industry. Salama *et al.* (n.d) had the same findings in Egypt.

GDP and construction activity have a positive association. This is in support with what is on the body of literature, Jiang (2013) in United Kingdom found the same direct relationship between gross domestic product and construction activity. Oladinrin (2012) also found the same results. An increase in GDP can affect construction activity as GDP is considered a macroeconomic indicator which handles the monetary value of all goods and services produced within an economy over a specified period.

Inflation and construction activity have a direct relationship, and this is not supported by the theory on the body of literature. The body of literature advocates for a negative relationship between inflation and construction activity. Gambo and Ashen (2012) moved in the same direction with literature as they forwarded an inverse relationship between the mentioned variables. Adegbembo and Adeniyi (2015) forwarded the same negative relationship between inflation and construction activities just like Gambo and Ashen (2012) but forwarded a positive relationship between the inflation and houses prices.

Interest rate and construction activity have a negative relationship. This view was consistent with the views of Poterba (1991) which forwarded a negative relationship between construction costs and construction activity which in turn cause a decrease in the housing market activity. The findings of Poterba (1991) were supported by Berger-Thompson & Ellis (2017) who also postulated a negative relationship between the mentioned variables. In a similar fashion, Mbusi *et al*. (2017) forwarded that there is no relationship between interest rate and construction activity.

Tax rate and construction activity had a negative relationship. This inverse association was analogous to the findings of Calitz *et al.* (2013), Balzarich (2017) and PwC (2019). The above-

mentioned factors made use of interest rates to formulate the relationship between tax rate and construction activities across the globe.

Table 4.4.6: Short Run and Long Run Coefficient for Construction Activities

Variable	C(1)	C(2)	C(3)	C(4)	C(5)	C(6)	C(7)	C(8)	C(9)
Coeff	-1.489	0.086	0.359	-1.544	-0.247	-0.611	0.046	0.763	0.074
P-Value	0.000	0.453	0.054	0.317	0.757	0.964	0.935	0.923	0.931

Similar to the model for house prices, the long run coefficient C(1) demonstrates long run causality amongst the model variables as it is negative. It also reflect that C(1) has the ability to bounce back to the equilibrium. C(2) up to C(8) represents the model explanatory variables and C(9) is the model intercept value. Statistically, C(2) means that a 1% increase in construction activities itself will lead to a 0.08% increase in construction activity. A 1% increase exchange rate will lead to a 0.35% increase in construction activities as evidenced by C(3). Considering C(4), C(5) and C(6) a 1% increase in GDP, inflation and interest rate will lead to a 1.5%, 0.25% and 0.6% decrease in construction activity respectively. Tax rate and the interaction variable (interest rate*tax rate) had a direct relationship with construction activities and statistically implied that a 1% increase in C(7) and C(8) will lead to a 0.05% and 0.76% increase in construction activities respectively. The overall model was statistically significant as demonstrated by the adjusted R^2 of 0.67, F-statistic of 22.11 and a DW statistic of 2.04.

Chapter 5 - Conclusions and Recommendations

This chapter of the study is dedicated to summarising the results and analysis of Chapter 4 of this study.

5.1 Summary of findings and recommendations

The main objective of the study was to look at the impact and relationship between interest rate and the real estate market in South Africa using quarterly time series data from 1993Q2 to 2017Q4. The dependent variables which represented the residential real estate market are house price indices and construction activity. When considering interest rates, the relationship with real estate was moderated by inflation, GDP, exchange rate and tax rates. When considering interest rates, the highly significant result coincides with what is expected from literature and practically, since most households must borrow to acquire a property in South Africa, depicted in table 4.3.1. Interest rates mostly has no significant impact on construction activity as per the results Table 4.3.2, however, Trass (2004) argues that investor have an emotional response to investing, particularly inexperienced investors.

As a result, it would be accurate to assume that interest rates play a hugely pivotal role in the housing prices and thus the housing market investments, however, not so much the construction activity. This shows that to some degree although interest rates can be considered, they cannot be considered on their own and there are other factors which may influence the market too and/or influence the market more. The factors considered in this paper need to be considered in conjunction with other factors that interplay with interest rates in the property market.

The stark inconsistency (when considering the construction activity) between what is expected when we look at the impact of the variables practically, and the results of the findings in this paper is surprising. However, it raises the possibility of future research into the factors impacting this part of the real estate sector. Demographics of the country and how this influences supply and demand of real estate and how the factors in this study would then interplay in that context could be another area to be investigated in future research. Other exogenous and endogenous factors should be considered, together with the factors specific to the country like levels of corruption, illiteracy, and the existence of the illegal property markets. Also, perhaps periods could be considered separately, as there could be a possibility of periodical dynamics in real estate. This paper agrees with the theory

by Grum and Grovekar (2015) that the prices of real estate and activity in the real estate market relate to the economic development of an individual country.

Relating to construction activity, the results obtained from the data analysis suggest that interest rates have an insignificant relationship with construction activity. Upon analysis, it is evident that the studies where an insignificant relationship was reported between the variables are in developing nations and where there was a significant relationship it was from results in more developed economies.

This implies that results of individual research could not be generalised to the context of all countries and regions with different environments, but these need to be considered separately. Furthermore, it suggests that the economic activity in the real estate market relate to the economic development of an individual country.

Stabilising the monetary policy could also influence the general economy and other markets which may have direct and indirect relationship with the real estate sector, with the overall goal of strengthening and stabilise the entire economy. The South African government and private sector need to work towards improving the socio-economic conditions in the country which would potentially enable a more inclusive economy for South Africans and bridge the inequality gap. This may lead to more robust participation in the economy and more investing in assets like real estate.

Policies that are set by government institutions need to focus on stimulating the economy and having a more inclusive economy with active local participants, which would increase the demand for real estate and thus more investments and construction. This would be a step in addressing the core issue of housing in South Africa and creating a channel to boost portfolio diversification into real estate. Supporting and subsidising local manufacturing of building materials is vital as most of construction activity depends on exported goods. This brings closer attention to the issue of foreign exchange, which is insignificant, therefore other factors influencing this might need to be considered.

5.2 Limitations of the study

One of the response variables, volume of transactions, which was intended to explain the real estate market, together with the housing price indices and construction activity, had to be omitted owing to a lack of relevant data for South Africa. Further, procurement of data

was a challenge as some of the data is not freely available or in a format that is usable. This would have improved the result of this study which would lead to more robust analysis and conclusion which is especially necessary for individual and institutional investors, creditors (banks), spatial planners (analysis of the most economic use of space) and other advisors.

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