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Thesis

Macroeconomic determinates of housing prices in South Africa

Submitted by Grace Mwenje (873 584)
2/27/2015

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Master of Management in Finance and Investments, 2014



Declaration

I, Grace Mwenje declare that this thesis is my own original research work and to the best of my knowledge contains no work previously submitted or written by another person, except where citations have been made in the report. All sources are identified and acknowledged in the list of references. This research report has been submitted in partial fulfilment of the Masters of Management in Finance and Investments degree at the Wits Business School and has not been submitted to any other University for award of a degree in my name.

Name: Grace Mwenje

Signature:

Date: 22 May 2015

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Abstract

This study investigates key macro-economic variables that influence housing prices in South Africa. Impact of shocks to macro-economic variables on housing prices in the short run is analysed as well as the nature of the relationship between housing prices and seven macro-economic variables in the long run. Using quarterly data from 1978 (3^{rd} quarter) to 2014 (1^{st} quarter) , the study shows that absa real house prices, rand/us$ exchange rate, household/debt disposable income, household net wealth/disposable income, new mortgage loans and prime interest rates have a long run equilibrium relationship. Macro-economic variables have a positive impact on house prices in the long run; household net wealth/disposable income and household debt/disposable income are leading variables in explanation of house price movements. Shocks to prime interest rates and rand/us$ exchange rate impact negatively on house prices in the short run.

Keywords: cointegration, house prices, impulse response, unit root, variance decomposition, vector error correction model

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1. Introduction

1.1 Motivation for the Study

The property sector is one of the key sectors of the South African economy. The first research commissioned by the Property Sector Charter Council to determine the size of South Africa's property sector established that the sector contributed about 8.3% of GDP in 2009 (Tau-Sekati, 2012). According to the study, residential property constituted about 61% of the property sector, commercial property 16%, undeveloped land and public owned property 11% and 12% respectively. To date, the sector remains one of the main contributors to South Africa's gross domestic product. Contribution to gross domestic product averaged between 6.2% and 6.7% from 2003 to 2010, and 5.9% in 2011 and 2012 as per the third quarter 2013 gross domestic product report of StatisticsSA (2013).

The South African housing market experienced booms in 1981 and 2004 which were subsequently followed by a sharp decline in prices. According to the ABSA Residential Property Index data, house prices grew by 38.3% in 1981 from 1980 and by 32.24% in 2004 from 2003 (House Price South Africa, 2011). Housing prices started declining in 1982 leading to a crash in 1984, decreasing by 7.69% and 3.97% in 1985 and 1986 respectively before picking up again in 1986. Housing prices growth was not uniform and from 2000, prices started to rise reaching a peak in 2004. After this, prices started declining from 2005, leading to a crash in 2009 following the global financial crisis. In 2010, housing prices recovered into positive growth. The 1980 boom took place in an environment of relatively low interest rates of around 10%; interest rates then rose to peak at 25% in 1984. Some factors that contributed to the boom from 2000 included the emergence of a financially stable black middle class, tax reliefs, inward repatriation of offshore funds , improved security and

stability and the introduction of the Financial Sector Charter, which boosted mortgage loan growth (Global Property Guide, 2014). During this period, prime interest rates were between 11% and 14.5%. Interest rates have remained relatively low since 2010 and a lot residential development has taken place. However, the weakening rand and effects of tapering of quantitative easing are likely to lead to an interest rate hike (Colombo, 2014). There are concerns from some property market analysts that any interest rate hike might lead to a crash in housing prices.

The 2008 financial crisis, which is believed to have been triggered by the crash in US housing prices, resulted in enormously adverse effects across many economies (Blanchard & Johnson, 2013). A lot of international research has since been carried out on property price volatility, relationship between property prices and business cycles in the developed economies. According to the studies carried out by the International Monetary Fund IMF (2000), it has been proven that, in industrialised countries, real property prices have a close relationship with business cycles.

In the South African market, two recent studies by Aye, Balcilar, Bosch, & Gupta (2013) and Simo-Kengne, Bittencourt & Gupta (2012) examined the relationships between housing prices and business cycles as well as housing prices and economic growth at the provincial level. Both studies have shown that housing prices have an impact on economic activity. According to Simo-Kengne et al. (2012), transmission of housing price changes to economic activity occurs through collateral and wealth effects. Increase in housing prices increase expected homeowners' wealth and their desired consumption. Financially constrained homeowners are able to use increased values of their homes as collateral to access credit. Household consumption which is a large component of gross domestic product is therefore

affected by changes in housing prices. Housing prices were found to have positively and significantly impacted on the four downward phases that occurred between 1981Q1 and 2009Q3 (Aye, Balcilar, Bosch, et al. 2013). Other recent studies by Aye, Balcilar, Gupta, et al. (2013) focused on fiscal policy shocks and dynamics of asset prices, and short and long run relationship between housing prices and stock prices. None of these studies have investigated macroeconomic variables that influence housing prices in South Africa.

Variables such as financing conditions, tax incentives, income growth and interest rates play a role in determining property prices in industrialised countries (IMF, 2000). In Europe, consumption expenditure, household consumption expenditure, housing expenses , national income and unemployment have been found to have significant impact on housing demand and prices (Renigier-Biłozor & Wiśniewski, 2012). Across the developed countries, household disposable income growth and level of interest rates are some of the long term determinants of housing prices according to Tsatsaronis & Zhu (2004). In South Africa, a recent study by Aye, Balcilar, Gupta, et al. (2013) showed that fiscal revenue shocks have an impact on housing prices.

Following from the above recent studies, my study seeks to develop further knowledge by identifying key macroeconomic variables that drive housing prices in South Africa, which recent published studies have not done. My study will further seek to ascertain the impact of the key macroeconomic variables on housing prices. Preliminary time series trend analysis of ABSA real house prices for the period January 1978 to March 2014 and macroeconomic variables, graphed in Figure 1, suggests the existence of a relationship between ABSA real house prices (on the one hand) and various macroeconomic variables (on the other), which warrant a detailed investigation. The analysis suggests a direct relationship between housing

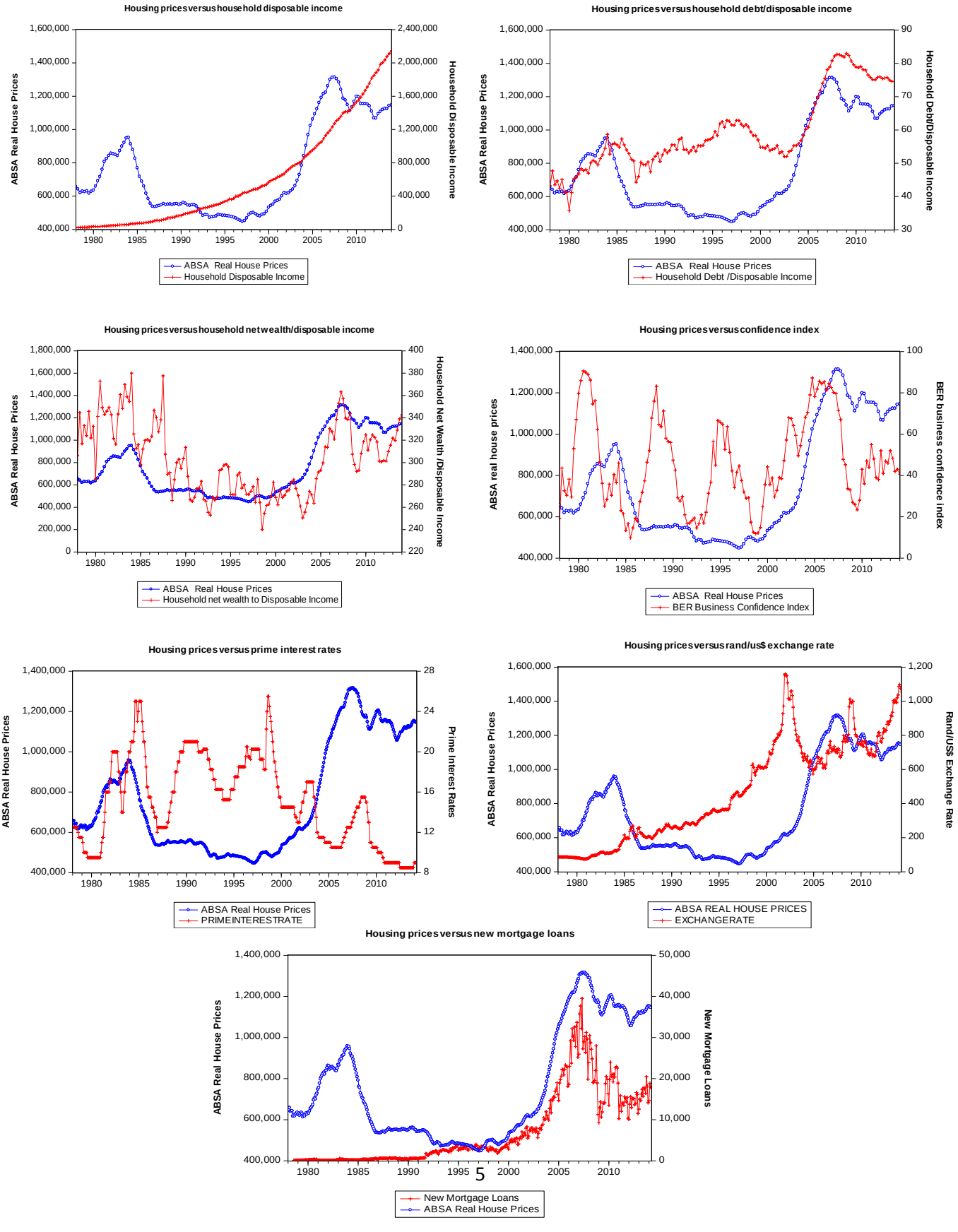
prices, household debt/disposable income and household net wealth/disposable income for the period January 1978 to March 2014. The BER Business confidence index seems to be leading the changes in housing prices. Growth in disposable income and net wealth is expected to increase demand for housing and prices, this is confirmed by the direct relationship between these variables as shown by the graphs in Figure 1 below. Increased disposable income increases consumers' credit worthiness hence increases demand for mortgages and housing. Availability of credit in the form of mortgages increases the demand for housing hence increase in new mortgage loans is expected to have an impact on housing prices. The dependent variable ABSA house prices are deflated by the CPI index hence inflation has not been included as an explanatory variable.

The graphs in Figure 1 show a positive correlation between housing prices and new mortgage loans from 1991 to 2014 and a negative correlation between prime interest rates and housing prices. Prime interest rates are inversely related to housing prices especially during the boom periods in 1980 and 2004 and post 2005. Increase in interest rates increases the cost of servicing mortgages and other household debt and therefore is expected to reduce demand for housing and hence reduce prices. A weakening currency is expected to attract foreign investors to the local property market as rand-denominated housing prices become relatively cheaper from the foreign investors' points of view. The increased demand for property triggered by foreign-investor activity then places an upward pressure on local housing prices. The graphs in Figure 1 show negative correlation between housing prices and the exchange rate consistent with this intuition.

Changes in housing prices affect property market stakeholders including home owners, property investors, mortgage lenders, and economic activity hence it is important to understand the behaviour of housing prices. In order to understand the behaviour of housing

prices, there is a need to better understand the macroeconomic variables that influence housing prices.

Figure 1: Time series trends in ABSA real house prices and macroeconomic variables



1.2 Problem Statement

Housing is a major component of the property sector in South Africa and changes in housing prices affect home owners, property investors, businesses, mortgage lenders, policy makers and other stakeholders. Changes in macroeconomic variables affect housing prices which in turn affect consumers' and property investors' consumption, investment and financing decisions. There is a need therefore to identify, investigate and understand the key macroeconomic drivers of housing prices in South Africa. Recent studies in South Africa have investigated the relationship between housing and business cycles (Aye, Balcilar, Bosch, et al., 2013) and the effect of housing prices on economic growth (Simo-Kengne et al., 2012). Based on my literature review, no study has examined the impact of various macroeconomic variables on housing prices. This study will focus on identifying and investigating key macroeconomic variables that influence housing prices in South Africa and determining the impact of these variables on housing prices.

1.3 Objectives of the Study

The specific objectives of the study are to:

(i) identify the key macroeconomic variables that influence housing prices in South Africa;

(ii) determine the impact of the identified macroeconomic variables on housing prices.

1.4 Research Questions

(i) What are the macroeconomic variables that drive housing prices in South Africa?

(ii) What is the impact of these macroeconomic variables on housing prices?

(iii) What is the nature of the relationship, if any, between the macroeconomic variables and housing prices in the long-run?

1.5 Significance of Study

This study will provide additional information to home owners, property investors, mortgage lenders, policy makers and other property market stakeholders on macroeconomic variables that influence housing prices and the impact of these variables on housing prices. This will aid home owners and property investors in decisions on when to enter the property market and whether housing values are supported by fundamentals. The study will provide insight to stakeholders on prediction of the impact of shocks on macroeconomic variables on future housing prices and will also aid policy makers in policy formulation and monitoring of the housing market.

1.6 Presentation of the Report

The report is organised as follows: Chapter 1 gives a brief background of the property sector and housing prices in South Africa. Preliminary time series trend analysis identifies a causal relationship between housing prices and several macroeconomic variables. Chapter 2 deals with Literature review. Chapter 3 outlines the data and methodology used in the analysis. Chapter 4 analyses the results of tests carried out in the investigation and chapter 5 presents conclusions reached.

2. Literature Review

A lot of research has been carried out on the relationships between asset prices (mainly equity and property prices) and the business cycles in markets outside of South Africa. Those studies have shown that property prices and business cycles are closely correlated and that fluctuations in property prices are transmitted to economic activity through different channels. In the South African market, published studies on property prices and business cycles is few but recent studies that looked at housing prices in particular have found that housing prices have an impact on economic activity (e,g., Aye, Balcilar, Bosch, et al ., 2013 and Simo-Kengne at al.,2012).

Fluctuations in property prices are believed to have played a role in the upswing and downswing of past business cycles (Zhu, 2005). Falling property prices accompanied recessions in European Union countries and Japan in the early 1980s, whilst growth in property prices in smaller European Union countries and Australia were associated with growth in economic activity since 1990 (IMF, 2000)

Determinants of property price fluctuations differ across countries. According to Zhu (2005), movements in property prices can be influenced by interest rates, risk premiums, changes in economic fundamentals and property market characteristics. Lagged and current income growth and real interest rates/mortgage costs partly influence property prices across different countries (IMF, 2000). Supply of housing and offices slowly increase in the short run , property prices therefore tend to be demand driven (IMF, 2000). In Canada and the United States, where there is less land constraints, correlation between real economic growth, property prices and real interest rates has been less pronounced (IMF, 2000).

According to IMF (2000) other factors that played a role in determining property prices include financing conditions, tax rates and tax concessions on deductibility of mortgage interests. High collateral values of houses arising from price increases encouraged consumers to take on more mortgaged debt. The studies showed that there is less correlation in property prices changes across countries hence policy makers have greater scope to influence domestic property prices unlike with equity prices (IMF, 2000).

The Reserve Bank of Australia (RBA) co-hosted its annual conference with the Bank for International Settlements (BIS) in 2012 under the theme 'Property Markets and Financial Stability,' at which various papers on the wider consequences of property prices were presented and discussed. According to Heath, (2012), many economies have experienced rapid increase in property market prices that have led to significant stresses on their financial systems. Financial instability has negative impact on economic growth. Falling property prices tend to increase non-performing loans which undermines banks' capital positions and lending capacity (IMF, 2000). US housing crisis was linked to financial and economic stability through various channels (Muellbauer, 2012). Lower demand for housing led to less home construction and slower GDP growth, consumption decreased as collateral values dropped and credit contracted reducing GDP growth. Lower capital of financial firms led to counterparty risk and contraction of credit further reducing GDP growth and decline in economic activity negatively impacted on home values amplifying the initial shocks.

According to Zhu (2005), economic activity and aggregate demand are affected by changes in property prices in many ways. Increasing property prices result in high expectations of property market returns which increase new construction and demand for properties. Consumption and private spending of households is affected by increase in property prices.

Financially constrained firms' decisions are influenced by commercial property price changes. Financial behaviour of existing and prospective home owners is affected by changes in housing prices.

Renigier-Biłozor & Wiśniewski (2012) studied the impact of macroeconomic factors on residential property price indices in Europe. They found that the variables that had the most influence on the real estate market were consumption expenditure, household consumption expenditure, housing expenses, national income and unemployment rate. They also noted that given the impact of the recent global crisis, excessive asset price inflation originating in the financial and real estate sector needs to be monitored.

According to Tsatsaronis & Zhu (2004) interest rates , disposable income growth , shifts in demographics and home ownership tax concessions are long term determinants of demand for housing. Long term determinants of housing supply include availability and cost of land, building costs and improvements on existing housing stock. The study focused on European Union countries, Canada, Japan, United States and Australia. They concluded that the strong link between inflation, nominal interest rates and housing prices, suggests that sharp decrease in price growth which follow periods of sharp price increases create misalignments between housing prices and long term determinants of residential estate values in the short term.

Aye, Balcilar, Bosch, et al. (2013) studied the housing and the business cycles in South Africa focusing on three variables namely growth of real house prices, real residential investment and number of building plans passed. They found that the impact of output on housing prices was negative and significant during the most recent downward phase (2009Q1

and 2009Q3) and that the impact of housing prices on output was positive and significant during the four downward phases that occurred between 1981Q1 and 2009Q3.

Simo-Kengne et al. (2012) examined the effect of house price changes on economic growth across the nine provinces in South Africa. They concluded that housing price changes impact on economic growth in all the regions. The transmission of changes in housing prices to economic activity occurs through collateral and wealth effects. Wealth effect of housing prices was found to be stronger than collateral effect at the aggregate level. Home owners increase their desired consumption as a result of increase in housing prices.

According to Ncube & Ndou (2011) housing prices and real interest rates have an impact on housing wealth which influences household spending. They concluded that the level of decrease in consumption due to the combined effect of housing wealth and interest rate changes varies across the four housing categories in the South African residential sector. This is supported by Das, Gupta, & Kanda (2011) who concluded that consumption responds significantly to housing price deceleration.

A recent study by Aye, Balcilar, Gupta, et al. (2013), analysed the impact of fiscal policy shocks on asset prices in South Africa by looking at three types of fiscal policy scenarios. They found that an unfinanced spending shock did not have an impact on housing prices while decreased tax revenues coupled with unchanged government expenditure, increased housing prices. A balanced budget shock financed with higher taxes resulted in a temporary fall in housing prices. The study showed that while both spending and revenue shocks affected stock prices only revenue shocks affected housing prices.

Leung, Chow, & Han (2008), used cointegration analysis to estimate reduced form demand-supply equations to analyse the long term and short term determinants of property prices in Hong Kong. They found that equity prices affect property prices in the short run, whilst real interest rates, residential investment deflator, land supply and real per-capita income determine long run real property prices. Their findings suggested that the spill over effects from the increase in stock market prices in 2007 could have contributed to housing prices overshooting during the same year. Increased wealth from increased equity prices increased demand for housing through the wealth effect.

Craig & Hua (2011) confirmed that macroeconomic fundamentals and property prices are cointegrated, when they investigated determinants of property prices in Hong Kong Special Administrative Region (SAR) using cointegration estimation methods. They found real GDP per capita, real interest rate, land supply, real domestic credit and real construction costs to have long run influences on property prices. Land supply was found to have significant lagged effects on property prices whilst real GDP per-capita and real domestic credit had the strongest and weakest influence on property prices respectively. Loan to value ratio and stamp duty had temporary effects on property prices hence they can slow down but not fundamentally reduce property prices. Speculative activity in the property market can be reduced by altering policy on loan to value ratio and stamp duty whilst land supply can restrain increase in property prices in the long run.

Liu, Luo, & Picken (2007) investigated causal relationships between housing prices, population , unemployment rates , mortgage rates and weekly earnings in Victoria using the Granger causality test, cointegration test and vector error correction model over three observation periods.

Cointegration tests found a long run relationship between housing prices and the four macroeconomic variables; however the VEC Granger causality test and the conventional pairwise Granger causality test found the causal relationships to be unstable in the three observation periods. These findings suggest that demographic and monetary policy may not always have an impact on housing prices hence prediction of housing prices might be difficult for property market participants and other stakeholders.

In Malaysia, a study by Mohamad (2012) confirmed cointegration between property prices and four macroeconomic variables: inflation rate, interest rate, GDP and exchange rate. Using the vector error correction model and variance decomposition, the results concluded that property prices in Malaysia are affected by inflation rate and exchange rate; however interest rate and GDP do not affect property prices. The conclusion that interest rate does not affect property prices is contrary to the conclusion by Leung, Chow, & Han (2008) and Craig and Hua (2011) that interest rate has long run influence on property prices in Hong Kong.

Adams & Fuss (2010) confirmed cointegration between house prices and three macro-economic variables: economic activity, construction costs and long term interest rates. They applied panel cointegration analysis to the data collected from 15 countries to determine long run equilibrium relationships. The results showed that in the long run, increase in construction costs and economic activity increases house prices, while increase in long term interest rates reduces house prices as residential investment is less attractive compared to other fixed income investments.

A study carried out by Agnello & Schuknecht (2011) on booms and busts in housing markets in industrialised countries found short term interest rates and domestic liquidity to have a significant influence on probability of occurrence of booms and busts. They also found that financial deregulation has increased the role of domestic liquidity in determining booms occurrence while regulatory policies that reduce credit and money growth reduce the probabilities of booms

Beltratti & Morana (2010) found that global macroeconomic shocks are a significant determinant of house prices fluctuations for G7 countries. The study investigated the link between the G7 housing market and general macroeconomic conditions. They found a bidirectional link between macroeconomic developments and real housing prices and that productivity shocks are more significant than demand shocks in determination of house prices. House price shocks were found to have a higher impact on the macro economy than stock market shocks. The results showed interconnection of housing markets across the G7 countries through shocks to macroeconomic variables.

In New Zealand, a study by Jou, Shi & Tripe found a significant and positive relationship between real interest rates and real housing prices. The study investigated the impact of changes in retail mortgage rates and policy rate on real housing prices. They found that real fixed interest rates have a positive impact on real housing prices after controlling for housing credit, unemployment rate, consumer confidence, real rental rates and household mortgage choices.

Based on my literature review, studies carried out in other countries across different markets have shown that various macroeconomic variables influence housing prices. A few studies recently carried out in the South African market have not explicitly focused on investigating the role played by macroeconomic variables in influencing housing prices. This study seeks to focus on identifying and investigating key macroeconomic variables that influence housing prices in the South African market and determining their impact on housing prices.

3. Data and Methodology

Quarterly time series data for the variables of interest (as outlined below) are collected from the South African Reserve Bank, Statistics South Africa, and Bureau for Economic Research, ABSA and other financial institutions. More information for the study will be sourced from the Property Sector Charter Council, property companies, Estate Agents, property market and economics journals and publications and websites.

This analysis will focus on residential prices only due to limited availability of data on commercial property prices. Data for the dependent variable (housing prices) is obtained from ABSA quarterly house prices which are deflated by the CPI index to get real house prices. The house price data is the weighted average for the middle segment for all sizes (80 – 400 square meters), smoothed and seasonally adjusted to exclude distortions. I collected the monthly CPI Index from Statistics South Africa and converted it to the quarterly index using three months simple average. Since the dependent variable (housing prices) is deflated by the CPI index, inflation is excluded from the analysis. The quarterly (explanatory) macroeconomic variables data including household disposable income, household debt/disposable income ratio, household net wealth/disposable income ratio, prime interest rates, rand/us$ exchange rate and new mortgage loans was obtained from the South African Reserve Bank. I obtained data for the business confidence index from the Bureau of Economic Research. The frequency for prime interest rates, exchange rates and new mortgage loans is monthly and the figures for the last month of each quarter are used for the analysis.

The causal relationship between housing prices and macroeconomic variables will be investigated using the cointegration tests. The series will be converted to logs before

performing the tests. Stationarity tests will be done using the Augmented Dickey Fuller (ADF) unit root tests in the level form. Phillips-Perron (PP) tests will also be done for comparison with the ADF tests to confirm the conclusion. It is important to perform this test since the behaviour of the series is influenced by its stationarity. If the levels for the series are non-stationary, tests will be repeated on first differences of the series.

Variance decompositions and impulse responses will be done to analyse the impact of shocks to macroeconomic variables on housing prices. The next step is to perform cointegration tests to establish if there is long run relationship between housing prices and macroeconomic variables. According to Brooks (2013), a cointegrating relationship between variables implies a long run relationship. Selection of optimal lag length will be done using the Schwarz (SBIC) information criteria. SBIC has been chosen because it selects a parsimonious model which has fewer parameters. Engle-Granger approach or the Johansen approach will be used to test for cointegration. Where there are more than two variables under investigation, Johansen method allows for more than one cointegrating relationship to be identified (Brooks, 2013).

Under the Engle- Granger test, a cointegration test is done indirectly by testing the residuals of the regression of one variables against another for stationarity (Brooks, 2013). If the variables are cointegrated, the residuals (u_t) will be stationary i.e. of the order I (0). Under this approach, the null hypothesis has a unit root and the alternative is stationary: H_0 : $\hat{u}_t \sim I(1)$; H_1 : $\hat{u}_t \sim I(0)$. if the null rejected, it means there is cointegration. I will then use the Johansen's systems approach to determine all cointegration relationships applying both the trace test and the maximum eigenvalue test. This approach considers r to be the number of cointegrating vectors. I will conduct the tests with the null hypothesis: $H_0 : r = 0$ and the

alternative : $H_1 : 0 < r \leq g$, where g is the number of variables. If the null is rejected, the null *r = 1* is tested and the value of *r* is increased until the null is no longer rejected.

If the results show cointegration of the variables, a vector error correction model will be estimated to determine the coefficient values in the cointegrating vectors and the speed of adjustment of the disequilibrium. The error correction model to be estimated is represented by equation:

$$\Delta Y_t = a + b_1 \Delta I_t + b_2 \Delta D_t + b_3 \Delta W_t + b_4 \Delta M_t + b_5 \Delta B_t + b_6 \Delta R_t + b_7 \Delta E_t + ECT_t + u_t$$

where Y_t is the dependent variable (absa real house prices), I_t is the household disposable income, D_t is the household debt/disposable income, W_t is the household net wealth/disposable income, M_t is the new mortgage loans, B_t is the business confidence index, R_t is the prime interest rate, E_t is the rand/us$ exchange rate, ECT_t is the error correction term and u_t is the white noise error term. The coefficients for the independent variables: household disposable income, household debt/disposable income, household net wealth/disposable income, new mortgage loans and business confidence index are expected to have a positive sign since the variables are expected to be positively correlated to real house prices, while prime interest rate and rand/us$ exchange rate are expected to be inversely correlated to real house prices hence the negative sign.

If cointegration tests do not suggest a long run relationship, Granger causality tests will be performed to test for causality of housing prices by macroeconomic variables. Granger-causality means a correlation between current values of one variable and past values of the other (Brooks, 2013). This study analyses the macroeconomic variables to test if they contain

useful information in predicting housing prices using the Granger causality tests. The following bivariate vector autoregressions (VAR) are used to run the causality tests:

$$Y_t = a_{11} + \sum_{i=1}^{n} b_{2i} X_{t-i} + \sum_{i=1}^{n} b_{3i} Y_{t-i} + u_t$$

$$X_t = a_{21} + \sum_{i=1}^{n} b_{10i} Y_{t-i} + \sum_{i=1}^{n} b_{11i} X_{t-i} + vt$$

where Y_t is real house prices , X_t is any one of the macroeconomic variables , *n* is the number of lagged variables, X_{t-i} and Y_{t-i} are lagged values of X and Y, u_t and v_t are the error terms. According to Brooks (2013), if X_t causes Y_t lags of X_t should be significant in the equation for Y_t and if this is not the case vice versa it means X_t Granger causes Y_t or there is a unidirectional causality from X_t to Y_t. If lags of X_t and Y_t are both significant, there is a bi-directional causality between the two variables. The null hypothesis X_t does not Granger cause real house prices (Y_t) is rejected if $b_{2i} \neq 0$, i.e. X_t Granger causes real house prices.

4. Tests and Results

Quarterly data for absa real house prices (dependent variable) , ber business confidence, rand/us$ exchange rate, household disposable income, household debt to disposable income, household net wealth to disposable income, prime interest rates and new mortgage loans from 1978 (3rd quarter) to 2014 (1st quarter) is used in this paper.

Tests and findings are discussed and presented below:

4.1 Unit Root Tests for stationarity

The variables are tested for stationarity in level form and first differences, results are reported in Tables 1.1 and 1.2 below. The series have been converted to logs to scale the variables similarly.

Table 1.1
Augmented Dickey- Fuller Test - Level form

Variable	Test Statistic	Critical Values : 1%	5%
absa real house prices	-1.188016	-3.477144	-2.881978
ber business confidence	-3.650634	-3.477487	-2.882127
exchange rate	-1.257577	-3.476805	-2.88183
household disposable income	-4.902933	-3.477487	-2.882127
household debt/disposable income	-1.35818	-3.476805	-2.88183
household net wealth disposable income	-2.840962	-3.476805	-2.88183
prime interest rate	-2.246311	-3.477144	-2.881978
new mortgage loans	-1.090179	-3.478189	-2.882433

Table 1.2
Augmented Dickey- Fuller Test - differenced form
Variable

absa real house prices	-3.901913	-3.477144	-2.881978
exchange rate	-11.41188	-3.477144	-2.881978
household debt/disposable income	-13.83581	-3.477144	-2.881978
household net wealth disposable income	-10.39303	-3.477487	-2.882127
prime interest rate	-7.380987	-3.477144	-2.881978
new mortgage loans	-5.792516	-3.478547	-2.88259

The results above show that two series: ber business confidence and household disposable income are stationary in level form at the 1% level. The null hypothesis which states that the series contain a unit root is therefore rejected since the test statistic is more negative than the critical value. The remaining series are all non- stationary in levels. The tests have been run including a constant in the test equation to capture a full model and SBIC as the default for lag length. The tests are repeated for non-stationary series to see if they contain a unit root in differenced form. Results in Table 1.2 show that, the six series are all stationary at the 1% level in differenced form. The null hypothesis that the differenced series contain a unit root is therefore strongly rejected.

One of the limitations of ADF is that its power is low (Brooks, 2013), so an alternative unit root test, Phillips – Perron (PP) has been carried out to confirm the ADF test results. The results of the PP tests are reported in Tables 1.3 (level form) and 1.4 (first differences) below.

Table 1.3

Phillips - Perron Test - Level form

Variable	Test Statistic	Critical Values : 1%	5%
absa real house prices	-0.717136	-3.476805	-2.88183
ber business confidence	-3.111208	-3.476805	-2.88183
exchange rate	-1.254114	-3.476805	-2.88183
household disposable income	-6.389612	-3.476805	-2.88183
household debt/disposable income	-1.307476	-3.476805	-2.88183
household net wealth disposable income	-2.762353	-3.476805	-2.88183
prime interest rate	-1.918712	-3.476805	-2.88183
new mortgage loans	-1.394566	-3.476805	-2.88183

Table 1.4

Phillips - Perron Test - differenced form

Variable			
absa real house prices	-3.921975	-3.477144	-2.881978
ber business confidence	-11.621490	-3.477144	-2.881978
exchange rate	-11.461880	-3.477144	-2.881978
household debt/disposable income	-13.724730	-3.477144	-2.881978
household net wealth disposable income	-14.805000	-3.477144	-2.881978
prime interest rate	-7.380987	-3.477144	-2.881978
new mortgage loans	-14.563840	-3.477144	-2.881978

The PP tests in level form confirm that ber business confidence and household disposable income series are stationary, however ber business confidence series is non- stationary at 1% level. The test statistics for the other six series are smaller in absolute value than the critical values at 1% therefore the null hypothesis cannot be rejected. As in the ADF test above, this confirms that the series are non- stationary in level form. The tests are repeated for non-stationary series to see if they contain a unit root in first differences. The results in Table 1.4 show that all the series are stationary in differenced form and this confirms the ADF test results above. The test on the ber business confidence is repeated to confirm the series is stationary at 1% in differenced form.

4.2 Determination of optimal lag length using Vector Autoregression model (VAR)

The next step is to determine the optimal lag length before running the cointegration tests to establish if there is a long run relationship. A VAR is estimated to determine the optimal lag length using information criteria. The smallest values of Akaike information criteria (AIC) and Schwarz information criteria (SBIC) select optimal lag lengths of 10 and 1 respectively. SBIC is used in selecting the optimal lag length to avoid over-parameterisation therefore an optimal lag length of 1 is used in the tests.

4.3 Impulse Response and Variance Decompositions

A standard VAR is estimated using all the variables with the absa real house prices as the dependent variable in the equation. An examination of impulse responses and variance decompositions is carried out to analyse the impact of changes in macro-economic variables in the model on absa real house prices. An analysis of the impulse response traces the responsiveness of absa real house prices to shocks in each of the macro-economic variables in the VAR model. Variance decompositions analysis indicate the proportion of movements in absa real house prices that are a result of shocks to itself compared to shocks to other macro-economic variables in the model. Impulse response analysis is reported in the graphs below in Figure 2 and variance decompositions analysis is reported in Table 2.1. These analysis focus on the movement from macro-economic variables to absa real house prices and the reverse movement from absa real house prices to macro-economic variables as well as between the other macro-economic variables has not been discussed.

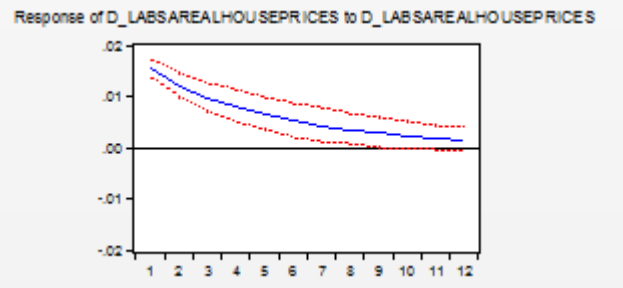
4.3.1 Impulse Responses

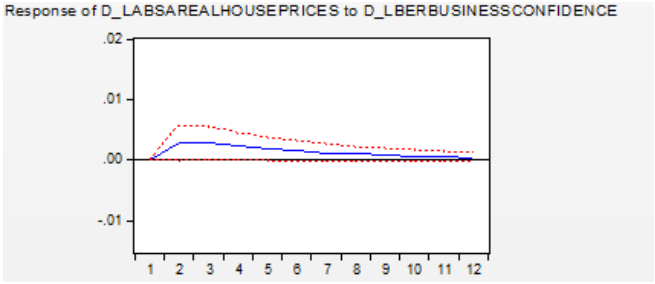
Impulse Responses and standard error bands for innovations in each of the macro- economic variable is illustrated below, 2 standard error bands are calculated using the analytic

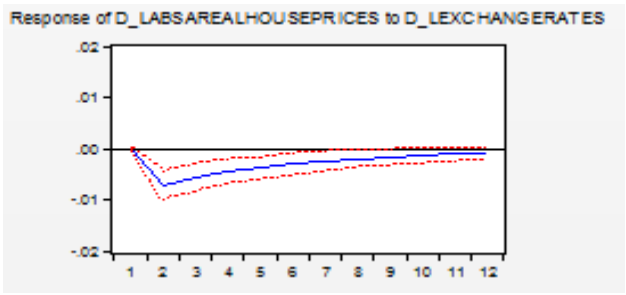
approach. The effects of the shocks are observed over 12 periods, and are expected to gradually work out of the VAR system. Innovations to rand/us$ exchange rate , household debt to disposable income and prime interest rates show a negative impact on absa real house prices as illustrated below. The effects of shocks to household debt to disposable income die away after 8 periods and that of prime interest rate and exchange rate after 12 periods. Innovations to ber business confidence, household disposable income, household net wealth/disposable income and new mortgage loans show a positive impact on absa real house prices and the effects of the shocks die away after 12 periods except for that of new mortgage loans which last up to 10 periods.

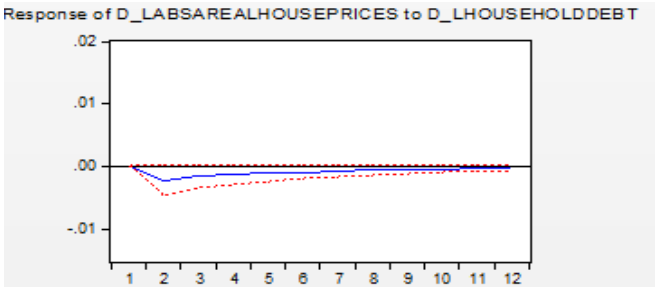
The results are consistent with expectations on the impact of shocks to these macro-economic variables on absa real house prices. As household debt to disposable income decreases, consumers have more disposable income and increased credit worthiness which increases demand for housing and prices. Increased ber business confidence, improved access to mortgage, increased household disposable income and net wealth boost demand for housing and prices. Increase in interest rates negatively impact on house prices as it increases cost of servicing debt hence reduces demand for housing and prices. As the rand/us$ exchange rate strengthens, the rand denominated house prices become more expensive for foreign investors hence reduces demand for housing and prices. Innovations to absa real house prices show a significant positive impact on itself and effects of the shocks persist beyond 12 periods as illustrated below.

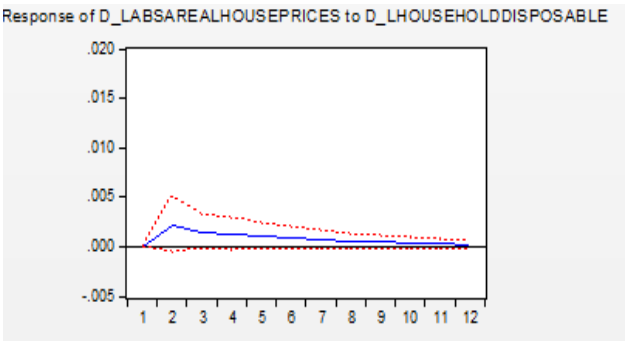
Figure 2 : Impulse Responses

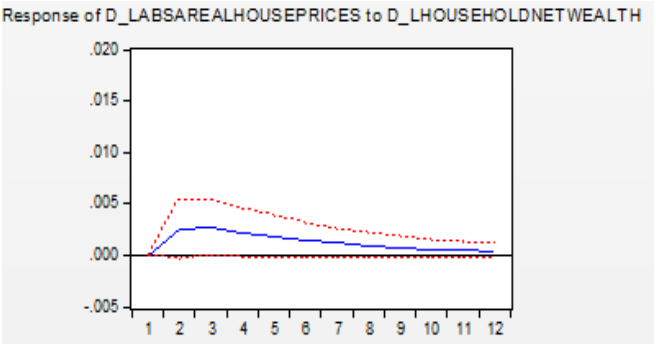


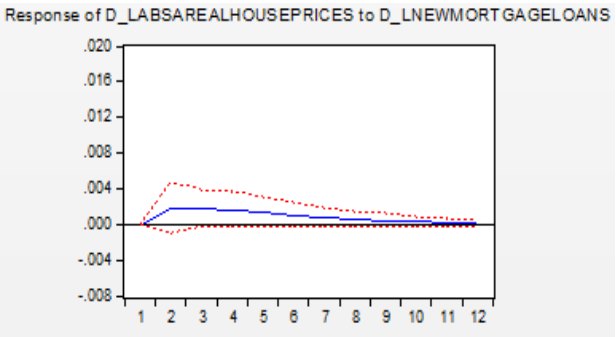


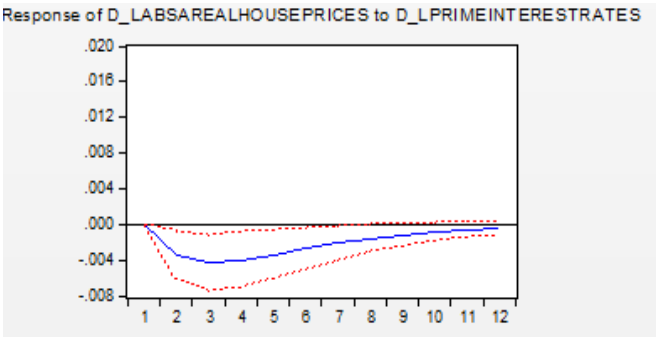












4.3.2 Variance Decompositions

Variance decompositions analysis for absa real house prices equation of the VAR for 12 periods is reported in Table 2.1 below. The analysis focuses on movement from macro-economic variables to absa real house prices therefore one ordering is applied as follows:

absa real house prices, ber business confidence, rand/us$ exchange rate, household debt to disposable income, household disposable income, household net wealth to disposable income, new mortgage loans, prime interest rates.

Table 2.1

Variance Decomposition of absa real house prices

Period	S.E.	absa real house prices	ber business confidence	exchange rates	hhold debt/ disp income	hhold disp income	hhold net wealth/ disp inc	new mortgage loans	prime interest rates
1	0.015	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.021	85.68	1.06	11.00	0.85	0.08	0.38	0.01	0.93
3	0.024	79.62	1.33	14.06	0.69	0.09	1.28	0.00	2.92
4	0.027	76.15	1.27	15.51	0.61	0.21	1.70	0.07	4.48
5	0.028	73.98	1.20	16.39	0.57	0.38	1.91	0.10	5.48
6	0.029	72.69	1.15	16.85	0.54	0.55	1.99	0.13	6.10
7	0.029	71.93	1.12	17.09	0.53	0.68	2.03	0.15	6.48
8	0.029	71.49	1.11	17.22	0.52	0.78	2.04	0.16	6.70
9	0.029	71.24	1.10	17.28	0.52	0.85	2.04	0.16	6.82
10	0.030	71.11	1.09	17.31	0.51	0.89	2.04	0.17	6.88
11	0.030	71.04	1.09	17.32	0.51	0.91	2.04	0.17	6.91
12	0.030	71.00	1.09	17.33	0.51	0.93	2.04	0.17	6.93

As is expected most of the movements in absa real house prices are due to their own shocks. The combined proportion of movements in absa real house prices explained by shocks to macro-economic variables in the VAR model is 28%. Shocks to exchange rate explain 17% of movements in absa real house prices while shocks to interest rates explain only 7% of the movements. An interesting observation is that shocks to household disposable income and household net wealth /disposable income explain only 3% of movements in absa real house prices in the short run. This is contrary to expectations as movements in disposable income and net wealth/disposable income are expected to have more explanatory power on house price movements. A possible explanation of this result is that an increase in disposable income and net wealth might not necessarily have a significant impact on demand for housing in the short run as consumers might opt for other options available in terms of household debt reduction, savings, investments and consumption. This is the same with household debt/disposable income, ber business confidence and new mortgage loans which explain less than 2% of house price movements in the short run. The results suggest that the relationship between house prices and macro-economic variables may not always be strong as expected. Liu, Luo & Picken (2007) found the causal relationships between housing prices and four macro-economic variables including income to be unstable and not as expected over three observation periods in Victoria, even though a long run equilibrium relationship was found among the five variables investigated.

The relationship between exchange rates and house price movements appear much stronger than expected, suggesting that key players in the housing market pay attention to exchange rate movements in the short run. A possible explanation is that, as rand/us$ exchange rate weakens; investors prefer to invest in housing to hedge against inflation as opposed to cash investments. This would mean that volatility in the rand/us$ exchange rate will result in

increased demand for housing from investors seeking to preserve value for their money. Another factor is that foreign investors respond to exchange rate movements as this affects the rand denominated house prices.

From this analysis, it is therefore important to carry out cointegration tests to establish if these variables have a long run relationship.

4.4 Cointegration Tests

Johansen approach is used to test for cointegration, the approach uses the trace and maximum eigenvalues tests and allows for more than one cointegrating relationships to be identified. According to Brooks (2013), all variables to be included in the tests should be non-stationary in level form. From the unit root tests performed, ber business confidence and household disposable income are stationary in levels; so these have been excluded from the tests. The results are shown in Table 2.2 and Table 2.3. The trace test shows that there is one cointegrating equation at the 5% level. For the null hypothesis of no cointegration, the test statistic is much greater than the critical value therefore the null is rejected. For the null of at most one contegrating equation , the test statistic is smaller than the critical value at 5% level hence the null is not rejected. The test therefore indicates that there is one cointegrating equation. The maximum eigenvalue test confirms the result of one cointegrating equation. These tests therefore suggest that absa real house prices, rand/us$ exchange rate, household debt/disposable income , household net wealth/ disposable income , prime interest rates and new mortgage loans have a long run relationship.

Table 2.2 Trace tests

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob
None *	0.284386	115.3273	95.75366	0.0012
At most 1	0.166677	68.81583	69.81889	0.0599
At most 2	0.125115	43.47144	47.85613	0.1215
At most 3	0.097341	24.89232	29.79707	0.1653
At most 4	0.065315	10.65733	15.49471	0.2335
At most 5	0.009084	1.268409	3.841466	0.2601

*denotes rejection of the hypothesis at the 5% level

Table 2.3 Maximum Eigenvalue test

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob
None *	0.284386	46.51146	40.07757	0.0083
At most 1	0.166677	25.34439	33.87687	0.3621
At most 2	0.125115	18.57912	27.58434	0.4477
At most 3	0.097341	14.23499	21.13162	0.3461
At most 4	0.065315	9.388922	14.2646	0.2552
At most 5	0.009084	1.268409	3.841466	0.2601

* denotes rejection of the hypothesis at the 5% level

4.5 Vector Error Correction Model

Cointegration tests confirmed that six variables are cointegrated therefore a vector error correction model is estimated to determine coefficient values for the cointegrating equation and the disequilibrium adjustment. The estimated model shows the leading variables in explaining changes in absa real house prices and which variables will be adjusted for much faster to restore equilibrium. The results of the VECM cointegrating equation are reported in Table 2.4.

Table 2.4 Vector Error Correction Estimates

Cointegrating Equation

Variables	Coefficient	Std Error	Test Statistic	Results
absa real house prices (-1)	1			
exchange rate (-1)	0.115129	(0.15583)	[0.73884]	insignificant
household debt/disposable income (-1)	0.916396	(0.49421)	[1.85426]	significant
household net wealth/disposable income (-1)	3.842539	(0.60152)	[6.38806]	significant
new mortgage loans (-1)	0.006533	(0.08415)	[0.07763]	insignificant
prime interest rates (-1)	0.019663	(0.18876)	[0.10417]	insignificant
constant	12.96801			

The results show that household net wealth/disposable income and household debt/disposable income are leading variables in explaining changes in absa real house prices in the long run. The coefficient for household debt/disposable income is significant at 10% level. Changes in these leading variables have a positive impact on absa real house prices. This result is in line with expectations, as household net wealth to disposable income increases, demand for housing increases thereby increasing house prices. Household debt to disposable income have a similar impact on absa real house prices , as disposable income increases consumers 'credit worthiness improve and they can afford to take mortgages thereby increasing demand for housing and house prices.

Exchange rates, new mortgage loans and prime interest rates have a positive impact on absa real house prices in the long run, but are weak in explaining movement in house prices. This result is contrary to expectations that rand/us$ exchange rates and prime interest rates have a negative impact on absa real house prices. A possible explanation for this result is that a stronger rand/us$ exchange rate might not necessarily negatively impact on house prices through demand from foreign investors , but may signal positive sentiments on the economy thereby boosting demand for housing and house prices in the long run. On interest rates there might be a possibility that foreign investors who are attracted by higher interest rates might

end up investing some of their funds in the housing market thereby increasing house prices in the long run. This result on positive impact of exchange rate on house prices is similar to findings by Mohamad (2012) in Malaysia; he also found cointegration between property prices and four macro-economic variables including interest rates and exchange rates. The Impulse response analysis have however shown that in the short run, shocks to these two variables have a negative impact on absa real house prices. Craig & Hua (2011) and Leung, Chow & Han (2008) also found long run relationship between property prices and macro-economic variables including interest rates in Honk Kong SAR and Honk Kong.

5. Conclusion

The findings of the study reported and discussed in chapter 4 are summarised below:

Unit root tests for stationarity ADF and PP were used in the analysis. Two explanatory variables ber business confidence and household disposable income were found to be stationary in level form at 1% level and were therefore excluded from the cointegration analysis. Impulse responses and variance decompositions were used to analyse the impact of shocks to macro-economic variables on housing prices over 12 periods. Impulse responses showed that innovations to rand/us$ exchange rate, household debt to disposable income and prime interest rate impact negatively on real house prices, while innovations to ber business confidence, new mortgage loans, household net wealth and household disposable income have a positive impact on real house prices. Innovations to absa real house prices have significant positive impact on itself.

Variance decomposition analysis shows that 28% of movements in absa real house prices are explained by shocks to macro-economic variables included in the VAR model. The combined proportion of movements in absa real house prices explained by shocks to prime interest rates and rand/us$ exchange rate is 24%, while shocks to household disposable income and household net wealth explain only 3%. Most movements in absa real house prices are explained by own shocks. Cointegration analysis was carried out using the Johansen approach. A long run equilibrium relationship was found among absa real house prices and macro-economic variables included in the analysis.

This study focused on analysing the relationship between absa real houses and macro-economic variables as well as the impact of these variables on housing prices. Using the Johansen cointegration techniques and vector error correction model , results suggest that absa real house prices, rand/us$ exchange rate, household debt/disposable income, household net wealth/disposable income, new mortgage loans and prime interest rates have a long run equilibrium relationship. The results also show that these macro-economic variables have a positive impact on absa real house prices in the long run, household net wealth /disposable income and household debt/disposable income are leading variables in explanation of house price changes. Impulse response analysis suggests that in the short run shocks to prime interest rates and rand/us$ exchange rate impact negatively on absa real house prices.

Based on these findings, home owners and property market stakeholders can predict direction of housing prices by following movements in the macro-economic variables to aid in their buying or selling decisions. It is recommended that policy makers should consider these macro-economic variables to aid their policy formulation in the development and monitoring of the housing market. The study only focused on residential sector, it is therefore recommended that a further study be carried out on commercial property prices to cover the whole property sector.

References

Adams, Z. , & Fuss, R. , (2010). Macroeconomic determinants of international housing markets. Journal of Housing Economics, 19, 38-50.

Agnello, L., & Schuknecht, L. , (2011). Booms and busts in housing markets: Determinants and implications. Journal of Housing Economics, 20, 171-190.

Aye, G. C., Balcilar, M., Bosch, A., & Gupta, R. (2013). Housing and the Business Cycle in South Africa.

Aye, G. C., Balcilar, M., Gupta, R., Jooste, C., Miller, S. M., & Ozdemir, Z. A. (2013). Fiscal policy shocks and the dynamics of asset prices: The South African experience. Public Finance Review, 1091142113501713.

Beltratti, A. , & Morana, C. , (2010). International house prices and macroeconomic fluctuations. Journal of Banking & Finance, 34, 535-545.

Blanchard, O., & Johnson, D. R. (2013). Macroeconomics (6th Edition ed.): Pearson.

Brooks, C. (2013). Introductory Econometrics for Finance (2nd Edition ed.): Cambridge University Press.

Colombo, J. (2014). A guide to South Africa's economic bubble and coming crisis. Retrieved 31 May, 2014, from http://www.moneyweb.co.za/moneyweb-soapbox/a-guide-to-south-africas-economic-bubble-and-comin

Craig, R. S., & Hua, C. (2011). Determinants of Property Prices in Hong Kong SAR: Implications for Policy: International Monetary Fund.

Das, S., Gupta, R., & Kanda, P. T. (2011). International articles: Bubbles in South African house prices and their impact on consumption. Journal of Real Estate Literature, 19(1), 69-91.

Global Property Guide (2014). South Africa's housing market slowing. Retrieved 31 May 2014, from http://www.globalpropertyguide.com/Africa/South-Africa/Price-History

Heath A, P. F. a. W. C. (2012). Property Markets and Financial Stability. Retrieved 18 May, 2014, from http://www.rba.gov.au/publications/confs/2012/pdf/conf-vol-2012.pdf

House Price South Africa (2011). Will the Current South African Economy mimic the 1980's recovery? Retrieved 1 June, 2014, from http://housepricesouthafrica.com/2011/01/26/will-the-current-south-african-property-market-mimic-the-1980s-recovery/

IMF. (2000). Asset Prices and the Business Cycle. Retrieved 12 May, 2014, from https://www.imf.org/external/pubs/ft/weo/2000/01/pdf/chapter3.pdf

Jou, J. B. , Shi, S. , & Tripe, D., (2014). Can interest rates really control house prices? Effectiveness and implications for macroprudential policy. Journal of Banking & Finance, 47, 15-28.

Leung, F., Chow, K., & Han, G. (2008). Long-term and short-term determinants of property prices in Hong Kong.

Liu, C., Luo, Z., & Picken, D. (2007). Granger causality among house price and macroeconomic variables in victoria. Pacific Rim Property Research Journal, 13(2), 234-256.

Muellbauer, J. (2012). When is a housing market overheated enough to threaten stability? Paper presented at the conference Property Markets and Financial Stability co-hosted by the BIS and the Reserve Bank of Australia, August.

Mohamad, S. (2012). Causality between property price and macroeconomic variables: an application of Vector Error Correction Model and Variance Decomposition methods to Malaysia. Retrieved 4 July 2014, from https://www.academia.edu/2309972/Causality_between_property_price_and_macroeconomic_variables_an_application_of_vector_error_correction_and_variance_decomposition_metods_to_Malaysia

Ncube, M., & Ndou, E. (2011). Monetary policy transmission, house prices and consumer spending in South Africa: An SVAR approach. African Development Bank Group Working Paper (133).

Renigier-Biłozor, M., & Wiśniewski, R. (2012). The Impact of Macroeconomic Factors on Residential Property Price Indices in Europe. Folia Oeconomica Stetinensia, 12(2), 103-125.

Simo-Kengne, B. D., Bittencourt, M., & Gupta, R. (2012). House Prices and Economic Growth in South Africa: Evidence From Provincial-Level Data. Journal of Real Estate Literature, 20(1), 97-117.

StatisticsSA. (2013). Statistical Release P0441 Third Quarter 2013. Retrieved 18 June 2014, 2014, from http://www.statssa.gov.za/publications/P0441/P04413rdQuarter2013.pdf

Tau-Sekati, P. (2012). New research values South Africa's property sector at R4.9 trillion Retrieved 31 May 2014, from: http://www.propertycharter.co.za/news_article.htm?contentID=7

Tsatsaronis, K., & Zhu, H. (2004). What drives housing price dynamics: cross-country evidence? Bis quarterly review, 3, 65-76.

Zhu, H. (2005). The importance of property markets for monetary policy and financial stability. BIS paper, 21.