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A comparative study of housing affordability in South Africa using the adjusted Debt-Service Ratio and Price-Income Approach

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A comparative study of housing affordability in South Africa using the adjusted Debt-Service Ratio and Price-Income Approach

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WITS Business School

Thesis presented in partial fulfilment for the degree of Master of Business Administration to the Faculty of Commerce, Law, and Management, University of the Witwatersrand

April 2021


WITS
UNIVERSITY

DECLARATION

I Lesotla Mmesi declare that this research report entitled '**A comparative study of housing affordability in South Africa using the adjusted Debt-Service Ratio and Price-Income Approach** is my own unaided work. I have acknowledged, attributed, and referenced all ideas sourced elsewhere. I am hereby submitting it in partial fulfilment of the requirements of the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. I have not submitted this report before for any other degree or examination to any other institution.



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Signed at Johannesburg on 30th April 2021

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ABSTRACT

This study compares the adjusted Debt-Service Ratio (DSR) model and the widely used Price-Income Ratio (PIR) in the South African context to establish which of the measuring approaches give better and reliable results over time. In South Africa, housing unaffordability remains a challenge and accurately quantifying the extent of the problem is of key importance. The adjusted DSR model was seen as an appealing housing affordability measure to be explored as it corrects for household income changes and net financing cost of the mortgage loan thereof giving a refined calculation for housing affordability.

The research also explores the relationship of both the adjusted DSR and PIR to key macroeconomic variables, that is, economic growth (EG), mortgage rate (MR), unemployment rate (MR) and house price (HPI). The findings show that the PIR is the better measure of housing affordability than the adjusted DSR. The PIR accurately parallels other banking sector data regarding housing affordability, whereas the adjusted DSR tends to underestimate housing affordability in the South Africa context. Another key finding is that, on average, the housing prices are too high for an economy like South Africa, which is still battling with, low GDP growth rate, high unemployment rate, inequality and poverty.

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DEFINITION OF KEY TERMS AND CONCEPTS

DTI	Department of trade and industry
MR	Mortgage Rate
UR	Unemployment Rate
HPi	House Price Index
CPi	Consumer Price Index
DSR	Debt Service Ratio (adjusted)
PIR	Price-Income Ratio
EG	Economic Growth (GDP growth)
GDP	Gross Domestic Product
SARB	South African Reserve Bank
NDP	National development Plan
IDT	Independent Development Trust
MDSR	Debt Service Ratio (unadjusted)
FLISP	Finance Linked Subsidy Programme
RDP	Reconstruction and Development Programme
ARDL	Autoregressive Distributed Lag
HA	Housing affordability
ECM	Error correction model
StatsSA	Statistics South Africa
CUSUM	Cumulative sum
BNG	Breaking New Ground
OLS	Ordinary Least Squares

1 INTRODUCTION TO THE RESEARCH

1.1 Background and context

1.1.1 Background to the economic value of homeownership and housing affordability

Shelter or a house is one of the basic human needs, and for many people a house is the largest asset they will ever own (Davenport, 2003). In South Africa, providing shelter is used as one of the solutions in combating poverty. The issue of housing affordability is an increasing concern among people; therefore, it is important to scrutinize the housing affordability within the economy because when households are forced to spend larger percentage of income on housing it leads to them having less residual income available for other non-housing necessities such as food, clothing, transportation, education and healthcare.

The rate at which housing prices grow relative to real household income is a concern (Feldman, 2002). When the housing prices are not stable and grow significantly faster than the real household income it may lead households to high level of indebtedness in trying to close the gap and may push them further and further away from saving, investing and generating wealth.

1.1.2 The concept of housing affordability

Stone (2006) asserts that "housing affordability is not a characteristic of housing; however it is the relationship between housing and people". For some people, all houses are affordable, no matter how expensive they are and for others no housing is affordable unless it is free.

Affordability is the largest barrier home buyers face when seeking shelter. According to Su Ling and Almeida (2016) there are three approaches that are commonly used to measure the housing affordability as indicated in Table 1-1.

Table 1-1: Comparison of Housing affordability Approaches

Approach	*Characterization*
Median multiple	Considers housing affordable when the median house price is less than three times median household annual income.
Housing Cost Burden	Considers housing to be affordable if households spend under 30% of their income on housing expenditure (mortgage payments, household insurance, rates, and energy costs).
Residual Income	It subtracts the costs of meeting necessities from household income and uses the remaining "residual" income as the household's capacity to spend on housing. This approach is primarily used by commercial banks when evaluating mortgage applications.

Source: Su Ling and Almeida (2016)

1.1.3 Fundamental determinants of house prices

Housing prices are generally determined by both the demand and supply factors in an economy.

Demand Factors

The demand-side independent variables include income per capita, unemployment, density and population growth (Davenport, 2003). The higher the real per-capita disposable income of households, higher employment levels and population growth, the higher the demand for housing and this pushes the prices higher. The other key determinant is the mortgage rate which is linked to the interest rate, it affects the cost of financing the house and may affect the demand for housing, and contribute to the overall price of the house (Apergis and Rezitis, 2003).

Supply Factors

Supply-side variables include regulation, geographic factors, and the cost of new housing construction including land. House prices tend to converge to the cost of new housing construction (Watson, 2013). Undersupply conditions also contribute to housing price, significant housing supply shortages fuels the prices. Policy, institutional, and structural factors (elasticity) are found to be important determinants of long-run equilibrium house prices.

1.2 Research conceptualisation

1.2.1 The research problem statement

Having a decent accommodation is a constitutionally enshrined right in South Africa, nevertheless even now, many South Africans are unable to own houses. Only 35% of South African household own a home (General Household survey, 2018). It is believed that the newly developed standard houses are unaffordable to the majority of South Africans including the middle class—whom are the "backbone of both the market economy and of democracy in most advanced societies" (Birdsall, Graham, and Pettinato, 2000). Their income level is disproportionate to the prices of the house; hence, many people resort to having 20-30 years mortgage loans in order to make the monthly repayments lower but end up spending more on interest payment and other additional costs related to mortgage.

Many South Africans, especially entry level income earners don't have enough disposable income to make extra payments to shorten their repayment period and save on interest payment. According to Old Mutual Savings and Investment Monitor (2019), only 25% of homeowners are paying more than the minimum bond repayments every month. In the long run the high interest that they end up paying on an already highly priced house over the period pushes them further and further away from generating wealth and may contribute to them being indebted, a household that is over-indebted puts a strain on the economy (DTI, 2003).

In 2019, the cheapest newly built house was estimated at R436 200 and it was a $40m^2$ house (HousingFinanceAfrica, 2019). Under the predominant mortgage terms, the house would be affordable to only 20.4% of urban households. The $40m^2$ area is a relatively small space for a standard family of four; hence many households would have to purchase a house for more than R436 200 if they were to look for a larger space to comfortably accommodate the standard family of four.

According to Housing Finance Africa (2019), a household earning R10 000 a month gross income would only be able to afford a house valued at R285 917 assuming mortgage payments of R3 000 a month (30% of income), a 20-year bond term, and an interest rate of 11.25%. This means that this particular household cannot afford the

cheapest newly build house in 2019, however there are several government subsidy programmes for low income households which in some cases may not be enough to assist with housing affordability.

Sager (2018) also states that during 2017 less than 7000 mortgage borrowers earning up to R15000 were successful, that translates to only 5% of total new mortgages. This was a significant decrease compared to 10 years prior when the figure was at 20% of total new mortgages (Sager, 2018). In 2019, a total of 157 159 mortgages were extended, 97% of which were to higher income earners. Over the same period only 4 754 mortgages were extended to households earning up to R15 000 a month, clearly indicating the housing affordability problem in the country.

1.2.2 The research purpose (aim and objectives) statement

The purpose of this research is to conduct a comparative housing affordability study in South Africa between the adjusted Debt-Service Ratio (DSR) model which corrects for household income changes and net financing cost, and the commonly used Price-to-Income Ratio (PIR) for the period 1990 – 2018.

The research aims to contribute knowledge and raise debates about the most appropriate and more accurate housing affordability measure, and try to remedy the situation through specific policy intervention which may have not been considered before in South Africa.

1.2.3 The research questions and hypotheses

The following hypotheses are tested in this research:

1.2.3.1 Question 1: Which is a better and consistent measure of housing affordability between the adjusted DSR model, unadjusted MDSR and PIR methods?

H-1: The adjusted DSR is a better measure of housing affordability than the unadjusted MDSR and PIR

1.2.3.2 Question 2: Which macroeconomic variables significantly affect the adjusted DSR and PIR?

H-2: There is a strong relationship between housing affordability measures, that is, adjusted DSR and PIR; and the key macroeconomic variables: mortgage rate (MR), unemployment rate (UR), Economic growth (EG), and House Price (HPI)

1.3 Delimitations and assumptions of the research study

The research intentionally focuses on only two housing affordability measures, that is, the adjusted DSR model and Price-Income Ratio to determine the extent of housing unaffordability problem within South Africa. The macroeconomic variables affecting the two ratios were delimited to only four key determinants of housing affordability, that is, GDP growth, Mortgage rate, Unemployment rate and House Price. The research also, does not interrogate the housing affordability standard threshold of 30% and 3.0 for DSR and PIR respectively, above which housing is deemed un-affordable as recommended in literature.

1.4 Significance of the research study

Improving the accuracy of the housing affordability measurement is critical for housing policy intervention. The research compares the two methods in the South African context and tries to establish which method give much more consistent and reliable results in relation to the macroeconomic variables that can be targeted for policy formulation.

2 LITERATURE REVIEW

2.1 Homeownership challenges in South Africa and government policy intervention towards affordability

Homeownership is one of the most important subjects in South Africa and it has a historical political context. Many black people were excluded from homeownership during the apartheid period (Marais and Cloete, 2015). Homeownership is seen as part of the restorative justice process given the history of the country, and it is used as a way of reducing state welfare burden (Forrest, 2011).

2.1.1 Pre-democratic period

The mortgage finance only became available to black household during the mid-1980s, when the apartheid government decided to increase housing finance to the disadvantaged black population (Marais and Cloete, 2015). In this period, the country underwent a critical transformation towards homeownership for the previously disadvantaged black majority. This was done through the transfer of 500 000 state rental low-income household (Marais et al., 2014).

In the early 1990s, the introduction of the capital subsidy scheme by the Independent Development Trust (IDT) also assisted about three million low-income household towards homeownership (Marais and Cloete, 2015). However; in 1992 there was evidence that the capital subsidy funding had limited options in accessing affordable land (Huchzermeyer, 2001) and that resulted in it having minimal impact on urban integration (Nuttall, 1997).

2.1.2 Democratic Government intervention for homeownership

There seem to be a significant increase in new mortgage loans granted for residential dwellings since the incoming of the new democratic government as can be seen in

Figure 2-1 and this could be attributed to a number of interventions discussed in this section.

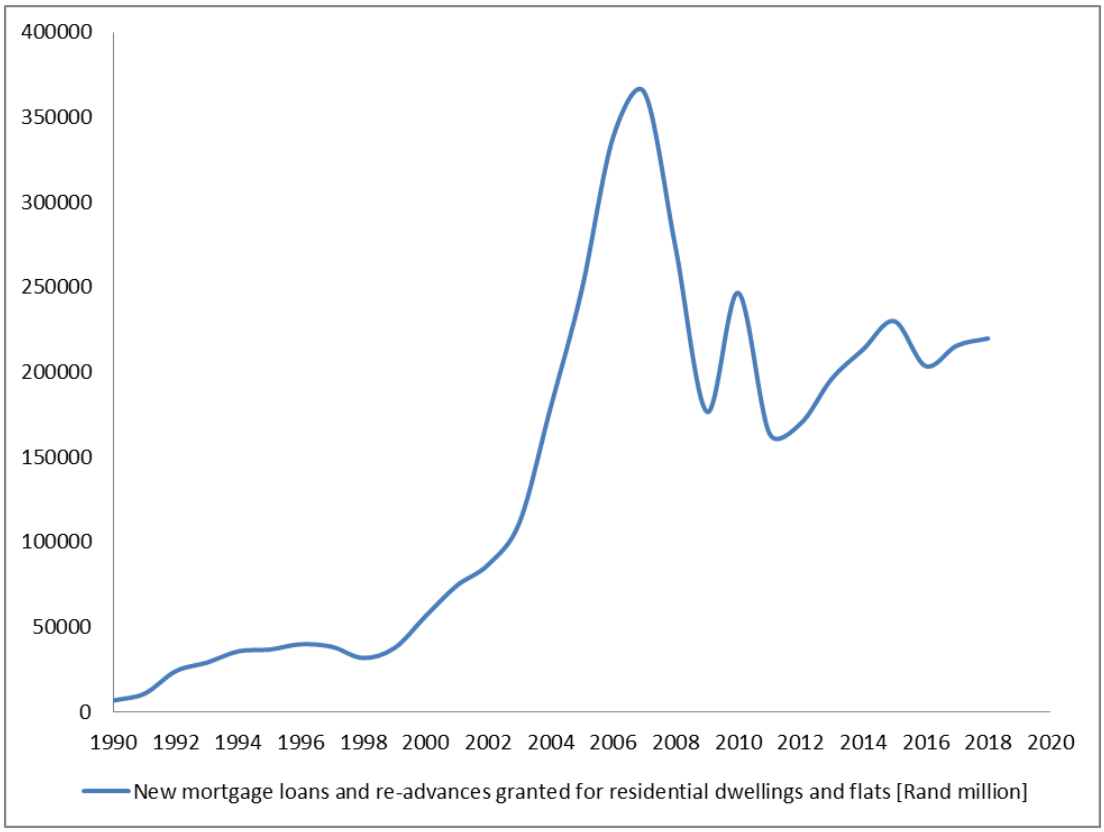

Figure 2-1: New mortgage loans granted for residential dwellings
Source: South African Reserve Bank

In April 1994 came in the new democratic government which introduced the White Paper on Housing to make strides in addressing the black majority homeownership issue. Tomlinson (1998) states that, at the centre of the White Paper were housing subsidy programme for low-income household earning between R800 – R3500. The government also signed Record of Understanding with the banks in 1994 hoping to bring private sector finance to assist low income beneficiaries improve their start-up homes (Tomlinson, 2007).

The Government then later in the 2000s, introduced Finance Linked Subsidy Programme (FLISP) for household earning between R3 500 – R 15 000 (Marais and Cloete, 2015), that category of household referred to as the middle –income earners included teachers, government employees, nurses, police officers, drivers and factory workers. In South Africa, that population group is also referred to as the missing middle or the gap market (Aurengroup, 2018), who earn between R3500-R20000, after the revised maximum from R15000 to now R20000 during the re-launch of FLISP in 2013.

The group is seen as "too well off" to qualify for the Reconstruction and Development Programme (RDP) house and also battles to qualify for a home loan (Aurengroup, 2018). Lemanski (2017) agrees that the group is financially debarred from homeownership due to lack of sufficient government subsidy support and inability at times to secure bank finance. They are unwillingly pushed to rental accommodation because the houses are unaffordable to them.

2.1.3 Housing prices and the Global Financial Recession

The housing prices rose by 20% per year during the period 2000- 2007 before taking a dip during the 2008 global financial recession into 2009 (Lemanski, 2017) as indicated in Figure 2-2. The prices then stabilized at 10% during 2013-2015 (AbsaHousePrice indice, 2014). The average annual house price increase averaged 3.8% and 3.6% in 2018 and 2019 respectively (FNB House Price Index, 2019).

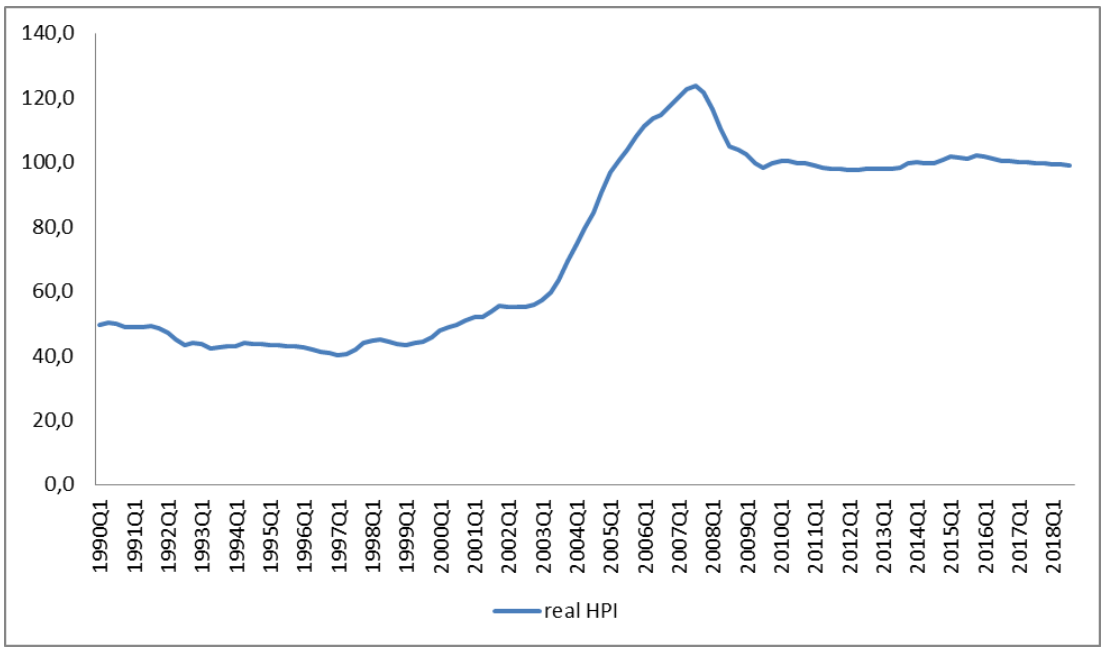

Figure 2-2: Real House Price Index (HPI)
Source: South African Reserve Bank

The increase of house prices above inflation has also been motivated by land inputs, including suitable land and infrastructure together with the development rights from the local municipality (Sager, 2018). It is difficult for the housing developers to contain the

costs. As Nuttall (1997) highlighted, there are limited options to gaining access to land that is available and affordable.

The housing unaffordability situation was made more difficult by the Global Financial Crisis of 2007 - 2008 for everyone including the middle-income group. According to (Cloete and Marais, 2015) the urban mortgage finance dropped from 15.2% to 8.5 % between 2008 and 2012, this is also distinctly apparent as indicated in Figure 2-1 looking at the significant drop in new mortgage loans granted for residential dwellings. Cloete and Marias (2015) reported using the NIDS data a decrease from 25.2% to 11.9% during 2008 to 2012 of households paying more than 30% of their income towards home loan. Clarke (2013) argued that due to the 2008 financial crisis, younger households, new buyers and minority groups disproportionately suffered because of tough credit restrictions. The households had to sell their units ((Berry et al., 2011) or deal with mortgage overdue ((Williams, 2011).

2.1.4 Debt levels and housing un-affordability

The middle class in South Africa are battling with debt and are in financial strain, the debt service cost-to-income trend is indicated in Figure 2-3. The DebtBusters Q4 2019 report shows the middle-class in South Africa to be hard hit by debt (Businesstech, 2020). Middle class or gap household is struggling to secure banking finance and Lemanski (2017) proclaims that suitable housing is not even available. Cirolia (2016) also points out that very few households in the gap income range, access housing funding. They are excluded from the bank housing affordability measures (CAHF, 2015) even with government assistance in the form of FLISP through necessary housing deposit due to poor credit rating (Lemanski, 2017). The traditional bond repayment period has also been extended to make mortgage affordable. Scanlon et al. (2008) highlights that, they are increasingly replaced by mortgages with non-standard features, such as longer terms to reduce the monthly repayments (Girouard, Kennedy, & Andre, 2007).

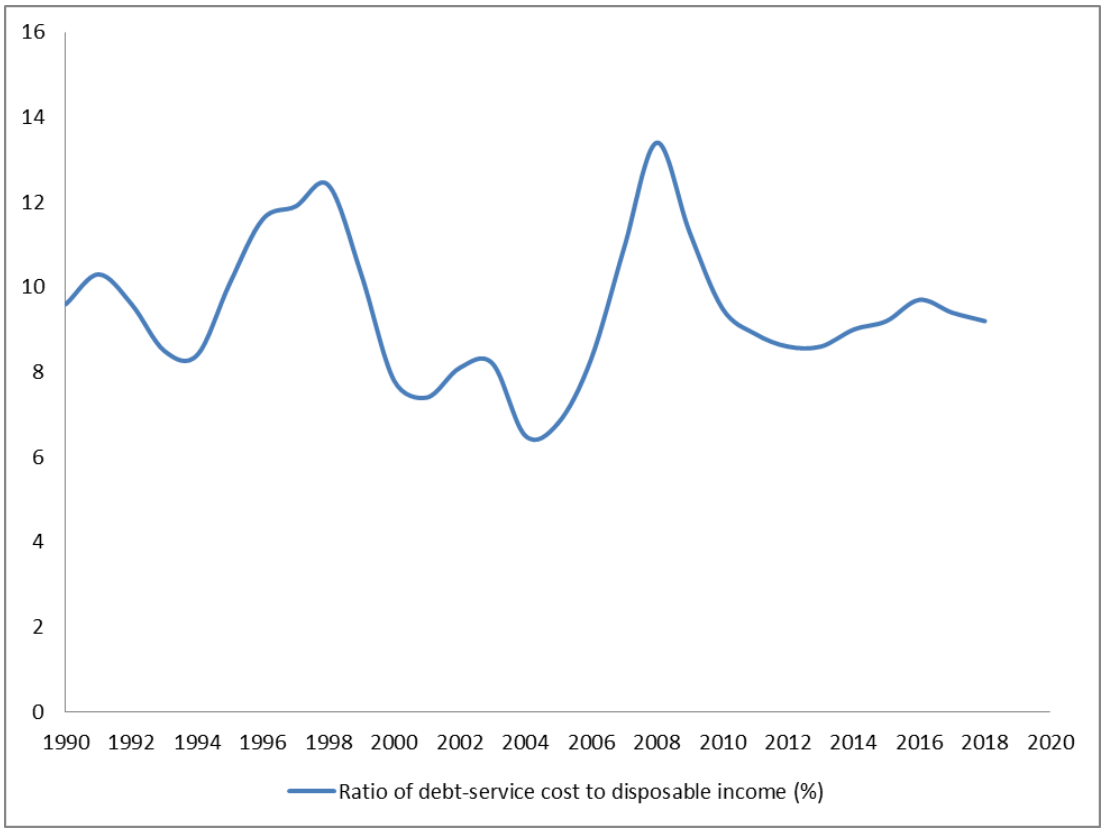

Figure 2-3: Debt-service cost to disposable Income
Source: South African Reserve Bank

2.1.5 Housing Policy Bias

Tomlinson (1999) argues that the policy for housing in South Africa is mainly focused on the needs of the poor and perhaps the needs of the elite. This was corroborated by Lemanski (2011) to say that South Africa has implemented a widespread housing program for the low-income household ownership. Far less attention has been given to the gap household (Lemanski, 2017). The state subsidized housing for the extremely poor has in fact not stimulated South African economic growth in the same scale as this kind of intervention had done in other countries (Gunter and Manuel, 2016).

According to Lemanski (2017) there is an inherent flawed assumption that the gap household is capable of housing affordability, he states that they require significant support not to rely on the state. Marais and Cloete (2015) support that and further state that "there is an implicit assumption that the banks should support gap housing policy

for homeownership through bank-finance. However reality has shown that it is not the case, there is no alignment between the government and banks in how they view homeownership as a priority.

2.2 Housing Affordability Measuring Approaches

2.2.1 The importance of housing affordability measurement

Housing affordability is a key factor in measuring the socio economic stability of the country (Suhaidab et al., 2011); it is directly related to homeownership ability which is an important priority for governments across the world. Today; housing affordability remains a problematic issue for many countries in the world; hence governments are required to get involved in the housing market (Oyalowo et al., 2018). However, in order for government to get involved it requires accurate measures to be able to structure and implement appropriate policy. Suhaidab et al. (2011) reiterates that understanding housing affordability and accurately measuring it help governments in developing effective housing policy.

Housing affordability has replaced the term "housing need" in the past two decades gaining popularity due to the housing market failures (Ndubueze, 2007). In spite the popularity of the term, there isn't an accord in the universal measurement of housing affordability. Many studies are agreeable that measuring housing affordability is complex (Suhaidab et al, 2011).

Literature presents different views on the appropriate methods of measuring housing affordability, however there is resounding agreement that this is a very important economic variable to measure as best as possible as it does help influence the direction of policy to help make housing more affordable within an economy.

2.2.2 Development of the housing affordability measure

The measure for housing affordability was first developed in 1977 by Weicher (1977). However, after modifications from the initial basic measurement of dividing house price

by income, the measurement has evolved. Linneman and Megbolugbe (1992) argue that housing affordability depends on many factors such as household income, house price, bank loan rates and loan term.

According to Gana and Hill (2009), there is a distinction in housing affordability concepts; firstly, the purchase affordability is based on whether or not a household is able to borrow sufficient funds for the purpose of purchasing a house. That definition supports Kosareva and Tumanov (2008) statement emphasising the ability to purchase housing. Secondly, repayment affordability draws from the burden resulting from housing loan repayment. Thirdly, the income affordability which is based on whether a household has sufficient income comparable to the price of the house they wish to purchase, that is, the house price-to -income ratio.

Geng (2018) asserts that the most widely used assessment method is long-run averages for price-to-income ratio and price-to-rent ratio. However, being useful as it is the price-to-income ratio is not the best method for measuring sustainability of housing prices due to deviations from historical averages deviations which may reflect fundamental drivers of house prices besides the income, such as interest rates (Geng, 2018).

2.2.3 The Price-to-Income Ratio Approach

The ratio approach emphasizes that if a household pays more than a certain percentage of its income then it may not have enough left to pay for other necessities (Stone, 2006). Ratios are pure numbers and they can be compared across time and space, and this makes it worth using for comparison purposes. The price-to-income ratio is the widely used method for housing affordability; it measures the median income to median house price (Gana and Hill, 2009), however Ndubueze (2007) put emphasis on the word "market", and expresses the ratio as the median market price of the house to median annual household income. In their study Gana and Hill (2009) show that this method can be extended to other quantiles to improve the accuracy of income affordability measurements.

Aşici and Özlem (2011) highlight that price-to-income ratio is popularly used by the United Nations, and they argue that it simply indicates the number of years it would take a household to pay-off the house if all their income goes towards the house. In their refined definition they define housing affordability as "the consumers' ability to purchase a house with relatively constant quality consistent with their socio-economic level, given the financial and income structure".

2.2.4 The housing cost-to-income ratio (the cost burden approach)

Ndubueze (2007) argues that no single affordability measure is accurate for every situation and the housing affordability concept is complex, as mentioned previously. For example, the rent-to-income ratio has stimulated critical discussions regarding the most appropriate income to use in the formula, that is, gross income, net income, equivalent income, equivalent after tax income (Ndubueze, 2007). Freeman et al. (1997) emphasizes that this resulted in many countries adopting different ratio measures towards specific housing subsidies.

According to Ndubueze (2007), one way of improving the results is to use an integrated approach. Chaplin et.al (1994) also suggested a joined approach by using an expenditure-to-income ratio and the residual income methods together, but those have since proven difficult to interpret as a combination. Freeman and Whitehead (1995) put emphasis and say expenditure-to-income ratio better compares housing affordability of households across different areas over time. Expenditure-to-income ratio has been noted to be conceptually flawed to determine the household ability to afford housing, but a very useful primary base, when using it with other affordability ratios (Bogdon & Can, 1997). In one of the studies, Thalmann (1999) shows how the combination of the three affordability indicators, that is, rent-to-income ratio, quality based measures and housing consumption measures was used to rental affordability in Switzerland. Nonetheless in 2003 he substituted rent-to-income by residual income method (Ndubueze, 2007).

2.2.5 The Composite Approach

Ndubueze (2007), states that not a lot of studies have been able to combine affordability indicators in a harmonic way and he proposes the composite approach as an aggregate housing affordability measure. This method brings together the expenditure-to-income ratio and shelter poverty method together while adjusting for quality to compile an aggregate housing affordability measurement. The method captures broader aspects of the housing affordability more than the conventional affordability ratios. The expenditure-to-income ratio puts focus on what the household pays for the house in relation to the household income. And the shelter poverty method puts emphasis on the basic household needs relative to the housing cost. According to Ndubueze (2007) these models cooperatively give a much more comprehensive housing affordability measure than a single measure, and can better guide the welfare policy.

2.2.6 The Residual Income Approach

The residual income concept of housing affordability puts emphasis on the amount that is left for non-housing expenses after the housing payment (Stone, 2006). This means that a household has an affordability problem if it cannot meet the non-housing expenses that it needs after paying for the house. The residual is actually the difference between the after tax income (disposable income) and housing payment, it is not the ratio between the two.

The residual income approach is inversely proportional to housing affordability or has a sliding scale because a smaller household will have a larger residual income than a larger household, meaning that they can afford to buy a house with a larger price tag assuming all other things equal (Stone, 2006). This standard depends on household size, type, and income. The residual income method is not universal; however the method is okay to compare two household types.

2.3 Qualitative attributes and quantitative variables key to the research

2.3.1 Standard measures to indicate Housing Un-Affordability

The housing cost-to-income ratio is the most conservative of all housing affordability measures. The ratio should be between 25-30% of household monthly income to indicate affordability (Ndubueze, 2007). In the USA the housing cost ratio approach has been widely accepted with the 'rule of thumb' of 30% as the affordability threshold for determining the eligibility for payment (Stone, 2006). The Price-to-Income Ratio (PIR) uses a different scale in determining the housing affordability levels within the economy. The International Demographia assigned the ratings indicated in Table 2-1 to indicate the state of affordability.

Table 2-1: Rating for Price-Income Ratio

Rating	*Median multiple*
Severely Unaffordable	>= 5.1
Seriously Unaffordable	4.1 - 5.0
Moderately Unaffordable	3.1 - 4.0
Affordable	<=3.0

For one to understand what is at the source of these ratios, they have to understand the macroeconomic factors and dynamics affecting it for effective policy determination. Many researchers have taken time to study and understand the key macroeconomic factors affecting housing affordability across the world.

2.3.2 Macroeconomic factors and the House Price dynamics

In their study Englund and Ioannides (1997) have documented a strong relationship between real house prices and key macro-economic factors, that is, GDP-growth rate and real interest rate change. The effect of inflation rate strongly affecting housing prices was later reiterated by Tsatsaronis and Zhu (2004), they further showed that bank credit and yield curve are also key determinants in house prices together with short term policy rates in their house price dynamics in 17 countries. The impact of bank credit was

in alignment with the Kasparova and White (2001) study which showed that mortgage rates have a significant impact on house price changes.

The elasticity of supply was also proven to be a key factor in determining the fluctuations or stability in house prices. Brounen et al. (2006) have shown that Germany house price stability had less fluctuation over the years due to the non-reliance on the bank financing system; they rely on alternative sources such as personal savings which helps reduce the impact of financial markets. Iacoviello (2000) using the vector autoregressive method on European countries showed that monetary shocks have a negative impact on the house prices fluctuations.

The demand side analysis by Brounen et al. (2006) shows that the rise in house prices in Belgium was largely due to increase in disposable income, reduced mortgage rates, increase in financing possibilities and tax deductibility of mortgage interest. A similar study was done in Netherlands which revealed the severe house price steep rise was due to growing incomes, decreasing mortgage rates, loosening restrictions on lending criteria by the banks, and substantial tax deductibility on interest, an inelastic housing supply and growing number of households. However the study in UK has shown that economic expansion, low unemployment and low mortgage rates led to steep rise in house prices starting in 1997.

Xu and Tang (2014) in the study looking at the period between 1971- 2014 concluded that construction cost, credit, GDP, interest rate and unemployment rate have a positive relationship to the house prices. However, disposable income and money supply have a negative correlation with house prices. Sabyasachi (2019) also reaffirms the previous studies regarding the key factors contributing to house prices fluctuations. According to his regression analysis, the most significant determinants of housing prices are inflation, interest rate, GDP growth rate, per-capita GDP and broad money (money supply) in the economy. However, the other determinants such as exchange rate, the fraction of population aged 15-64 are also statistically significant.

House prices of medium and large sized houses in South Africa are mainly related to short run changes in economic growth, real mortgage rates and sovereign risk (Hutchings, 2007), whereas small size houses in the short run are less associated with

real mortgage rates. Mbeleki and Nel, (2005) have pointed out that the key risk is derived from the buy-to-let investors, which can fuel the growth of house prices.

2.4 Framework(s) for interpreting research findings

The framework for interpreting the research findings will be in the South African context for the period 1990- 2018. Firstly, the comparison will be the relative changes between adjusted Debt-Service Ratio (DSR) and Price-Income-Ratio (PIR) over this period, and determine the significance of the changes.

The research will further be broken down into four to five distinct political periods and compare the effectiveness of the different policy intervention and leadership. The research will conduct a regression analysis on both the DSR and PIR to determine which macroeconomic independent variables have statistically significant impact on housing affordability, lastly to determine which method of housing affordability measure is consistent and more accurate. The findings will be based on averages, which will be presented in periodic trends, and strength of correlations and statistical significance.

2.5 Summary and conclusion

2.5.1 Summary of literature reviewed

Literature has revealed the importance of homeownership and the impact it has on the economy and that housing affordability is an important factor in measuring the socio-economic stability of the country and has a key role in alleviating poverty. It has also shown that there could be an underlying challenge of housing un-affordability in South Africa and it has some historical context dating to the apartheid period. Researchers have shown that measuring housing affordability is a complex task, however the extensive work done on the subject has offered key important methods to use, that includes the housing cost-to-income ratio, the price-to-income ratio, the residual income ratio, the composite approach, the rent-to-income ratio, the debt-service ratio (DSR) as the adjusted alternative and the less popular quality based measures.

There are key macroeconomic factors affecting housing affordability and in order to improve the situation for the population it is important to understand the strength of each factor and ensure that the appropriate policies are put in place and aligned based on reliable measuring method. For governments to tackle the problem of housing un-affordability effectively, they need to have a clearer understanding of the impact of macroeconomic variables on the house price dynamics. Those include inflation, interest rate, mortgage rate, GDP growth rate, GDP per capita, money supply, household disposable income, the unemployment rate, the exchange rate, the fraction of the population between 15-64 years, geographic factors, regulation and structural factors (elasticity). Those include both the supply and demand factors of the economy and a crucial balancing act has to be established.

3 RESEARCH METHODOLOGY AND DATA

This section provides the methods used in answering the research questions as outlined in Chapter 1, it covers the research design and methodology to test the hypotheses. Firstly, the section describes why the chosen model is the appropriate model for the research, secondly it presents the models used for the research and it offers the definition of the variables of the models including the macroeconomic variables. Thirdly, the chapter describes the source of data, the procedure for data collection, and lastly it presents the methodology for answering hypothesis 1 and 2 in the form of data analysis and interpretation.

3.1 Research Strategy

The strategy for this research is a quantitative strategy that only makes use of secondary data at macroeconomic level; it looks at the data for the country as a whole in studying the housing affordability during the period 1990 – 2018. This research will analyse the dynamics and effect of macroeconomic variables on housing affordability. This strategy draws from the research work by Brounen et al. (2006), in their research they develop the housing affordability model called the Debt-Service Ratio (DSR) which can be used for computation of housing affordability measurement. Secondly, the research strategy also draws from the work by Chee Yin et al. (2018), in their research they use key economic variables to predict the onset of housing affordability problems by a recursive forecasting method.

3.2 Research Design

The research design used is a comparative research that looks at essentially two different approaches of measuring housing affordability and tries to establish which method gives dependable results. Morley (2009) uses a similar research design in his study comparing the conventional monetary model of exchange rate and an alternative model that includes the stock price measure.

The two housing affordability measures are compared to their respective threshold standards for housing affordability, and an analysis is conducted to analyse the impact that housing policy has on them and the significance of each macroeconomic variable. The benefits for the design is that it will give a quantitative indication of which method give better and reliable measurement for housing affordability.

3.3 Research Procedure and Methods

The research uses the three-step analysis approach, which consists of statistical correlation analyses, graphical analyses and the regression analyses showing the relationship and responsiveness of each key independent macroeconomic variable that influence the measures of housing affordability, that is, the adjusted Debt Service Ratio (DSR) and the Price-to-Income Ratio (PIR).

A graphical analysis is used for pictorial view of the trends over time and to understand firstly how comparable the adjusted DSR and PIR are to one another and how different housing policy may have affected them, and secondly the responsiveness of the two affordability measures to key macroeconomic variables. Based on comprehensive literature review, whereby among others, the mortgage rate (MR), the economic growth (EG) and housing price (HPI) are chosen as the key macroeconomic determinants for housing affordability. Xu and Tang (2014) in their research show that unemployment rate is a critical component in housing affordability. This study will also include the unemployment rate (UR) because unemployment is one of the major socio-economic challenges facing South Africa.

Statistical correlation and regression analyses are used to accurately quantify and reveal the relationship between the housing affordability measures and the economic determinants. Autoregressive Distributed Lag (ARDL) regression technique will be applied for housing affordability modelling; this is because it is highly unlikely that housing affordability can be based on only the present state of dependent and independent variables (Chee Yin et al., 2018).

In his comparative study of two alternative monetary approaches to exchange over long run, Morley (2009) applies the ARDL for the period 1984Q1- 2004Q2. The ADRL and

the Bound test approach developed by Pesaran et al. (2001) are important as they allow to test for long run relationship in a mix of lower bound I(0) and upper bound I(1) variables (Morley, 2009).

3.3.1 Methodology for Research Hypothesis-1

H1: The adjusted DSR is a better measure of housing affordability than the unadjusted MDSR and PIR

In order to answer the research hypothesis 1, this study will first compute the adjusted DSR using the variables as indicated in Equation 1 for the period 1990-2018 on a quarterly basis, all variables are sourced from the South African Reserve Bank (SARB). Secondly, the study will use the PIR and unadjusted MDSR obtained from the SARB and Federal Reserve Bank of St. Louis respectively. However, no computation is required for the PIR and the unadjusted MDSR. The study will then analyse the trends and compare which results closely and accurately support other available data from literature and the impact that the housing policy implemented in South Africa had on them.

Description of the adjusted Debt-Service Ratio (DSR) model

The adjusted Debt-Service Ratio (DSR) model used in our research was derived by Brounen et al. (2006). The model is a modified housing cost-to-income ratio, which corrects for household income changes and net financing cost of the mortgage loan as indicated by Equation 1 below. The model is appropriate as it takes into account other financing costs related to mortgage, by doing so it present a broader view and refined calculation for housing affordability when compared to the widely used Price-to-Income Ratio (PIR).

In Chapter 2, it was indicated that there are other methods to determine housing affordability and the emphasis was made regarding the importance of accurately measuring housing affordability as the results can inform policy formulation. This DSR model gives that alternative by looking at the overall cost associated with housing which makes it unique and different from other techniques. The model just like other cost-to-

income ratios considers housing to be affordable when households spend under 30% of their income on mortgage repayments and other financing costs associated with housing.

$$DSR_t = \frac{[ac_t + I_t(1 - \tau_1 - \tau_2)]S_t + R_t}{Y_t}$$

…… Equation 1

The DSR model consists of key independent variables that are used in the computation of the dependant variable (DSR) at a specific time (t); these are defined in Table 3-1 below.

Table 3-1: DSR variables and definition

Variable	*Definition*
i. Net household income (Y_t)	The total disposable income that household earn after tax; this is the net amount of money available to the household for goods and services at time t.
ii. Gross mortgage rate (I_t)	The rate that the banks offer homebuyers; it is linked to the interest rate. It differs for each household depending on the risk factors.
iii. Average mortgage tax relief (τ_1)	The Tax relief on leased property whereby the rental income is only included in taxable income after all the costs incurred to generate the rental income are deducted from the rental. This does not apply to primary residence where the owner of the house occupies the house and therefore no taxable income is generated.
iv. Non fiscal subsidies (τ_2)	These are non-tax or non-government benefits to assist in homeownership, for example employer housing subsidy available for employees.
v. Additional costs (ac_t)	These are obligatory costs associated with homeownership, they include housing insurance, levies, municipality rates and taxes
vi. Outstanding mortgage debt (S_t)	The outstanding mortgage debt is the house purchase price multiplied by the initial loan-to-value ratio ($S_t = P_t$ x (loan amount/value))
vii. House price (P_t)	The purchase price of the house
viii. Supplemented repayment on mortgage (R_t)	They are extra loans repayments for home improvement or second mortgage

The unadjusted mortgage debt service ratio (MDSR) gives the mortgage repayments as a percentage of household income. It significantly differs from the adjusted DSR described above.

$$MDSR_t = \frac{I_t x\, S_t}{Y_t} \quad \text{…….. Equation 2}$$

I_t = Gross mortgage rate at specific time period

S_t = Outstanding mortgage debt at specific time period

Y_t = Net household income at specific time period

In Chapter 2, it was indicated that Price-to-Income (PIR) ratio is the widely used method for housing affordability (Gana and Hill, 2009) and popularly used by the United Nations (Aşici and Özlem, 2011). The method is also known as the median multiple method and shown by Equation 3 below. The numerator is the median-price house, meaning that it is the price of house whereby 50% of houses are priced below it and 50% are priced above it. The denominator is the gross median income of the household from all income sources.

$$PIR_t = \frac{P_t}{Y_t} \quad \text{…….. Equation 3}$$

P_t - the median ratio of the free market price for housing unit at specific time period

Y_t - the median of household income at specific time period

The International Demographia assigns ratings to indicate the state of housing affordability as indicated in Table 3-2. We note that according to the ratings, housing is affordable when the median multiple is below or equal to the 3.0. Above which housing is unaffordable ranging from moderate to severely unaffordable in very extreme cases where median multiple is >=5.1.

Table 3-2: Price-Income Ratio affordability indicator

Rating	Median multiple
Severely Unaffordable	>= 5.1
Seriously Unaffordable	4.1 - 5.0
Moderately Unaffordable	3.1 - 4.0
Affordable	<=3.0

3.3.2 Methodology for Research Hypothesis -2

H-2: There is a strong relationship between housing affordability measures, that is, adjusted DSR and PIR; and the key macroeconomic variables: mortgage rate (MR), unemployment rate (UR), Economic growth (EG), and House Price (HPI)

To answer Hypothesis-2, the study adopts the three-stage approach, that is, the quantitative descriptive statistics, the graphical analyses and thirdly the regression analysis. The first part presents descriptive statistics results and the Pearson correlation coefficient to give quantitative meaning to the relationships. The graphical results show the trends and vivid responsiveness of each key independent variable that influence the two measures of housing affordability. The regression analysis gives the final quantification of the relationship for modelling and predictive purposes.

In the first approach of analysis, this study make use of pearson correlation coefficient to determine the strength and direction of linear relationship between dependent and independent variables; and also check the significance of the correlation using the p-value. The pearson correlation coefficient ranges between 0 to 1.0. When the correlation is between 0.1 - 0.5 it implies very low to low correlation where the degree of association is negligible to weak. And between 0.51 – 1.0 the correlation is moderate to high with a moderate to strong degree of association (Morton et al.,1996). The coefficient also has either positive or negative sign indicating the direction of the relationship. The two sets of data, that is, adjusted DSR and PIR are used as the dependent variables to determine the strength of the relationship to each of the macroeconomic independent variables MR, UR, EG and HPI.

The second approach for the analysis of hypothesis 2 is that of graphical trend analysis of the two housing affordability measures, that is, the PIR and DSR in the South African housing market for the period 1990 -2018. This study makes use of the graphs to vividly reveal the responsiveness of the housing affordability to the changes in the chosen macroeconomic variables. This is to periodically study the housing affordability dynamics rather than take the overall relationship throughout the whole period as proposed in the previous section. This is critical as one can closely monitor housing affordability for different periods and their responsiveness to macroeconomic economic changes per period.

In the third approach for answering research hypothesis 2, the study adopts the ARDL technique to build on the available research with the introduction of the forth-independent variable, that is, the unemployment rate. Pesaran et al. (2001) highlights that, ARDL is a useful technique to use in time series data, because it reduces the effects of omitted variables and autocorrelation. Chee Yin, et.al, (2018) uses the ARDL technique in predicting the onset of housing affordability problems. In their study, they use economic growth, mortgage rate and housing price index as the regressors to derive their forecasting model for housing affordability. The ARDL model uses a combination of endogenous and exogenous variables. Ghouse et al. (2018) reiterates, "the model expresses the dependent variable by means of the lag and current values of independent variables and its own lag value". Morley (2009) uses ARDL bounds test to test for long run relationship in a mix of lower bound I(0) and upper bound I(1) at 5% significance, and modelling the long run by determining if there is co-integration. Pesaran and Shin (1999) state that this technique can be used when there is direct comparability between the variables of interest.

Equation 4 gives the generalised ARDL (p,q) model for housing affordability (HA) for short-run and no co-integration. However, where there is co-integration the ARDL model will take the long-run form, which is the error correction model (ECM) as shown in Equation 5. As mentioned previously, the four economic variables used in the regression analysis are mortgage rate (MR), economic growth (EG), unemployment rate and housing price (HPI). In addition, the outputs or dependent variables are the two housing affordability (HA) measures, adjusted DSR and PIR.

$$\Delta HA_t = \beta_0 + \beta_1 \sum_{i=1}^{p} \Delta HA_{t-i} + \beta_2 \sum_{i=1}^{q} \Delta HPI_{t-i} + \beta_3 \sum_{i=1}^{q} \Delta MR_{t-i} + \beta_4 \sum_{i=1}^{q} \Delta UR_{t-i} + \beta_5 \sum_{i=1}^{q} \Delta EG_{t-i} + \varepsilon_t$$

Equation 4

$$\Delta HA_t = \beta_0 + \beta_1 \sum_{i=1}^{p} \Delta HA_{t-i} + \beta_2 \sum_{i=1}^{q} \Delta HPI_{t-i} + \beta_3 \sum_{i=1}^{q} \Delta MR_{t-i} + \beta_4 \sum_{i=1}^{q} \Delta UR_{t-i} + \beta_5 \sum_{i=1}^{q} \Delta EG_{t-i} + \lambda ECT_{t-1} + \varepsilon_t$$

Equation 5

HA = housing affordability measure [DSR, PIR]

β_0 = constant term

β_1 = coefficient of endogenous variable, DSR/PIR

β_2 β_3 β_4 β_5 = coefficients of independent variables,

p= optimal lag value of endogenous variable- HA

q = optimal lag value of the exogenous variable - HPI, MR, UR, EG

ε = error term

ECT = error correction term

Table 3-3 below show the expected coefficients signs of independent variables relative to the housing affordability measures DSR and PIR. A very important factor to note when interpreting the signs is that they are based solely on the direction of the movement of the value of DSR or PIR; however, one must be careful when interpreting the implications of the DSR or PIR movement. For example, an increase (+) in DSR or PIR does not mean an improvement in housing affordability, it simply mean the deterioration in housing affordability. The lower the value of the DSR or PIR, the better it is the housing affordability.

In Table 3-3, one sees that mortgage rate (MR) has a directly proportional relationship with mortgage rate and housing affordability ratios DSR and PIR, this means that when the mortgage rate (MR) increase then the value of DSR and PIR also increase, translating to the deterioration in housing affordability. Similarly, with the unemployment rate (UR) and House Price (HPI), they have a positive relationship with the DSR and PIR based on values but the interpretation is that when UR and HPI increase then housing affordability worsens because the value of the ratio is also increasing. However, economic growth (EG) relationship with DSR and PIR is slightly

different; it can be either positive or negative depending on the magnitude of the economic growth.

Table 3-3: Expected Coefficient signs

Variables in the ARDL model	Expected Coefficient Sign		Literature support
	DSR	PIR	
Mortgage rate (MR)	+	+	Kasparova and White (2001) Chee Yin, et.al, (2018) Englund and Ioannides, (1997) Apergis and Rezitis (2003)
Economic growth (EG)	+/-	+/-	Brounen et al.(2006) Englund and Ioannides (1997) Sabyasachi (2019) Chee Yin, et.al, (2018)
Unemployment rate (UR)	+	+	Xu and Tang (2014)
House Price (HPI)	+	+	Chee Yin, et.al (2018)

Mortgage rate (MR)

The mortgage rate is directly linked to the repo rate and interest rate and affects both the demand and supply of housing (Kasparova and White, 2001). The higher mortgage rate tends to increase the loan repayments, which has a direct impact on affordability hence reducing the demand (Chee Yin, et.al, 2018). On the supply side the high interest rate can impact access to development funds to housing developers reducing the supply of housing which makes the prices even higher impacting on affordability (Englund and Ioannides, 1997). Apergis and Rezitis (2003) highlight that when the interest rate decrease due to the money supply growth the demand for housing rises, hence affordability improves because the value of DSR and PIR decreases.

Economic growth (EG)

On the demand side, the GDP growth may lead to the GDP per capita increase and increased household wages which may drive the demand for housing eventually pulling housing prices higher (Brounen et al, 2006). There is a strong direct relationship between real house price and GDP-growth (Englund and Ioannides, 1997), Sabyasachi (2019) also reiterates the direct relationship between GDP growth rate and house price, which is directly linked to housing affordability.

On the supply side, the GDP growth may drive the construction industry including the real estate development industry which may push the overall house prices higher due to added value of housing. However, for housing to still be affordable the rate of increase in housing price may not be extremely larger than the rate of household income increase (Chee Yin, et.al, 2018), hence the relationship can either be positive or negative.

Unemployment rate (UR)

The unemployment rate affects the total household income, meaning that more households may find it difficult to afford housing when unemployment increases. Unemployment fuels housing un-affordability (Xu and Tang, 2014). Increase in unemployment rate reduces the total household income and puts a strain in housing affordability.

House Price index (HPI)

The increase in house prices causes and increase in DSR and PIR; this is interpreted directly from the housing affordability equations in literature, which places the house price as the numerator.

3.4 Data

Secondary data was sourced from the South African Reserve Bank (SARB), Statistics South Africa (StatsSA) and Federal Reserve Bank of St. Louis based on national observations. The data is in the form of time series on quarterly basis for the period 1990 – 2018. As mentioned previously, the period was chosen to cover different political periods and leadership in South Africa. This is from the fall of apartheid (1990 – 1994), to the dawn of democracy under President Mandela (1994 – 1999), the third period under President Thabo Mbeki (1999- 2008) and the fourth period under President Jacob Zuma (2009 – 2018). This will help determine which policy interventions as discussed in Chapter 2 and leadership that made the most impact.

3.4.1 Data analyses and interpretation

E-Views statistical tool will be used for data analysis and interpretation of the results. For hypothesis 1, focus is on the graphical trends of the computed DSR, PIR and unadjusted MDSR.

For hypothesis 2, the study first use descriptive statistics and pearson correlation to present the relationship between the housing affordability and macroeconomic independent variables and graphical trends. The analyses for regression model will start with the selection of the appropriate lag length for the ARDL models on both the DSR and PIR computation using the appropriate information criterion. This will then be followed by deriving the general model and work towards the specific model using the Wald Test for systematic elimination of the non-significant variables. The bound test and Johansen test will be done to check for co-integration in the variables, the study will make use of the F-statistic against the lower bound I(0) and upper bound I(1) at the widely used 5% significance critical value. Where there is co-integration, the ARDL model will take the long-run model which is the error correction model (ECM). Other critical statistical interpretation includes the Durbin-Watson-statistic, R-squared, adjusted R-squared and F-statistic. Lastly, the study will do a validity check on the models and conduct a serial correlation and stability test of the models using the Breusch-Godfrey Serial Correlation LM and CUSUM stability respectively.

4 PRESENTATION OF RESEARCH RESULTS

4.1 Research Results Relating to Hypothesis-1

H1: The adjusted DSR is a better measure of housing affordability than the unadjusted MDSR and PIR

Figure 4-1 below shows the trends of the three affordability measures on their individual scales to accurately reveal the trend over the same period under consideration, that is, 1990-2018. The adjusted DSR closely reflect the trend of the widely used housing affordability measure PIR than the unadjusted MDSR, this means that the two, that is DSR and PIR are more comparable to one another than the unadjusted MDSR.

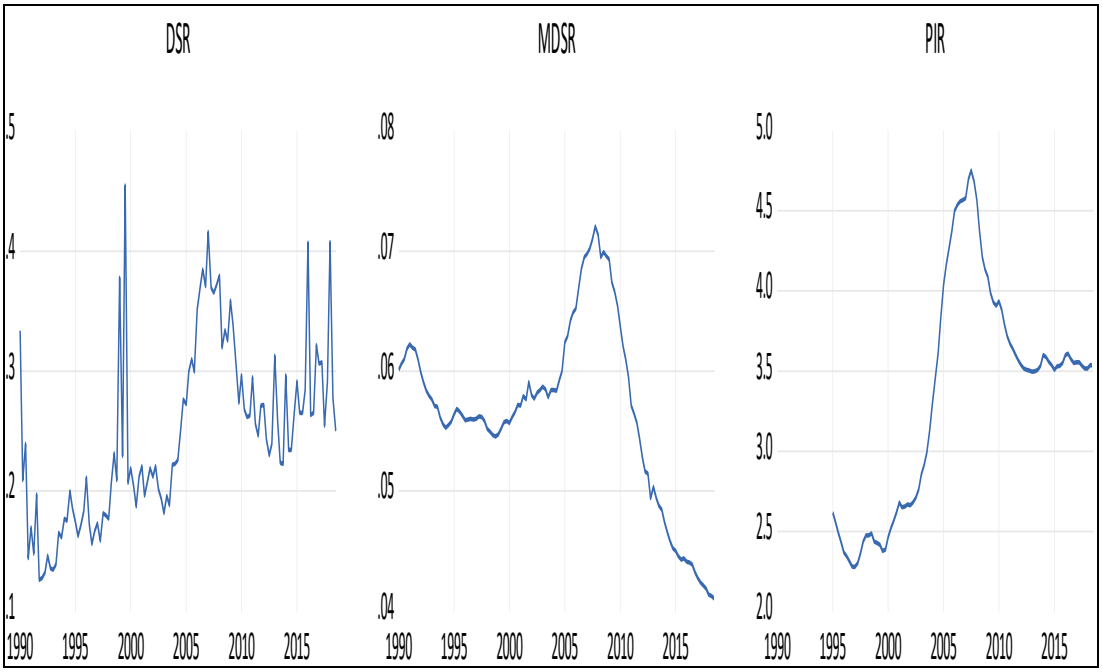

Figure 4-1: DSR, MDSR and PIR housing affordability trends on individual scales

The results also show that the unadjusted MDSR underestimate housing affordability as indicated in Figure 4-2, where the graphs are superimposed on each other. According to the results, the mortgage-debt service payment as a percentage of disposable income over the period is less than 10%. This means that if one were to use the housing affordability cost-to-income ratio threshold of 30%, it would mean that housing un-

affordability would simply not be an issue in South Africa if we based the analysis on the unadjusted MDSR however; literature has shown that housing un-affordability in indeed a problem in the country. The analysis shows that the adjusted DSR is more dependable than the unadjusted MDSR.

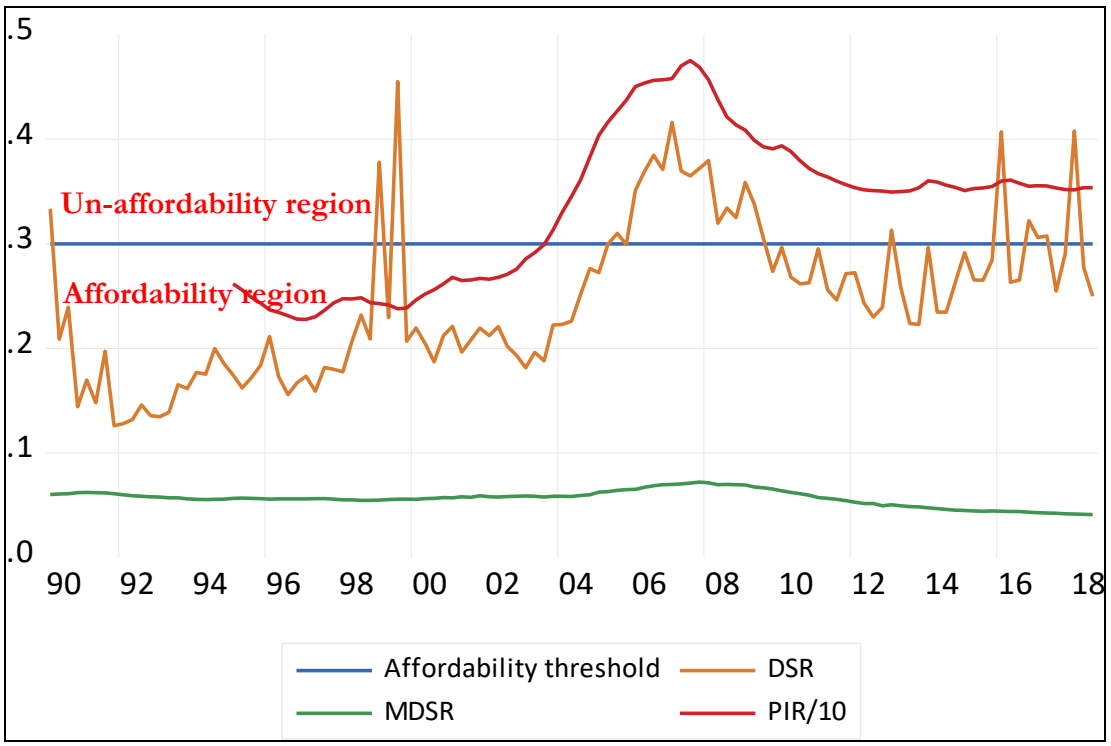

Figure 4-2: DSR, MDSR and PIR housing affordability trends

Further analysis on the adjusted DSR show that for the period 1990 to 2005 housing was generally affordable with the exception of the spikes into the un-affordability region observed in 1990Q1, 1999Q1 and 1999Q3, these spikes are mainly associated with a sudden drop in household income. Then affordability started becoming a problem from 2005Q3 where the threshold of 30% was crossed. The housing unaffordability carried on through the period 2005Q3 to 2009Q3, and this period included the period characterised by the Global Financial recession throughout the period 2007-2009. However, housing affordability recovered from the period 2009Q4 up to the 2012Q4 before hitting 31,3% in 2013Q1. Then affordability was restored from 2013Q2 before reaching very high unaffordability level at 40,7% in 2016Q1 and the other high unaffordability level 40,8% in 2018Q1.

The Price-to–Income Ratio (PIR) shows a slightly different picture whereby during the period 1995Q1 to 2003Q2 housing was affordable with the ratio being below the 3,0

affordability threshold as shown in Figure 4-2. According to this measure, housing affordability started deteriorating from 2003Q4. There is a distinct period of high unaffordability starting from 2004Q4 reaching a peak in 2007Q2 of 4,7 before stabilising at around 3,6 in 2011Q3 towards 2018 with only small fluctuations. PIR seem to be a leading affordability measure as it precedes the DSR. This is shown by it reaching the threshold almost 2 years earlier than DSR.

The PIR trend show that housing has not been affordable since 2003 to 2018 where it is above the threshold >3.0. This is in line with literature whereby Sager (2018) highlights that only 5% of total new mortgages were successful for people earning up to R15000, pointing to housing un-affordability, although the DSR shows that in 2018Q1 the housing was affordable in South Africa, which seem to contradict the available banking sector data.

One also take note that in 2008, only 20% of new mortgage were approved Sager (2018), however this is also indicated by both affordability measures whereby both were above the thresholds of 3.0 and 30% for PIR and DSR respectively in 2008. In 2012 the approved urban mortgage finance was only 8.5% compared to 2008 at 15,2% (Cloete and Marais, 2015), which highlighted the problem of housing un-affordability. These statistics are in agreement with the PIR in 2012 having a value of >3.0 whereas the DSR shows <30% in the affordability region which again is in contradiction with the banking sector data presented in literature.

In 2017, the middle class was struggling to secure banking finance, and that no suitable housing was even available (Lemanski, 2017). The PIR trend supports housing un-affordability for 2017 where the level was >3.0, but the DSR is also slightly above 30% for the 2017Q1-Q3 and dropping to below 30% only in the 2017Q4. And yet again, the PIR showing a consistent result when compared to other available literature. From those few examples, the PIR parallels more of the literature and other statistical data than DSR, this gives it some credibility for true indication of housing affordability than the DSR.

The other analysis is the impact that housing policy had both the adjusted DSR and PIR. In Table 4-1, we note that during the dawn of democracy under President Mandela, there was a slight deterioration in DSR of -13,6% (-2.3 percentage points), however still in the affordability region. This is the period where the White Paper on housing was introduced, to help with subsidy for low income earners. The PIR before 1994 was not available in the SARB records as previously mentioned. Similarly the first period under President Mbeki also shows a deterioration of housing affordability of -14,1% and -12% for DSR and PIR respectively, during the period where FLISP was introduced. The change is more comparable but with DSR slightly higher than PIR, but both still in the affordability region.

Table 4-1: Effect of housing policy on affordability

		DSR		***PIR***		
Period	**Political Leadership**	**Avg**	**%Change**	**Avg**	**%Change**	**Policy Interventions**
1990Q1-1994Q1	De Klerk	17,0 %	-	-	-	Capital subsidy scheme by the independent development trust (IDT) (Nell and Rust,1993)
1994Q2 – 1999Q1	Mandela	19,3 %	-13,6%	2,4	-	White Paper on housing to spearhead ownership, through housing subsidy programme for low-income earners. Signing of Record of Understanding with the banks to bring private sector finance to assist low-income earners. (Housing White Paper, 1994)
1999Q2-2004Q1	Mbeki	22,0 %	-14,1%	2,7	-12%	Introduction of Finance Linked Subsidy Programme (FLISP) for household earning between R3500 - R15000
2004Q2 - 2007Q1	Mbeki	31,9 %	-45,0%	4,2	-56%	Introduction of Breaking New Ground (BNG) in 2004, a policy for the development of human settlements through reducing reliance private sector to provide loans/finance (Adebayo, 2011)
2007Q2-2009Q1	Motlathe	35,3 %	-10,7%	4,4	-6%	
2009Q2 – 2014Q1	Zuma	26,9 %	23,9%	3,7	17%	Re-launch of FLISP in 2013, revised the maximum salary from R15000 to R20000 (Aurengroup, 2018)
2014Q2 – 2018Q3	Zuma	28,8 %	-7,3%	3,5	3%	

One also note the huge deterioration in adjusted DSR and PIR of -45% and -56% respectively in the second term under President Mbeki significantly shifting housing affordability into the un-affordability region. This period correspond with the Breaking New Ground (BNG) policy. The housing affordability deteriorated further after

President Mbeki was removed as the president before finishing his second term, and was temporarily replaced by President Motlanthe.

We also note the significant improvement in DSR and PIR of 23,9% and 17% respectively during the first term of President Zuma, however this was the period following the Global Financial Recession. DSR records an average of 26,9% which is still in the affordability region but the PIR records an average of 3,7 which is a moderately un-affordable level, the period includes the re-launch of the FLISP in 2013. Finally; President Zuma second term sees a deterioration of -7,3% DSR but a 3% improvement in PIR, however still in the un-affordability region. Overall; on the responsiveness to housing policy, both measures move in-sync except in the last period, and the DSR tends to consistently overestimate the changes than the PIR.

From the first and second analysis, the study rejects hypothesis-1, and concludes that PIR is a better a measure of housing affordability because it tends to parallel other statistical data available in literature more often than the adjusted DSR. Secondly, the adjusted DSR and unadjusted MDSR tend to underestimate housing affordability, which could be more detrimental to the society by misleading the policy makers not to effectively act believing that all is good. There is a serious risk associated with underestimating key economic indicator could (Taylor, 2008). Taylor (2008) highlights how the underestimation of the risk associated with putting the adjustable-rate subprime and other mortgages into complex mortgage-backed securities by the rating agencies was at the nuclei of what led to the Global Financial Recession of 2007-2009. Quantitatively underestimating the situation may lead to ineffectively acting on the situation.

4.2 Research Results Relating to Hypothesis-2

H-2: There is a strong relationship between housing affordability measures, that is, adjusted DSR and PIR; and the key macroeconomic variables: mortgage rate (MR), unemployment rate (UR), Economic growth (EG), and House Price (HPI)

In answering Hypothesis-2, the three-stage approach is used, that is, the quantitative descriptive statistics, the graphical analysis and the regression analysis. The first part

presents descriptive statistics results and the pearson correlation to give quantitative meaning in the form of strength and direction of the relationships. The graphical results show the trends of each key macroeconomic independent variable that may influence the two measures of housing affordability. Lastly, the regression analysis gives the models that linearly show the relationship between the housing affordability measures to the macroeconomic independent variables.

4.2.1 Descriptive Statistics and Pearson Correlation

In the first approach of results presentation for hypothesis 2, the study makes use of the degree of association scale as explained in Chapter 3. As shown in Table 4-2, the Pearson correlation reveal that DSR is weakly negatively correlated to MR with a magnitude of -0,48 at significance level of 1%, however the DSR is moderately positively related to the HPI with magnitude of 0,633 at significance level of 1%. There is negligible degree of association between DSR and UR with magnitude 0,156 however not significant and similarly with EG at magnitude -0,18 but significance level of 10%.

The Pearson correlation show that PIR is moderately weakly correlated to MR with magnitude of -0,642 with significance level of 1%, this is slightly better than DSR. PIR is also moderately positively correlated to HPI with a magnitude of 0,704 at significance level of 1% which is also better than the DSR. There is a moderate degree of association between the two housing affordability measures with a correlation coefficient of 0,737 and significance of 1%. On average the Mortgage rate (MR) and unemployment rate (UR) have been high during the focus period with a low economic growth (EG).

Lastly, the pearson correlation results show that only HPI, UR and EG give the expected sign of (+) on both the adjusted DSR and PIR, but not significant on UR. MR gives the unexpected sign of (-) on both adjusted DSR and PIR. The increase in MR is expected to increase the value of DSR and PIR, leading to the deterioration in affordability. The negative sign implies that the increase in MR leads to the decrease in the value of DSR and PIR, meaning that there is improvement in affordability. But according to literature that is not true. The EG gave a negative sign on both DSR and PIR, meaning that an increase in economic growth reduces the PIR and DSR value leading to improved housing affordability.

Table 4-2: Descriptive Statistics and Pearson Correlations

	Descriptive Statistics			Pearson Correlations					
	Mean	Std. Dev	N	DSR	PIR	MR	HPI	UR	EG
DSR	24,7%	7,4%	115	1					
PIR	3,35	0,72	95	.737**	1				
MR	14,0%	4,1%	115	-.480**	-.642**	1			
HPI	66,08	47,10	115	.633**	.704**	-.835**	1		
UR	24,1%	2,8%	99	0,156	0,105	-.444**	.445**	1	
EG	2,5%	1,2%	114	-.180*	-0,067	.248**	-.400**	-.246**	1

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

However, further analysis was done by dividing the total period into sub-periods. The correlations results reveal the inconsistency with regards to the expected sign on MR and UR on different periods. Only HPI show consistency throughout the different periods for both DSR and PIR as indicated in Table 4-3. Note that during the De Klerk period, no PIR data could be retrieved from the SARB. During the Mandela period, the DSR corresponds with the expected sign on all variables, and PIR only correspond with only two variables HPI and EG. And during the Mbeki period, both DSR and PIR only correspond with the expected signs of two variables HPI and EG. The Motlanthe corresponds with expected sign on three variables HPI, UR and EG. And PIR only correspond with expected sign on HPI and EG. And lastly, the DSR during the Zuma period correspond with all expected sign on all variables and PIR only corresponded MR, HPI and EG. Based on the sub period analysis it would seem the DSR gives the expected sign more often than the PIR throughout the period.

Table 4-3: Sub-period correlations

		Descriptive Statistics			Pearson Correlations					
		Mean	Std. Dev	N	DSR	PIR	MR	HPI	UR	EG
De Klerk (1990-1994Q1)	DSR	17,0%	5,3%	17	1					
	PIR	-	-	0	.a	1				
	MR	18,5%	2,1%	17	0,382	.a	1			
	HPI	13,628	1,229	17	-.640**	.a	-.863**	1		
	UR	20,0%	0,0%	1	.a	.a	.a	.a	1	
	EG	3,3%	0,9%	16	0,189	.a	-0,182	0,117	.a	1
Mandela (94Q2 - 99Q1)	DSR	19,3%	4,8%	20	1					
	PIR	2,4	0,1	17	0,129	1				
	MR	18,8%	2,1%	20	0,331	-0,350	1			
	HPI	19,2	2,3	20	.529**	0,110	.766**	1		
	UR	20,6%	2,9%	20	.425*	-0,057	.547**	.854**	1	
	EG	2,6%	1,0%	20	-0,153	-0,005	-0,304	-.399*	-.440*	1
Mbeki (1999Q2-2007Q1)	DSR	25,7%	7,5%	32	1					
	PIR	3,3	0,8	32	.685**	1				
	MR	13,5%	2,4%	32	-.418**	-.791**	1			
	HPI	50	23	32	.687**	.995**	-.764**	1		
	UR	25,1%	2,2%	32	-.635**	-.492**	.384*	-.455**	1	
	EG	3,0%	1,2%	32	.318*	0,072	-0,129	0,101	-0,137	1
Motlanthe (2007Q2-2009Q1)	DSR	35,3%	2,3%	8	1					
	PIR	4,4	0,3	8	.654*	1				
	MR	15%	2%	8	-.791**	-0,435	1			
	HPI	98	2	8	.653*	.894**	-0,276	1		
	UR	22,3%	1,0%	8	0,075	-0,211	0,014	-0,406	1	
	EG	2,4%	1,4%	8	0,258	0,605	0,083	.716*	-0,390	1
Zuma (2009Q2-2008Q3)	DSR	27,8%	4,1%	38	1					
	PIR	3,6	0,1	38	0,178	1				
	MR	9,7%	0,7%	38	.527**	.530**	1			
	HPI	121	18	38	0,232	.606**	0,239	1		
	UR	25,5%	1,2%	38	0,246	-.385**	.317*	.809**	1	
	EG	1,8%	1,0%	38	-.454**	0,164	-0,134	-.285*	-0,191	1

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

4.2.2 Graphical Analysis

4.2.2.1 Housing affordability against House Price (HPI)

The housing prices show a steady slow increase for the period 1990Q1 - 2003Q3. The period 2003Q4 - 2007Q4 has seen rapid rise in house prices, this corresponds to the rapid rise in the DSR during the period 2003Q4 until 2007Q1, similarly with PIR it is seen during the same period before the brief fall in prices for period 2008Q1 - 2008Q3. The house prices then stabilised for a brief period from 2008Q4 to 2009Q3 before they continued on a steady moderate increase from 2009Q4 towards 2018Q3 as indicated in Figure 4-3.

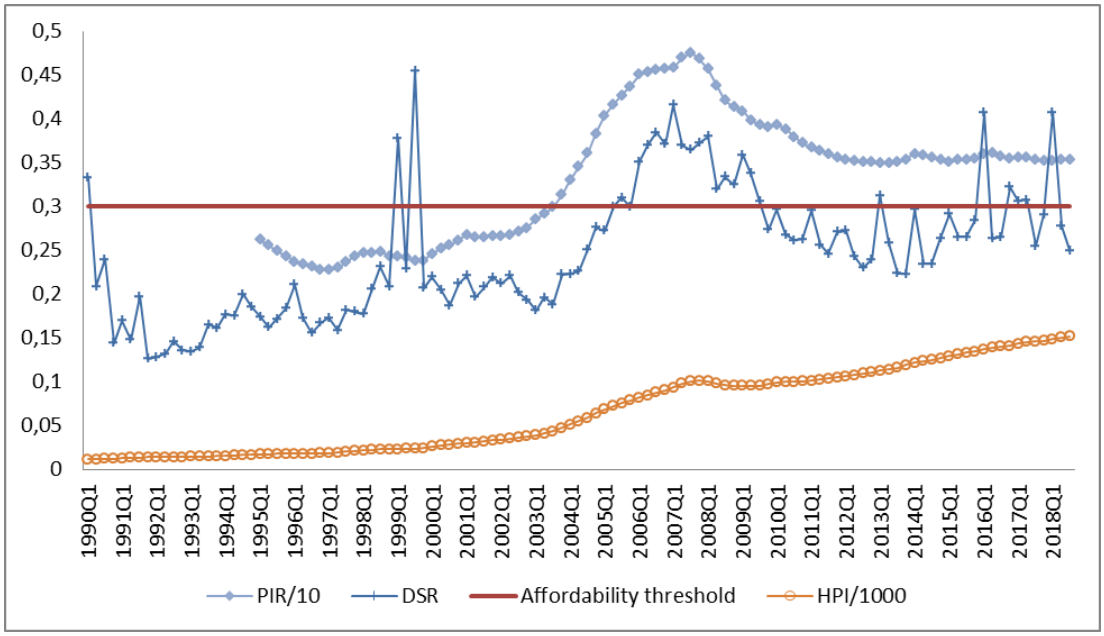

Figure 4-3: Housing Affordability (HA) against HPI trend

There is some association between the two housing affordability measures and the housing price, this shows that indeed the housing price has a great effect on the affordability and it is indeed a strong economic determinant for housing affordability, this agrees with the results presented in section 4.2.1. The rapid rise in the housing prices does lead to unaffordability for both affordability measures. The graphical analysis shows the responsiveness of DSR and PIR to HPI, and is more consistent with PIR.

4.2.2.2 Housing affordability against Economic Growth (EG)

Figure 4-4 shows the real GDP growth rate on a quarterly basis, experienced by South Africa during the period. The economic growth had been mainly positive, however very low for the period 1990 - 1998. This was followed by higher real positive growth during 1999Q1- 1999Q4. This growth correspond to the two unaffordability spikes reflected on the DSR curve in 1999Q1 and 1999Q3 of 37,8% and 45,5% respectively as mentioned previously, this is mainly associated with the sudden drop in the disposable household income. The DSR seem to be more responsive to EG, than the PIR in this case also confirming what was revealed in section 4.2.1 when looking at the magnitude of the pearson correlation.

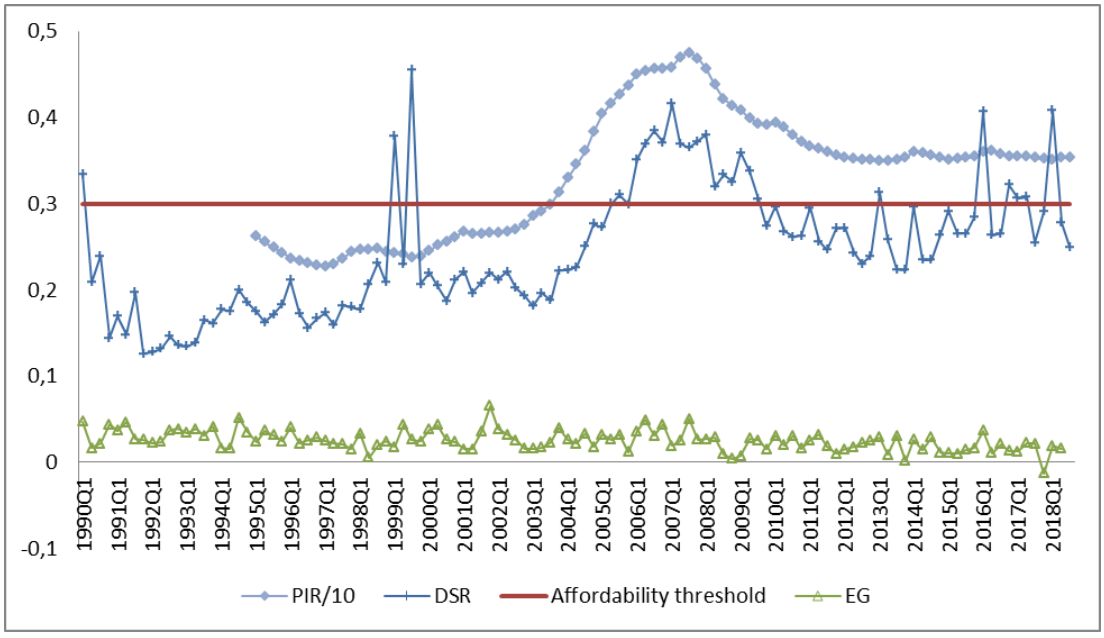

Figure 4-4: Housing Affordability (HA) against EG

The period was then followed by another higher growth from 2001Q1 - 2003Q3, during this period the PIR showed steady growth with DSR showing some stagnation. From 2003Q3 - 2007Q1, there was generally a positive real economic growth which corresponded to the period where there was rapid deterioration in housing affordability shown by both the PIR and DSR. The period from 2007Q2 - 2018Q3 has experienced largely negative real growth, which has slightly improved housing affordability as compared to when there was positive real growth during 2003Q3 - 2007Q1, however PIR shows that housing is still not affordable. On the other hand DSR show a different picture with more fluctuations and two very high levels in 2016Q1 and 2018Q1 at

40,7% and 40,8% respectively due to the drop in household disposable income. The graphical analysis shows the responsiveness of DSR and PIR to EG, however not always consistent.

4.2.2.3 Housing affordability against Mortgage Rate (MR)

The period 1990Q1 - 1999Q2 was largely defined by high mortgage rate reaching the highest level in 1998Q4 at 23,3% as indicated in Figure 4-5. For period 1999Q3 - 2002Q1 there was a sharp drop in the mortgage rate, this correspond with the period of the slight drop in PIR meaning that affordability was improved, however the DSR show two distinct rises meaning that housing was unaffordable during those two quarters.

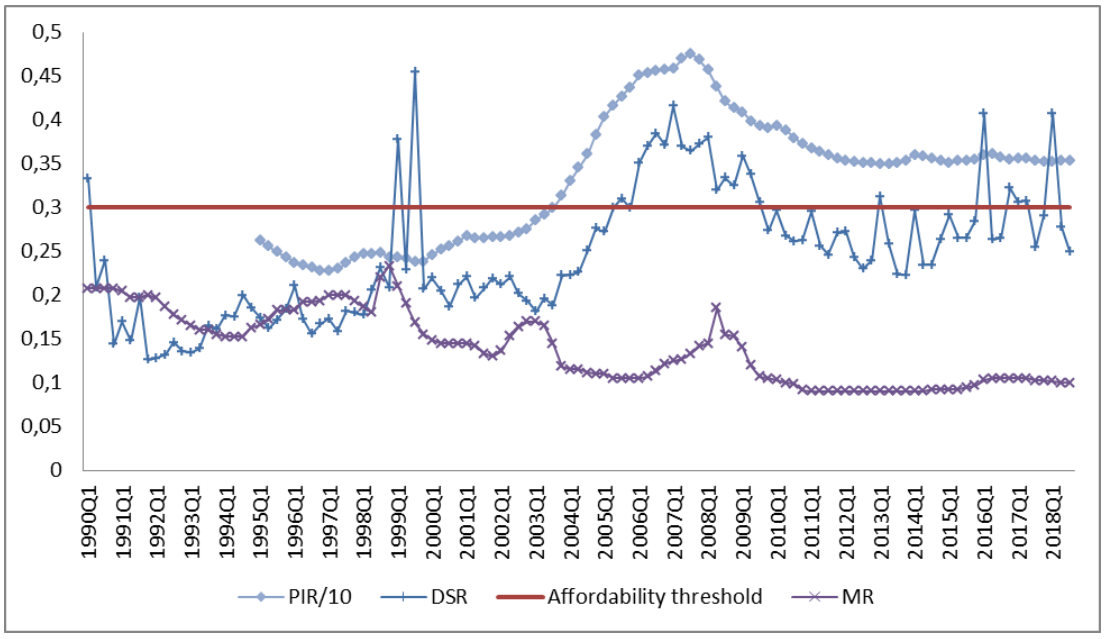

Figure 4-5: Housing affordability (HA) against MR

There was another sharp rise in mortgage rate from 2002Q2 - 2003Q1 which corresponds to the drop in DSR, however this sharp rise in mortgage rate correspond to a sharp rise in the PIR before passing the threshold in 2003Q4. In this particular instance, the PIR responded much better to increasing mortgage rate than DSR. This was in line with theory to say that when there is a rise in mortgage rate, the cost for housing is increased making them more expensive and the demand for housing decreases.

This was followed by a period 2003Q4 - 2005Q3 where there was a consistent drop in the mortgage rate leading to a sharp rise DSR reaching the 30% threshold in 2005Q3 signifying the beginning of housing unaffordability. The period 2006Q3 - 2008Q2 shows yet another sharp rise in mortgage rate which perpetuated the period for housing unaffordability even further as shown by both the PIR and DSR. This period is also largely marked by the global recession.

The period 2008Q3 - 2009Q2 show yet another sharp drop in the mortgage rate which correspond to the sharper downward slope of the PIR and DSR easing housing un-affordability before the mortgage rate reach a steady rate with small fluctuations for period 2009Q3 – 2018Q3. The graphical analysis shows the responsiveness of DSR and PIR to MR, however not always consistent.

4.2.2.4 Housing affordability against Unemployment Rate (UR)

The period 1994Q1 - 2003Q2 shows largely a steady consistent rise in UR reaching 29,3% in 2003Q2 just before the PIR went over 3.0 threshold in 2003Q4 as indicated in Figure 4-6. For that period it would seem that there is directly proportional relationship between in UR and housing un-affordability. This is in line with theory to say that unemployment reduces the income of the household hence making housing unaffordability level high more towards unaffordability.

That period was followed by the period showing improvement in UR for period 2004Q1 - 2007Q4 dropping from 26,4% to 21,1% before starting to steadily increase again from 2008Q1 (23,2%) to 2018Q3 (27,5%). The dropping of UR during 2004Q1 to 2007Q4 correspond with the period of the very steep rise in both the PIR and DSR, and the rise in UR seem to correspond with the downward slope of the PIR and DSR where there was easing in housing unaffordability. The graphical analysis shows the responsiveness of DSR and PIR to UR, with some consistency.

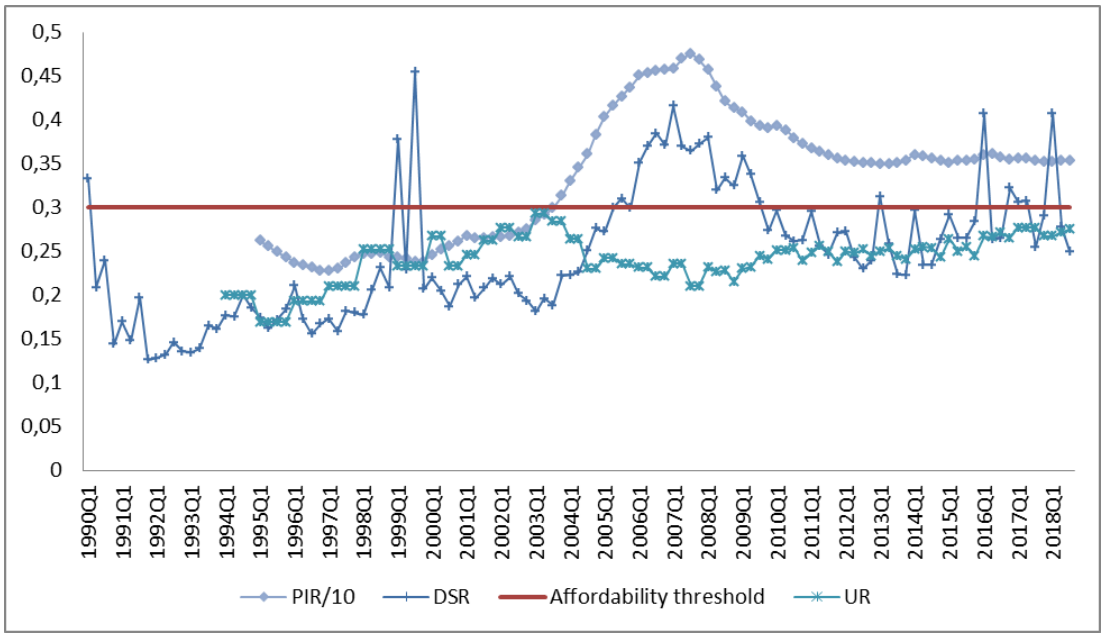

Figure 4-6: Housing Affordability against UR

4.2.3 Autoregressive Distributed Lag (ARDL) model results

4.2.3.1 Lag Length selection results

The optimal lag length on DSR and PIR was determined to be 2 for both housing affordability measures using the Schwarz information criterion (SC) which was shown to be the most appropriate information criterion based on the data, refer to Appendix 1.1 and Appendix 2.1. The Schwarz information criterion (SC) was selected because it has lower magnitude than the Akaike information criterion.

4.2.3.2 Primary ARDL regression model

The initial ARDL regression models were derived, refer to Appendix 2.2. Afterwards general model was subjected to the Wald Test (Woolridge, 2012) and systematically eliminating non-significant variables, final results are indicated in Table 4-4. These models are in agreement with the optimal lag length. The ARDL models somewhat confirms what was reveled in section 4.2.1 regarding the direction or sign of the relationship of housing affordability (HA) measures and the independent variables. The results show that HPI significantly affects the DSR and PIR for which the correlation

coefficient was deemed moderate and the other variables weak to negligible. The HPI sign of the correlation corresponds to the expected sign for both DSR and PIR for current period t. However the first lag (-1) contradicts the expected sign, but the second lag also give the expected sign.

The ARDL models show that the economic growth is significant at 5% level on the PIR model. The PIR also explains 99,9% of the variations whereas DSR only explains 67% of the variations in housing affordability. Both DSR and PIR have a Durbin Watson statistic of close to 2.0, which is indicative of no autocorrelation (Pesaran et al., 2001).

Table 4-4: ARDL Models for housing affordability forecast

	Autoregressive Models	
	DSR	**PIR**
Constant	0,043***	0,032**
HA(-1)	0,315***	1,473***
HA(-2)	0,421***	-0,482***
HPI	0,006*	0,045***
HPI(-1)	-0,006*	-0,064***
HPI(-2)	-	0,019***
EG	-	-0,511**
R-squared	0,676	0,999
Adjusted R-squared	0,664	0,999
F-statistic	56,420	18301,570
Prob(F-statistic)	0,000	0,000
Schwarz criterion	-3,304	-4,651
Akaike info criterion	-3,424	-4,841
Durbin-Watson stat	2,018	2,041

*HPI- house price; EG – economic growth; HA-Housing affordability; ***significance at 1%; **significance at 5%; * significance at 10%*

4.2.3.3 Co-integration Test Results

The Bound Test on the DSR model couldn't conclude if there is co-integration because the F-statistic is between the lower bound I(0) and the upper bound I(1) at 5% significance (Woolridge, 2012). The PIR model on the other hand was found to have co-integration because the F-statistic is greater than the upper bound I(1) at 5% significance as shown in Table 4-5.

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Table 4-5: Bound co-integration Test Results

		5% significance		
	F-statistic	I(0)	I(1)	Co-integration
DSR	5,37	4,94	5,73	Inconclusive
PIR	6,57	3,79	4,85	Yes

Further tests for co-integration using the Johansen co-integration test were conducted. The result on Table 4-6 show that there is no co-integration on the DSR due to the Trace statistic and Max-Eigen being lower than the critical value at 5%. The results also reiterated co-integration on the PIR model because both the Trace statistic and Max-Eigen statistic are greater than critical value at 5%. This means that the DSR model is a short-run model and it is complete as it is. However the PIR is a long run model and required the error correction term.

Table 4-6: Johansen co-integration Test results

No. of CE(s)	Trace Statistic	Critical Value at 5%	Max-Eigen Statistic	Critical Value at 5%	Decision
DSR					
None	9,638718	15,49471	8,855144	14,26460	No Co-integration
At most 1	0,783574	3,841465	0,783574	3,841465	No Co-integration
PIR					
None *	54,52056	29,79707	38,73831	21,13162	Co-integration
At most 1 *	15,78225	15,49471	15,68210	14,26460	Co-integration
At most 2	0,100148	3,841465	0,100148	3,841465	No co-integration

The long-run model for PIR was estimated using ARDL but with the error correction model (ECM) estimated using the Ordinary Least Squares (OLS). The ECM (-2) has a coefficient of -0.339, this implies that approximately 33.9% of the disequilibrium from the previous period converges back to the long-run equilibrium of the current period.

Table 4-7: Final ARDL models for housing affordability

	Autoregressive Models	
	DSR	**PIR**
Constant	0,043***	-0,0012
HA(-1)	0,315***	0,5202***
HA(-2)	0,421***	0,406***
HPI	0,006*	0,042***
HPI(-1)	-0,006*	-0,015*
HPI(-2)	-	-0,026***
EG	-	-0,424***
ECT	-	-0,339
R-squared	0,676	0,917
Adjusted R-squared	0,664	0,910
F-statistic	56,420	131,390
Prob(F-statistic)	0,000	0,000
Schwarz criterion	-3,304	-4,557
Akaike info criterion	-3,424	-4,778
Durbin-Watson stat	2,018	1,971

*HPI- house price; EG – economic growth; HA-Housing affordability; ***significance at 1%; **significance at 5%; * significance at 10%, ECM-error correction tem*

From the regression results in Table 4-7, it seems the HPI is a dominant variable in housing affordability, and this correspond to the results found in section 4.2.1 using the pearson correlations. The long run ARDL model for PIR has a Durbin Watson statistic of 1,971 very close to 2, indicating no autocorrelation. Similarly the sign of coefficient of HPI at current time correspond to the expected sign, but the first (-1) and second lag (-2) did not. The coefficient of EG also does not correspond to the expected sign. The PIR ARDL long run model explains 91% of the variations, which is, still better that the DSR short run model with no co-integration.

Based on the results for answering hypothesis-2, this study rejects hypothesis-2. The first part of the results reveal HPI as the main driving force of housing unaffordability, and with the consistent correct expected sign. The other variables are simply weak to negligible, and have inconsistency revealing the correct sign. However the expected sign on EG can either be positive or negative depending on the magnitude of the change,

that being said it reveals the expected sign. Similarly, the regression models have also indicated that the current HPI coefficient is significant with the expected sign. This means that when the housing price increase, the housing affordability measure increases towards the un-affordability region, and there is a general deterioration in affordability and more and more people can't afford housing.

4.2.4 Validity of the Models

The regression models were checked for serial correlation and stability over time. Table 4-8 present the Breusch-Godfrey Serial Correlation LM results at two lags, serial correlation was not detected for both models. Both models are stable with the 5% critical boundary line as indicated by the recursive residual (CUSUM) and the CUSUM of Square stability graphs in Figures 4-7 and Figure 4-8 below. These results also support the Durbin Watson statistics as discussed in the previous section showing that there is no autocorrelation.

Table 4-8: Breusch-Godfrey Serial Correlation LM Test results

DSR	Null hypothesis: No serial correlation at up to 2 lags			
	F-statistic	1.435629	Prob. F(2,106)	0.2426
	Obs*R-squared	2.980145	Prob. Chi-Square(2)	0.2254
PIR	Null hypothesis: No serial correlation at up to 2 lags			
	F-statistic	0.821802	Prob. F(2,83)	0.4432
	Obs*R-squared	1.805868	Prob. Chi-Square(2)	0.4054

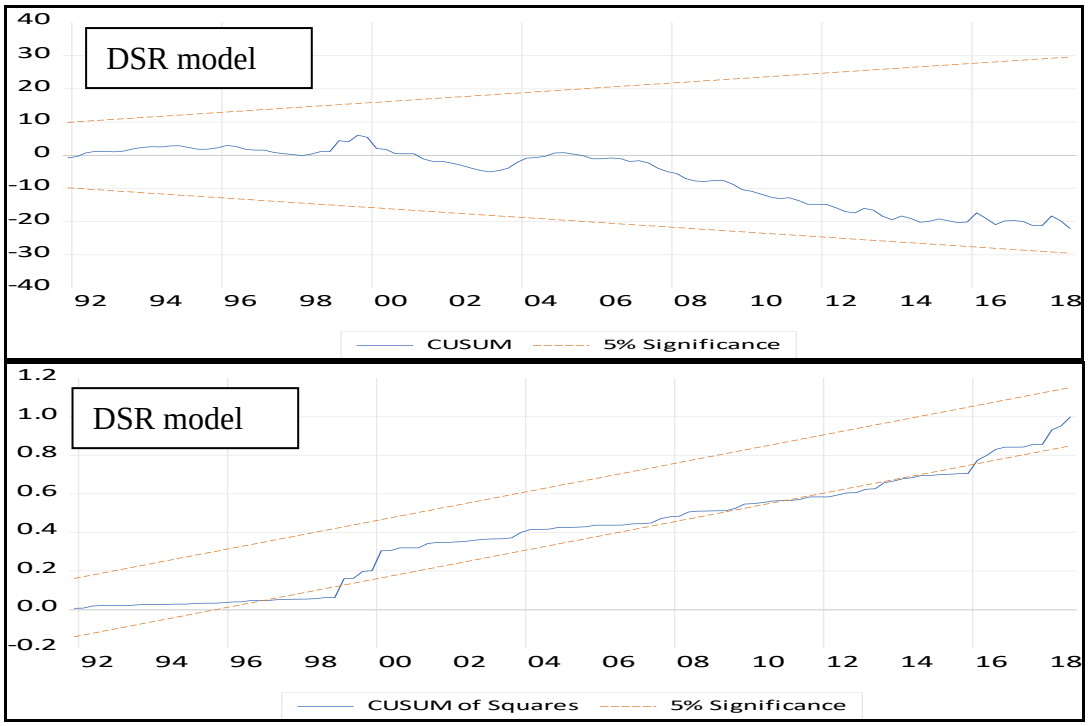

Figure 4-7: DSR Cumulative sum of recursive residual (CUSUM) and CUSUM of squares

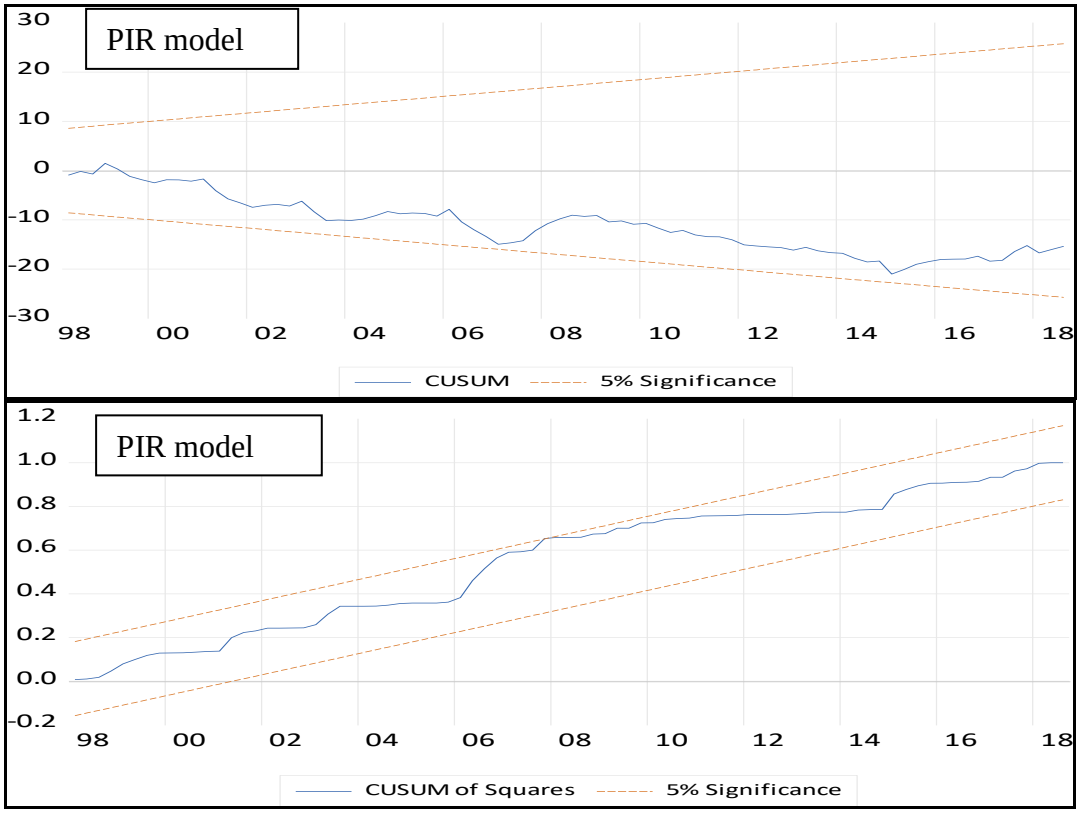

Figure 4-8: PIR cumulative sum of recursive residual (CUSUM) and CUSUM of squares

5 DISCUSSION OF RESEARCH FINDINGS

5.1 Introduction

This study focussed on finding out if there are any significant differences between the two housing affordability measures, the adjusted Debt-Service Ratio and Price-to-Income ratio. In Chapter 1, the study highlighted the critical importance of getting an accurate housing affordability measure as it can help point towards effectively improving the issue. The previous chapter focused on presenting the research findings with an attempt to answer the two research questions and the derived hypothesis. This current chapter focusses on providing context and making sense of the results from hypothesis 1 and hypothesis 2.

5.2 Discussion of results regarding Hypothesis 1

The research findings regarding hypothesis 1 have shown that PIR has an advantage over the adjusted DSR in consistently paralleling other housing affordability data statistics, especially the banking sector data. The DSR also tends to underestimate housing affordability, and this can be seen as more risky to society than a measure that tends to closely-estimate or overestimate the socioeconomic situation. More harm could come from underestimating the situation as it might lead the policy makers not to act believing that all is good. Whereas the effects of over-estimation, may not be as severe to the society as compared to those where under-estimation is the case.

The comparison with regards to the impact that housing policy had on PIR and DSR, has generally revealed that the two moved in-sync and are impacted in a similar way except in the last period under President Zuma, but the DSR showing wider fluctuations than the PIR. The breakdown of different political periods also highlighted key factors on the responsiveness of DSR and PIR to policy per period.

De Klerk period (1990Q1- 1994Q1):

The end of apartheid, on average, marks the period where the DSR had the lowest level ever, meaning that housing was mainly affordable. Unfortunately, the PIR for the period could not be found for comparison purposes. Putting it into context, this was also the period when the majority of the population was politically excluded from the economy however major shifts were being implemented towards democracy. The major housing policy was the Capital Subsidy Scheme by the Independent Development Trust (Nell and Rust, 1993) as indicated in Chapter 2.

Mandela period (1994Q2 – 1999Q1):

The rise of democracy during the leadership of President Mandela, was marked by a slight increase in DSR, and the data for the PIR was also available for comparison. As indicated in Chapter 2, the government was pushing for overall inclusion of black South Africans, and still suffering from remnants of the past. That fact could explain why the sudden increase in DSR, but still within the affordability region. The key housing policies included the introduction of White Paper guidelines for low income earners and the signing of record of understanding with the banks to finance low-income earners (Housing White Paper, 1994), this explains why there was a generally lower mortgage rate and improvement in economic growth. However, since there is a time lag between policy implementation and its impact, the effects may only be seen after a certain period long before perhaps flowing into the next political period. Our research did not determine the time frame to start seeing the effects of the implemented policy.

Mbeki period: (1999Q2- 2004Q1) and (2004Q2 - 2007Q1)

During the first term of President Mbeki leadership, on average there was an in sync rise in both PIR and DSR, but DSR showing a larger standard deviation during the period, meaning larger deviations, and also the DSR showed a larger change from the Mandela period than the PIR. During this period there was an introduction of the FLISP policy for households earning R3500 – R15000, and it is also possible that the effects of the policy introduced during and prior Mandela period were also creeping in and the effects becoming apparent. Overall during this period there was a further deterioration in

housing affordability, perhaps indicating that the policies did not work very well as it was hoped for, perhaps due to other economic factors.

The second Mbeki period has seen the largest deterioration in housing affordability; the period corresponded with the Breaking New Ground Policy (Adebayo, 2011). The period propelled South Africa into the housing un-affordability region as indicated by both the DSR and PIR, however with larger fluctuations on DSR. The BNG policy was not a success on a number of fronts including the housing non-durability and poor workmanship (Mkuzo et al., 2019). Buys and le Roux (2013) state that "low cost houses from the BNG were not strong; suffered from cracks and they compromised the health and safety of occupants." The life span of such houses are very short and may require more repairs costing the occupant even further money on the house. Though no established direct link, but that may be one of the contributing factors that led to housing unaffordability and can be researched further.

Motlanthe period (2007Q2- 2009Q1):

For a brief period president Motlanthe was brought in to take over from president Mbeki after he was forcefully removed as president by his political party. The period is marked by an even further deterioration in housing affordability levels, and slump in real economic growth, but we also note that the period was marred by the 2007-2009 Global Financial Crisis. No significant new policy was introduced during the two years for housing affordability policy.

Zuma period (2009Q2 – 2014Q1) and 2014Q2 – 2018Q3

This period showed a significant improvement in housing affordability after the highest levels experienced during the Mbeki period. In this period the DSR show levels below the threshold, but PIR still being in the un-affordability level. The period is marked by the re-launch of FLISP with revised maximum salary from R15000 to R20 000 (Aurengroup, 2018). One could say that the revised FLISP had somewhat contributed positively to the housing affordability, and the effect in improvement seem to have continued into the second Zuma term.

5.3 Discussion of results regarding Hypothesis 2

The Pearson correlation was consistent in revealing that housing price (HPI) is positively moderately correlated to both DSR and PIR, this was consistently in agreement with the expected sign as highlighted in literature. This makes the HPI the most critical variable out of the four in relation to housing affordability followed by economic growth and mortgage rate (MR), however MR is not always consistent with DSR and PIR, whereby it recorded low negative degree of association and moderate degree of association respectively. This was in line with the regression models on DSR and PIR whereby the housing price (HPI) seem to have a major impact on the magnitude of the housing affordability measure and recording high significance levels both in the short and long-term. The other variables had a negligible degree of association. With the increase in housing prices, the housing affordability measure tends to go up towards the affordability threshold, meaning that there is deterioration in affordability.

In the South African context, it means that when policy makers want to make an impact and improving affordability, HPI is the critical variable to look closely into. There has to be more regulation regarding control of the housing prices and household income, together with the control of mortgage rate. It would seem that low mortgage rate (MR) on an already highly priced house does not have a significant impact as it is economically hoped for, and this was apparent in the data which seem to contradict the available literature. However, that has a lot to do with the structure of the economy of South Africa, and the elasticities of supply and demand curves. For example, when dealing with high unemployment problem the concept of labour supply elasticity becomes of critical importance. When elasticity is less than 1 ($e<1$), then the increase in wages will increase household income, however when elasticity is greater than 1($e >1$) the increase in wages reduces the household income due to high unemployment. For a country such as South Africa, it would be more beneficial to have more people employed and paid relatively lower wages than having less people employed and paying them relatively higher wages. And that comes directly from the kind of labour supply elasticity that the country has, which may be different from first world countries from which most literature and studies come from. The concept becomes critical in the discussion regarding the minimum wage for the country.

The Mbeki period tried to remedy the situation of high housing prices by providing low cost housing through the introduction of BNG policy (Adebayo, 2011), but its downfall was in its implementation and the appointment of incompetent contractors to build which led to low quality housing (Mkuzo et al., 2019). The provision of low cost (price) housing will go a long way in making an impact on housing affordability, as it was seen in the DSR and PIR results. The country need creative ways in making that happen together with competent political leadership.

Though the PIR show some responsiveness to economic growth (EG), on average the growth was lower at 2,5% during the period, which seem to have not done much to have impact on job creation where unemployment rate (UR) remained relatively high averaging 24,1% over the period. According to the National Development Plan (NDP), the country GDP has to be growing by at least 5% to make an impact on unemployment and poverty (NDP, 2012) which will result in positive spins in overall socioeconomic challenges including housing un-affordability.

6 SUMMARY CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

6.1 Summary

This chapter summarises the findings of the research, it then give recommendations and conclusion. Furthermore, it gives suggestions for further research.

The main objective of the study was to assess the reliability of the adjusted Debt Service Ratio (DSR) model in the South African context and compare the output with that of the widely used Price-to-Income (PIR) housing affordability measure. The adjusted DSR was developed and proposed in developed countries as an alternative to measuring housing affordability, and had not yet been assessed within the South African context. Many South Africans still have trouble in affording housing and we can only be confident of the data only when the housing affordability measure is reliable and consistent. Measuring of housing affordability is indeed crucial as it can help guide housing policy direction.

The adjusted DSR as a housing affordability measure gave a more defined depiction of housing affordability than the unadjusted mortgage debt service payment (MDSR) because it takes into account other financing costs related to mortgage, it corrects for household income changes and net financing cost of the mortgage loan thereof giving a refined calculation for housing affordability. The results also showed that the PIR was the better measure of housing affordability than both unadjusted MDSR and adjusted DSR.

The PIR has shown to accurately parallel other banking sector data regarding housing affordability, whereas the adjusted DSR tends to underestimate housing affordability. That result is important due to the risk associated with underestimation of the economic situation, which could have many dire and serious effects. Taylor (2008) highlights how the underestimation of the risk associated with putting the adjustable-rate subprime and other mortgages into complex mortgage-backed securities by the rating agencies was at the core of what led to the Global Financial Recession of 2007-2009. Quantitatively

underestimating the situation may lead to ineffectively acting on the situation, and that is the major shortcoming with the adjusted DSR.

Housing policy intervention over the years has mainly shown not to be effective in addressing housing unaffordability, the problem seems to be complex and multi-layered. One of this research main finding was the significant degree of association between housing prices and affordability; on average, the housing prices are too high for an economy such as South Africa. The country is still struggling with high levels of unemployment, inequality and poverty, which are more closely related to the economic growth. As mentioned before, according to the NDP the GDP is supposed to grow by at least 5% per year, and over the period it has not. For an economy that is not growing at the level that is supposed to be growing to create sufficient jobs, it would seem that providing low cost housing to be a positive policy in the short to medium term. This policy was implemented by President Mbeki but did not yield expected results due to poor implementation.

Another important finding was that reducing the repo rate, linked to interest rate and mortgage rate to stimulate affordability, seem not to be that effective in an economy like South Africa with a number of socio-economic challenges. Perhaps that technique works well in the developed countries where the adjusted DSR model was developed.

6.2 Recommendation and Conclusions

The Price-to-Income ratio (PIR) reaffirmed its position as to why it is the widely used measure of housing affordability. In this study, it came through as a better and reliable measure of housing affordability and should take preference over the adjusted DSR. Getting an accurate measure of housing affordability is important, but effectively acting upon it is what makes the difference and it starts with credible leadership in government and private sector to grow the economy as stipulated in the National Development Plan.

The housing price has proven to be the major factor affecting housing affordability; there need to be a coordinated approach to provide affordable housing in South Africa. Providing government subsidy to low income and middle income earners is good, but has limited impact. One of the recommendations is for government to help sharply

increase the supply of good quality low cost housing, which will help put a downward pressure on the prices of newly developed houses. This can be done by establishing state capacity in the form of state housing entity or enterprise that drives and strictly focus on building and selling low cost housing, and abolish the tender system. The tender system seem to be counterproductive and has been abused and tends to overcharge the government and in most cases for sub-standard work. Government can establish construction across the country using this entity and due to the scale; they can take advantage of discounts in an open market for buying huge quantities of quality construction materials.

Lastly, the study recommends that the results of this research be taken into consideration when looking for alternative ways in formulating specific housing policy which should look broadly at the situation and take into consideration the role of unemployment rate, mortgage rate, housing price and economic growth, and especially housing prices.

6.3 Limitations and suggestion for further Research

The study was limited to comparison of essentially two measures of housing affordability to establish the accuracy and reliability over time in the South Africa context. One should take note that the study was solely focussed at the macroeconomic level, and does not reflect the effect of income and wealth inequalities created by apartheid. Hence, this study encourages further research to explore microeconomic study to incorporate the effect of wealth inequalities.

Secondly, this study encourages a comprehensive comparative study looking into all other housing affordability measures which includes the Composite Model, Rent-to-Income, Residual Income approach, PIR and standardized PIR to see which one is more consistent and reliable over time.

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APPENDICES

Appendix 1.1: Selection of Information Criteria

Table 6-1: Results for Information Criteria

	DSR	EG	UR	MR	HPI
DSR(-1)	0.061304	0.032901	-0.018025	0.013329	0.341763
	(0.10909)	(0.02608)	(0.03361)	(0.02376)	(1.27203)
	[0.56198]	[1.26145]	[-0.53639]	[0.56090]	[0.26867]
DSR(-2)	0.291867	0.024390	0.011168	-0.027280	-1.277935
	(0.10644)	(0.02545)	(0.03279)	(0.02319)	(1.24119)
	[2.74206]	[0.95834]	[0.34057]	[-1.17652]	[-1.02960]
DSR(-3)	0.268061	0.026165	-0.028852	-0.034050	-0.027276
	(0.11820)	(0.02826)	(0.03641)	(0.02575)	(1.37827)
	[2.26794]	[0.92585]	[-0.79237]	[-1.32243]	[-0.01979]
DSR(-4)	0.302420	0.032423	0.017715	-0.001889	-0.394042
	(0.11342)	(0.02712)	(0.03494)	(0.02471)	(1.32252)
	[2.66648]	[1.19566]	[0.50702]	[-0.07647]	[-0.29795]
EG(-1)	-0.481108	-0.094439	-0.042167	0.231717	-1.794722
	(0.45596)	(0.10902)	(0.14046)	(0.09933)	(5.31688)
	[-1.05516]	[-0.86626]	[-0.30020]	[2.33286]	[-0.33755]
EG(-2)	-0.950052	-0.133575	-0.047670	0.254586	-4.732210
	(0.46476)	(0.11112)	(0.14318)	(0.10125)	(5.41953)
	[-2.04417]	[-1.20204]	[-0.33295]	[2.51455]	[-0.87318]
EG(-3)	-0.796053	-0.126412	0.098626	0.049205	4.346510
	(0.50046)	(0.11966)	(0.15417)	(0.10902)	(5.83586)
	[-1.59063]	[-1.05643]	[0.63970]	[0.45133]	[0.74479]
EG(-4)	-1.374493	-0.257372	-0.037598	-0.036256	2.314202
	(0.45324)	(0.10837)	(0.13963)	(0.09874)	(5.28522)
	[-3.03258]	[-2.37495]	[-0.26927]	[-0.36720]	[0.43786]
UR(-1)	-0.632152	0.160006	0.791826	0.137147	-7.311395
	(0.37854)	(0.09051)	(0.11661)	(0.08246)	(4.41411)
	[-1.66998]	[1.76787]	[6.79015]	[1.66315]	[-1.65637]
UR(-2)	-0.270468	-0.205720	-0.041062	-0.026213	13.82121
	(0.48773)	(0.11661)	(0.15025)	(0.10625)	(5.68731)
	[-0.55455]	[-1.76411]	[-0.27329]	[-0.24672]	[2.43018]
UR(-3)	0.478270	0.143105	0.031999	-0.149270	-0.734054
	(0.48639)	(0.11629)	(0.14984)	(0.10596)	(5.67170)
	[0.98331]	[1.23055]	[0.21356]	[-1.40879]	[-0.12942]
UR(-4)	0.473758	-0.123733	0.132145	-0.065556	-2.832614
	(0.41387)	(0.09896)	(0.12750)	(0.09016)	(4.82614)
	[1.14469]	[-1.25038]	[1.03644]	[-0.72711]	[-0.58693]
MR(-1)	0.754379	0.037426	0.026647	1.023665	-16.92793
	(0.53463)	(0.12783)	(0.16470)	(0.11647)	(6.23429)
	[1.41103]	[0.29278]	[0.16179]	[8.78939]	[-2.71530]

MR(-2)	0.595687	-0.217799	-0.229615	-0.092143	18.40401
	(0.74069)	(0.17710)	(0.22818)	(0.16135)	(8.63714)
	[0.80423]	[-1.22983]	[-1.00629]	[-0.57106]	[2.13080]
MR(-3)	-0.403357	0.230095	0.320618	-0.035087	-15.26422
	(0.75625)	(0.18082)	(0.23297)	(0.16474)	(8.81860)
	[-0.53336]	[1.27252]	[1.37620]	[-0.21298]	[-1.73091]
MR(-4)	-0.586609	-0.305004	-0.055145	0.072232	10.01058
	(0.55450)	(0.13258)	(0.17082)	(0.12079)	(6.46598)
	[-1.05790]	[-2.30053]	[-0.32282]	[0.59797]	[1.54819]
HPI(-1)	0.016011	-0.004581	0.000903	0.001141	2.391988
	(0.00895)	(0.00214)	(0.00276)	(0.00195)	(0.10442)
	[1.78809]	[-2.13984]	[0.32752]	[0.58495]	[22.9080]
HPI(-2)	-0.036763	0.011642	-0.004140	-0.004114	-2.458109
	(0.02095)	(0.00501)	(0.00645)	(0.00456)	(0.24432)
	[-1.75461]	[2.32383]	[-0.64138]	[-0.90145]	[-10.0610]
HPI(-3)	0.040911	-0.010070	0.004886	0.006708	1.597609
	(0.02103)	(0.00503)	(0.00648)	(0.00458)	(0.24518)
	[1.94578]	[-2.00306]	[0.75438]	[1.46453]	[6.51611]
HPI(-4)	-0.020341	0.002585	-0.001576	-0.003641	-0.533997
	(0.00885)	(0.00212)	(0.00273)	(0.00193)	(0.10320)
	[-2.29837]	[1.22173]	[-0.57799]	[-1.88838]	[-5.17422]
C	0.046087	0.080159	0.014338	0.019645	0.515139
	(0.08382)	(0.02004)	(0.02582)	(0.01826)	(0.97746)
	[0.54981]	[3.99957]	[0.55526]	[1.07581]	[0.52702]
R-squared	0.721209	0.441862	0.829284	0.958361	0.999911
Adj. R-squared	0.645861	0.291014	0.783144	0.947107	0.999887
Sum sq. resids	0.122462	0.007001	0.011622	0.005812	16.65197
S.E. equation	0.040680	0.009727	0.012532	0.008862	0.474370
F-statistic	9.571611	2.929187	17.97336	85.15899	41619.88
Log likelihood	181.2578	317.1917	293.1157	326.0358	-52.08512
Akaike AIC	-3.373849	-6.235614	-5.728753	-6.421807	1.538634
Schwarz SC	-2.809308	-5.671073	-5.164211	-5.857266	2.103175
Mean dependent	0.262203	0.023919	0.242537	0.131228	77.03433
S.D. dependent	0.068359	0.011552	0.026912	0.038533	44.64140

Determinant resid covariance (dof adj.)	3.33E-16
Determinant resid covariance	9.55E-17
Log likelihood	1078.169
Akaike information criterion	-20.48777
Schwarz criterion	-17.66507
Number of coefficients	105

Appendix 2.1: Optimal Lag Length Determination

Table 6-2: Optimal Lag Length on DSR

Sample: 1990Q1 2018Q3
Included observations: 91

Lag	LogL	LR	FPE	AIC	SC	HQ
0	385.4754	NA	1.61e-10	-8.362096	-8.224137	-8.306438
1	885.9501	934.9528	4.66e-15	-18.81209	-17.98433	-18.47814
2	967.5344	143.4449	1.35e-15	-20.05570	-18.53815*	-19.44346
3	994.0732	43.74530	1.32e-15	-20.08952	-17.88217	-19.19899
4	1041.417	72.83714	8.28e-16	-20.58060	-17.68345	-19.41178
5	1082.391	58.53346*	6.06e-16*	-20.93166*	-17.34472	-19.48456*
6	1100.334	23.66090	7.52e-16	-20.77656	-16.49982	-19.05116
7	1123.360	27.83407	8.56e-16	-20.73319	-15.76665	-18.72950
8	1155.909	35.76862	8.18e-16	-20.89911	-15.24278	-18.61713

Table 6-3: Optimal lag Length on PIR

Sample: 1990Q1 2018Q3
Included observations: 87

Lag	LogL	LR	FPE	AIC	SC	HQ
0	196.5907	NA	8.41e-09	-4.404384	-4.262665	-4.347318
1	910.8924	1330.079	1.11e-15	-20.25040	-19.40009	-19.90800
2	989.3219	137.0264	3.25e-16	-21.47867	-19.91976*	-20.85094*
3	1012.124	37.21643	3.47e-16	-21.42813	-19.16063	-20.51507
4	1044.131	48.56358	3.04e-16*	-21.58923	-18.61313	-20.39084
5	1070.029	36.31556	3.11e-16	-21.60985	-17.92516	-20.12614
6	1092.565	29.01240	3.53e-16	-21.55322	-17.15993	-19.78418
7	1113.344	24.36130	4.30e-16	-21.45618	-16.35430	-19.40181
8	1152.092	40.97570*	3.61e-16	-21.77224*	-15.96177	-19.43254

Appendix 2.2: General ARDL before Wald Test

Table 6-4: DSR general ARDL model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DSR(-1)	0.272033	0.097017	2.803975	0.0062
DSR(-2)	0.423562	0.095264	4.446205	0.0000
EG	-0.001577	0.431550	-0.003655	0.9971
UR	-0.207290	0.189105	-1.096162	0.2759
MR	0.332998	0.245695	1.355332	0.1787
HPI	0.009794	0.004406	2.223144	0.0287
HPI(-1)	-0.009349	0.004325	-2.161420	0.0333
C	0.039807	0.068265	0.583123	0.5613

R-squared	0.614769	Mean dependent var	0.259062
Adjusted R-squared	0.585136	S.D. dependent var	0.068723
S.E. of regression	0.044264	Akaike info criterion	-3.319912
Sum squared resid	0.178300	Schwarz criterion	-3.110205
Log likelihood	172.3356	Hannan-Quinn criter.	-3.235064
F-statistic	20.74603	Durbin-Watson stat	2.082407
Prob(F-statistic)	0.000000		

Table 6-5: PIR general ARDL model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
PIR(-1)	1.484120	0.095092	15.60712	0.0000
PIR(-2)	-0.493937	0.094830	-5.208631	0.0000
EG	-0.455051	0.218711	-2.080608	0.0406
EG(-1)	0.370146	0.211807	1.747569	0.0842
UR	0.103309	0.110748	0.932831	0.3536
MR	0.144955	0.117301	1.235754	0.2200
HPI	0.046864	0.003855	12.15777	0.0000
HPI(-1)	-0.066819	0.009157	-7.296715	0.0000
HPI(-2)	0.019813	0.006435	3.078989	0.0028
C	-0.031915	0.042612	-0.748968	0.4560

R-squared	0.999264	Mean dependent var	3.366853
Adjusted R-squared	0.999185	S.D. dependent var	0.716651
S.E. of regression	0.020464	Akaike info criterion	-4.838965
Sum squared resid	0.034760	Schwarz criterion	-4.566642
Log likelihood	235.0119	Hannan-Quinn criter.	-4.729009
F-statistic	12526.87	Durbin-Watson stat	2.126256
Prob(F-statistic)	0.000000		