



**UNIVERSITY OF
KWAZULU-NATAL** TM

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**Impact of country risk and macroeconomic factors on South African housing market
segments under different regimes**

by

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**A thesis submitted in fulfillment of the requirements for the degree of Master of
Commerce**

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DECLARATION

I **Mandy Khumalo**... declare that:

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ACKNOWLEDGEMENTS

“But thanks be to God! He gives us the victory through our Lord Jesus Christ”

~ 1 Corinthians 15:57 Amen.

First and foremost, I am thankful to the Almighty God for blessing me with the opportunity, strength, courage, and perseverance to pursue this study. Throughout this journey, the Lord Jesus Christ has been my rock and fortress and it would have been impossible to achieve this without His guidance. The journey was an exciting one yet challenging at the same time. I would like to extend my heartfelt gratitude to my supervisors, Dr. Bomi Nomlala and Mr. Hilary Muguto who have mentored me throughout this process. I thank you for using your knowledge and dedicating countless hours towards providing constructive feedback which always aimed at reaching the greater height and depth of my research. Thank you for continually motivating me to give it my best shot even when the journey got difficult. Without your continuous support, advice, guidance, and sincerity, this thesis would have not been possible.

I would like to pay special regard to my family whose love and support are with me in whatever I pursue. A special thank you goes to my loving mother Sibongile Khumalo and my prayerful grandmother Nomvuyo kaMajozini Khumalo for persistently supporting and encouraging me throughout my career. A big thank you goes to my supportive uncle Dumisani Khumalo who has supported me throughout this journey and always prayed for me. My gratitude is extended to my sisters in Christ who has prayed with me throughout the hardest times during this journey, Nothando Dlamuka and Bukeka Jiyane. Thank you to all my colleagues in the Discipline of Finance who have contributed to my journey in various ways especially Dami Oyetade and Lawrence Tunde.

Financial assistance provided by the Moses Kotane Institute in respect to the costs of this study is hereby acknowledged. This work is based on the research supported wholly by the Moses Kotane Institute.

LIST OF ABBREVIATIONS

AD	- Anderson-Darling
ADF	- Augmented Dicky-Fuller
AIC	- Akaike Information Criterion
AMH	-Adaptive Markets Hypothesis
APT	-Arbitrage Pricing Theory
CAPM	-Capital Asset Pricing Model
CFI	-Corporate Finance Institute
DW	-Durbin Watson
EMH	-Efficient Market Hypothesis
EMP	-Employment
ER	-Economic Risk
FR	-Financial Risk
GDP	-Gross Domestic Product
GSADF	-Generalized Supremum Augmented Dicky Fuller
HDI	-Household debt-to-disposable Income Ratio
HPI	-House Price Index
HQIC	-Hannan and Quinn Information Criterion
JB	-Jarque-Bera
KPSS	-Kwiatkowski-Phillips-Schmidt-Shin
LB	-Ljung-Box
LER	-Log of Economic Risk
LFR	-Log of Financial Risk

LM	-Lagrange Multiplier
LPR	-Log of Political Risk
M2	-Money Supply Growth Rate
MPT	-Modern Portfolio Theory
MS	-Markov regime-switching
MS2	-Money Supply Growth rate (M2)
MS-VAR	-Markov Switching Vector Autoregression
PP	-Phillips and Perron
PR	-Political Risk
RHPI	-Real House Price Index
RHPIL	-Real House Price Index for Large segment
RHPIM	-Real House Price Index for Medium segment
RHPIS	-Real House Price Index for Small segment
SADF	-Supremum Augmented Dicky Fuller
SARB	-South African Reserve Bank
SIC	-Schwarz Information Criterion
SK	-Shapiro-Wilk
STATSA	-Statistics South Africa
U.S	-United States

ABSTRACT

The housing property market in South Africa contributes to economic growth and attracts foreign investors, however, the market has fallen victim to price bubbles. Moreover, the South African housing market can be affected by various risk factors. The purpose of this study is to investigate and compare the presence of price bubbles across the South African housing segments, and to conduct an empirical analysis of the effects of country risk and macroeconomic factors on the South African housing market. The GSADF unit root test was employed to investigate the presence of price bubbles in the South African small, medium, and large houses. The Markov regime-switching of conditional mean model was used to evaluate the effects of financial, economic, and political risk factors of country risk on housing prices of different segments in bullish and bearish market conditions. The influence of macroeconomic factors namely, employment, households' debt-to-disposable income ratio, and money supply growth rate on different housing segments in bullish and bearish market conditions was examined using the Markov switching vector autoregressive model. The study was conducted based on 263 monthly time-series data from January 1995 to November 2016.

The results showed that there were five periods of explosive bubbles in the small housing segment, three periods of explosivity in the medium housing segment, and four periods of explosive bubbles in the large housing segment. In terms of the effects of country risk components on the three housing indices, it was found that the small house price index was significantly affected by economic risk in a bullish market condition whereas, the medium house price index was significantly influenced by financial risk and political risk in a bearish market condition. Moreover, the large house price index was significantly affected by financial risk and political risk in a bullish market condition. In terms of the impact of macroeconomic factors on housing prices, it was found that employment, household debt-to-disposable income ratio, and money supply growth rate have a significant influence on the three housing indices. This study concluded that the existence of price bubbles in the housing market differed across the three housing segments, and that the response of housing prices to shocks in country risk components and macroeconomic factors varied across the three housing segments and across the two market conditions. Therefore, this study presented the first comparison of price bubbles in the housing market and the response of the three housing segments to shocks in country risk components and macroeconomic factors in different market conditions.

Keywords: Housing price bubbles, country risk, macroeconomic factors, GSADF, Markov regime-switching model, Vector autoregressive model.

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CHAPTER 1: INTRODUCTION

1.1. Background

In many countries, the property market makes up the largest component of wealth as individuals hold most of their wealth in housing property rather than financial assets (Benjamin, Chinloy, & Jud 2004; Tsatsaronis & Zhu, 2004). The sector provides investors with diversification benefits (Olaleye, 2003). According to Markowitz (1952), diversification is minimizing the risk by not putting all eggs into one basket and likewise, in finance, these baskets are different assets such as property, stocks, and bonds. On the other hand, an investor can also minimize risk by diversifying within the asset class (Nystrom & Lind, 2012). Seiler (1999) asserts that the different methods of diversifying within property exist since the property is heterogeneous, meaning that it differs in property type, size, economic and geographic region.

There exist other factors aside from diversification that impact investment decisions on property and how these factors add value to their investments. These factors arise since the property market provides investors with hedging benefits against inflation (Benjamin, Sirmans & Zietz, 2001). According to Home Union (2021), hedging against inflation involves investing in an asset to increase or maintain its value over a period of time. Hence, investing in property is considered a hedge against inflation since house prices typically rise during times of inflation (Home Union, 2021). The property market also provides investors with stable income in the form of rental income (Roijhert & Ahlander, 2016).

The popularity of the property market investment amongst investors may explain why the subprime mortgage crisis that started in the United States was so catastrophic and why it spread to the entire world through contagion in the late 2000s (Bouchouicha & Ftiti, 2012). The significantly bullish period was due to the expansionary policies that the U.S government was following before the crisis increased the demand for houses. This caused an enormous increase in housing prices. As the housing prices continued to rise, it quickly turned into a housing bubble (Wachter, 2018). When the bubble burst, housing prices fell significantly. The crisis spread to other sectors of the economy and other countries via contagion¹ (Amadeo & Anderson, 2020).

¹ A contagion refers to a situation where a shock in a particular region or economy spreads out and affects others by price movements (The Economic Times, 2020).

In South Africa, housing prices increased from an average of R23 200 in 1975 to R358 700 in 2002 which represented an average of 11% increase (Luus, 2005). This increase was due to the annual average inflation of 11,5% in this period. The political and economic uncertainties that prevailed in South Africa before 1994 interfered with the housing market significantly. The Soweto student uprising brought about a huge impact on investor confidence and negatively affected economic performance. As a result, from the third quarter of 1976 to the fourth quarter of 1979, housing prices decreased by 22,4% (Luus, 2005).

Between 1981 and 1983, the property market held up well and peaked in the first quarter of 1984. However, house prices declined by not less than 42% during the period from mid-1984 until the end of 1987. From the end of 1986 to the end of 1991, housing prices kept pace with inflation. From 1992 through 1993, house prices continued to drop as investor confidence in South Africa dropped owing to the uncertainty about the country's political future. However, with the advent of a new era in early 1994, confidence was restored, and housing prices recovered due to changes in macroeconomic policies by the new democratic government (Luus, 2005).

In 1998, the property market started to recover on the back of lower interest rates and inflation, increased economic growth, and improved fiscal conditions (Luus, 2005). However, contagion effects from the Asian crisis caused a huge fall in the rand which caused the interest rate to rise swiftly by 7% during 1998. The house price boom started in late 1999 when the situation stabilised. In mid-2003, housing prices approximately doubled in nominal terms from their 1998 values. The housing boom resumed again from 2000 to 2006 which saw property prices increase by an average of 20% per annum, reaching a peak of 35.7% in October 2004 (Delmendo, 2019).

According to the Global Property Guide (2013), the boom in South Africa was driven by four main factors. Firstly, the bearish global developments coincided with the emergence of the black financially stable middle class supported by tax reliefs. Secondly, people who had placed funds offshore during the apartheid era brought their funds back and invested in South African property. Thirdly, there was an improvement in security and stability in the country which, in turn, improved business activities. Lastly, the Financial Sector Charter in 2003 saw improved growth in mortgage loans and this, combined with the 2006 increment of the capital gains tax exemption on primary houses and the lowering of transfer duties on properties, contributed to the increase in property prices in South Africa.

However, the housing boom of the early 2000s ended following the global financial crisis. The decline was also linked to the enactment of the National Credit Act in 2007, which aimed to lower the supply of mortgage loans. This fuelled interest rate increases and lowered purchasing power in the property market (Gil-Alana, Ave & Gupta, 2013). Nevertheless, prices of property somewhat recovered quickly as the South African Reserve Bank decreased interest rates twelve times from the start of December 2008 to 6% in September 2009 (Global Property Guide, 2012). Although property prices remained quite distressed up to the second quarter of 2009, they improved in all segments of the market when the interest rate decreases finally trickled into the system. The FIFA World Cup hosted by South Africa in 2010 also helped in reviving the South African property market (Gil-Alana, et al., 2013).

Despite this revival, Delmendo (2019) notes that between 2008 and 2018, property prices after adjusting for inflation dropped by approximately 4.8%. In the first quarter of 2019, the nominal housing price increased by 3.96%, which represents a 0.51% decline after adjusting for inflation. Pettinger (2019) asserts that this fall in property prices was symptomatic of a distressed macroeconomic environment. This assertion was drawn from various studies that have examined the impact of shocks in macroeconomic factors such as interest rates (Gasparėnienė, Remeikienė & Skuka 2016), money supply (Grum & Govekar 2016), employment rates (Olatunji, Wahab, Ajayi & Liman 2017), inflation and household debt-to-disposable income ratio (Sibanda & Mhlanga, 2013) on property prices.

Hence, macroeconomic factors are essential driving forces behind property price changes. The housing market has several particular features that may lead to different responses of housing prices to macroeconomic changes. According to Demary (2010), there are three transmission mechanisms between macroeconomic variables and property prices based on economic perception: (i) The interest rate approach is the situation when a contractionary monetary policy leads to a rise in mortgage rate which causes high costs of financing housing activities; (ii) The inflation approach is a situation when a rise in inflation may encourage or dampen housing projects, leading to an increase or decrease in housing prices.

Accordingly, the first scenario follows the view that the monetary authority is likely to respond to rising inflation by increasing interest rates. This will then lead to an increase in housing financing costs, which in turn decreases the demand for houses and hence house prices. In the second scenario, market participants believe that property is a good hedge against inflation. So, a rise in inflation encourages property investment since market participants try to protect their

wealth which increases property prices, and (iii) The output approach is when a positive shock on output increases a firm's labour demand which in turn raises household labour income. The increase in household labour income can be either invested in property or consumed in non-property goods.

Therefore, when the economy is booming, being employed qualifies someone for an affordable mortgage loan, and firms need more office space. This will then trigger the demand for property which leads to a rise in house prices. Household disposable income and employment changes are known to be on the high list of factors impacting the South African housing property market. Due to low economic growth in South Africa, both these factors have not shown significant growth since the mid-1980s (Luus, 2005). As noted by Luus, (2005), various factors influencing property prices in South Africa, i.e., lower interest rates could support house prices over the future.

Nevertheless, investments in foreign property markets have become popular among investors trying to improve the performance of their portfolios by under-priced assets. Accordingly, there has been growing attention towards the impact of country risk on housing property prices. This phenomenon can be defined as the possibility of a loss or uncertainty of earning the expected returns due to influences relating to the location of an investment in another country (Scott, 2020). According to Vengesai and Muzindutsi (2019), country risk has three components - political, economic, and financial and, as noted by Damodaran (2015), may differ significantly across countries as each component of country risk is linked to a host of factors.

Notably, the country risk rating is likely to be higher for developing nations compared to developed nations (Damodaran, 2015). The Political Risk Services provides numerical values (scores) of country risk for each country where the scores range from 0 to 100 are broken into categories, with high scores of 80-100 indicating very low risk and low scores of 0-49.9 indicating very high risk (The Political Risk Services Group, 2020). Therefore, in many developing countries, country risk is higher because the profitability and stability of foreign investments are difficult to guarantee and anticipate due to concerns linked to social upheaval, political risk, expropriations, and regulatory uncertainties (Campisi, 2016).

In South Africa, the three-country risk components namely; financial, economic, and political risks are frequent on the following occasions: high rate of corruption and low GDP growth of 1%; the downgrade to junk status in November 2017 as stated by Standard and Poor's Global Ratings after a notable cabinet reshuffle and, low trade and investment with high public debt

(Institute of Risk Management South Africa, 2017). According to Bartenstein (2020), these negative factors have resulted in a rise in the country risk of South Africa as the country was downgraded to junk status in 2020.

Housing price bubbles are usually undesirable developments due to the economic distortions that they may cause once they burst. According to Franken (2007), the housing price bubble is a sharp and unsustainable increase in house prices that attract speculators and buyers' intent on short-term profits. It is when the price of the property deviates from its intrinsic value for an extended period (Hattingh, 2006; Stiglitz, 1990). Property booms and bursts have been a frequent occurrence in the international economy (Bordo & Jaenne, 2002). A property boom refers to an extended and sustainable period of growth in property prices and, a property burst/crash is a liquidity crisis caused by sudden shocks to the market with falling house prices (Franken, 2007).

Housing bubbles create instability in the property market and can lead to a financial crisis as mortgage loans turn bad and market participants cannot repay. However, monetary policy rarely reacts or even may not react at all to an impending bubble, and the market crash may be difficult to contain with monetary policy alone as bubbles are mostly not detected (Luus, 2005). The wealth effect related to the bursting of the property market bubble may be more severe the higher the level of indebtedness in an economy. In South Africa, housing booms are comparable from a historical perspective in terms of the new democratic era from 1994 as the government introduced new housing policies which allowed low-income households to access mortgage loans (Rust, 2006).

The occurrence of booms and bursts in the housing market is driven by economic perspectives as stated by Agnello and Schuknecht (2011). Moreover, the boom in house prices is supported by several economic factors such as low inflation, growth in disposable income, low-interest rates, greater affordability, a decline in the household debt to disposable income ratio, an increase in domestic and foreign demand for housing (Du Toit, 2004b; Franken, 2007). Hence, it is important to acknowledge that the housing property market is influenced by many factors and that these factors drive the occurrence of market booms and bursts.

1.2. Problem Statement

There seems to be a consensus among researchers that country risk and macroeconomic factors have an impact on housing prices worldwide. This consensus is attributable to the noted fluctuations in the housing prices that corresponds to the variations in these factors (Lee, 2006; Sibanda & Mhlanga, 2013; Grum & Govekar 2016; Savva, 2018; Muzindutsi et al. 2020). According to Burger and van Ransburg (2008), the market for different house sizes behaves differently. Gupta, Jurgilas, and Kabundi (2010) found that the effects of monetary policy on each housing segment were different depending on the size of the property. On the other hand, Nneji, Brooks and Ward (2013) confirmed that the response of house prices to economic factors differs depending on whether the market is in a bullish or bearish market condition.

It is possible that the impact of country risk and macroeconomic factors on the South African housing prices of different sizes is less likely to be the same as each housing segment behaves differently in bullish and bearish market conditions. However, there is no consensus regarding the impact of these same factors on houses of different sizes under changing market conditions. This is drawn from the fact that studies did not take into consideration that different housing segments respond differently to shocks in macroeconomic and country risk factors under changing market conditions (Kwangware 2008; Simo-Kengne, Bittencourt & Gupta 2012; Sibanda & Mhlanga 2013; Muzindutsi, Jamile, Zibani & Obalade, 2020). The changing market conditions in the housing market are associated with increasing prices which is a bullish condition and decreasing prices which is a bearish market condition (Nneji et al., (2013).

If housing prices increase, the rise in house prices lowers demand for housing as it become less affordable to people. Moreover, homeowners fail to afford to pay off their mortgages and this affects banks, thus creating an economic problem (Baily, Litan & Johnson, 2008). According to the Absa House Price Index, from 2002 to 2020, house prices rose by approximately 62% (Delmendo, 2021). Moreover. As reported by Absa (2021), there was a housing boom in the South African housing market from 2000 to 2006 where house prices rose by an average of 20% per annum. These price rises peaked in October 2004 reaching an annual growth rate of 32.5% (Absa, 2021). When these bubbles burst, house prices fall significantly, resulting to widespread financial crisis (Baily, et al., 2008). An example of this would be the 2008 financial crisis.

The potential existence of price bubbles in the South African housing market is of concern as it could have adverse effects to the economy. Although Das, Gupta and Kanda (2011) tested for price bubbles in five housing segments and Patterson and Steenkamp (2017) tested for bubbles in three housing segments, none of these studies focused on price bubbles in the context of country risk and macroeconomic factors. Since housing prices differ according to size of the property, a comparison of housing price bubbles is essential. In addition, it is not clear whether the effects of country risk and macroeconomic factors under changing market conditions varies across the South African housing segments. Hence, the influence of country risk and macroeconomic factors on housing price bubbles across the small, medium and large houses needs to be examined.

1.3. Research objectives and questions

The aim of the study is to test for price bubbles in small, medium, and large houses and examine the effects of country risk components and macroeconomic factors on the three housing segments in bullish and bearish regimes.

In particular, the study seeks to:

1. identify the levels of price bubbles in the prices of small, medium, and large houses over the sample period;
2. investigate how country risk components affect prices of small, medium, and large houses in bullish and bearish market conditions, and;
3. examine how macroeconomic factors affect prices of small, medium, and large houses in bullish and bearish market conditions.

To address the above objectives, the study seeks to answer the following questions:

1. What is the level of price bubbles in the prices of small, medium, and large houses over the sample period?
2. How do country risk components affect prices of small, medium, and large houses in bullish and bearish market conditions?
3. How do macroeconomic factors impact the prices of the small, medium, and large houses in bullish and bearish market conditions?

The study makes three null hypotheses based on the three research objectives and questions stated above as follows:

1. H_{0a} : There are more price bubbles in large house prices relative to small and medium house prices because of higher investor attention on the former.
2. H_{0b} : The impact of country risk components on prices of the small, medium, and large houses differs across the three housing segments in a bullish and bearish regime.
3. H_{0c} : The effect of macroeconomic factors on prices of the small, medium, and large houses differs across the three housing segments in a bullish and bearish market condition.

1.4. Research significance

This study seeks to contribute to the existing body of literature focused on housing bubbles in South Africa and secondly, to fill the existing gaps in information on the effects of country risk components and macroeconomic factors on housing prices, paying particular attention to the small, medium, and large houses of South Africa. Previous international studies, such as Yumei and Dandan (2011), Xie (2016), Gorzen-Mitka (2018), and Monfared and Pavlov (2019) have only evaluated the influence that a single risk component- either financial, economic, or financial risk has on the housing market. To the author's knowledge, no study has collectively explored this effect.

With regards to the macroeconomic effects on the housing market, international studies such as Post and Berkhout (2014) and Grum and Govekar (2016) have examined the effects, however, this effect was not examined in consideration of changing market conditions. With regards to South African studies, only Muzindutsi et al., (2020) have explored the influence of country risk components; economic, financial and political risk on housing prices and, only Clark and Daniel (2006), Sibanda and Mhlanga (2014), and Akinsomi, Mkhabela and Taderera (2018) have investigated the effects of macroeconomic factors on housing prices. However, these effects were not appraised in changing market conditions such as the bullish and bearish regimes which this study aimed to do.

Information on housing price bubbles, country risk components, and macroeconomic factors will be beneficial to policymakers and banks, who will use the information to drive policy changes that will influence both the society and economy by reducing the formation and bursting of house pricing bubbles (Chang et al., (2016). The current lack of information about the effects country risk components and macroeconomic factors have on the housing market

hinders stakeholders' decision-making. Policymakers in the South African government can use the information to adjust variables such as property gains tax rates and interest rates to discourage speculators from buying and selling houses within short periods of time, which drive up house prices. Investors can use the information to better assess the value of houses within the three segments and make decisions keeping the existence of price bubble in mind. This study seeks to provide that information.

1.5. Methodology scope of the study

The investigation of the first objective of this study entailed employing the RTADF which included the Supremum ADF statistic (SADF), and the generalized SADF (GSADF). The RTADF method enables the testing of the presence of bubbles and the identification of the corresponding dates to the start and end of the bubble terms (Phillips, Wu & Yu, 2011). The results were analysed using the GSADF test as its test for the existence of multiple price bubbles in large, medium, and small houses, illustrating graphically the point of creation and bursting of house price bubbles. Furthermore, the study employed the Markov regime-switching model of conditional mean to achieve the second objective.

The model was relevant as it employed several structures to explain how housing prices of each segment behaved in different regimes and was able to show regime-specific connections between country risk components and each house price index. The Markov regime-switching model is mostly used in research that analyses bull and bear market conditions and has been said to be the most relevant model in achieving the second objective of the study. The Markov switching vector autoregressive (MS-VAR) model was employed in the study to achieve the third objective. The MS-VAR was used as it is commonly used in the housing market and has been employed to model house price cycles (Chowdhury & Madennan, 2014). Moreover, the MS-VAR employs the regime-dependent impulse response functions which were used in this study to examine the response of house prices of each segment on macroeconomic shocks.

1.6. Structure of the study

The structure of this study is organized into five chapters. Chapter 1 introduces the background of the study and discusses the problem statement which motivates this research study. Furthermore, the objectives and significance, as well as the methods of this study, are introduced in Chapter 1. Chapter 2 begins with various theories that explain the effects of macroeconomic and country risk factors on house prices as well as theory on house price bubbles. Chapter 2 also examines the existing literature on house price bubbles. The Chapter

further highlights the existing literature on the influence of country risk components and macroeconomic factors on housing property prices and point out the existing gaps which are addressed in the form of empirical analysis. The third chapter provides a detailed description of the data and the methods employed in the study. Subsequently, the fourth chapter presents the findings of the empirical models employed in the study as well as related discussions. Lastly, Chapter 5 provides a detailed conclusion with a discussion of the findings in the context of the research objectives. Moreover, the limitations of the study are revealed and recommendations for future empirical research are proposed in Chapter 5.

1.7. Summary of the chapter

Chapter 1 commenced with the background regarding the effects of country risk and macroeconomic factors. It provides an in-depth discussion of both the international and South African housing market as well bubble formation and burst in the housing market. It further elaborates upon the theories that dictate the reaction of the housing market to fluctuating country risk and macroeconomic factors and the continuous debate that prevails. The problem statement is then presented, which formed the basis for the study, and the research objectives and questions are mentioned. Thereafter, the research significance providing a detailed discussion as to why this study is relevant is presented. Lastly, the methodology scope, and structure of the study is then presented. The following chapter presents a more detailed discussion on the theoretical framework and international and local literature review that explains the existence of housing bubbles and the effects of country risk components and macroeconomic factors on the housing market.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The 2008 global financial crisis demonstrated the adverse effects of bursting of housing price bubbles to the economy (Baily et al., 2008). Since then, numerous studies (Case & Shiller, 2003; Agnello & Schuknecht, 2011; Yiu, Yu & Jin, 2012; Arayici & Pitros, 2016; Yip, Wong & Lim, 2017; Das et al., 2011; Chang, Liu, Aye & Gupta, 2016; Patterson & Skeenkamp, 2017) have been conducted on the existence of housing price bubbles in different countries, cities and housing segments. The literature presented in this review revealed the following phenomena of housing price bubbles: (i) indicators of the existence of price bubbles in the housing market, (ii) the connection between house prices and country risk and macroeconomic factors, (iii) housing segments where house price bubbles exist in South Africa and their sensitivity to country risk and macroeconomic factors (Sibanda & Mhlanga, 2013; Patterson & Steenkamp, 2017; Muzindutsi et al., 2020).

The aim of this literature review is to acquire further understanding of the underlying theories behind housing price bubbles, country risk and macroeconomic factors. The theoretical framework is used to elucidate theories relating to this study namely, the Efficient Market Hypothesis, behavioural finance (herding), Arbitrage Pricing Theory, Modern Portfolio Theory, and the Adaptive Market Hypothesis. The empirical literature review section explores the findings of previous studies that investigated the presence of price bubbles in the housing market and have also examined the effects of county risk and macroeconomic factors on housing prices. The empirical literature review is then used to determine the solidity of the theoretical framework.

2.2. Theoretical framework

This section commences with a detailed discussion that involved the theoretical basis surrounding housing price bubbles, country risk and macroeconomic factors. Firstly, the Efficient Market Hypothesis is identified which determined the effects it has on housing prices. Secondly, the behavioural finance theory with specific reference to herding is examined to determine why investors attributed irrational behaviour, thereby, implying that the housing market is inefficient. Following this, the Arbitrage Pricing Theory, Modern Portfolio Theory and the Adaptive Market Hypothesis are identified and a discussion is presented whereby the reasons surrounding the arguments of each theory are considered. Lastly, a concluding paragraph which contains a synthesis of the important findings of each theory and the effects it said to have on housing price bubble, country risk and macroeconomic factors is presented.

2.2.1. Efficient market hypothesis

The Efficient Market Hypothesis was developed by Fama (1965) who is of the view that asset prices reflect all available information, and it is not possible to beat the market. According to Fama (1965), the asset markets are efficient as they reflect all available information regarding the asset market or any other individual asset. According to Malkiel (2003), the EMH follows the assumption that asset prices adjust to fully reflect all relevant information indicating that the difference between asset prices and intrinsic values are minimal. Haung (2019) attests that many market participants analyse assets, meaning that, a number of competing investors who attempt to adjust the asset price hence, new information arrives randomly. Therefore, according to Malkiel (2003), the EMH is based on three assumptions, which gave rise to the three forms of EMH, namely the weak-form efficiency, semi-strong form efficiency, and the strong form efficiency.

The weak form efficiency is of the assumption that asset prices are a reflection of historical information only and when the change of these asset prices are random. The semi-strong form efficiency is of the assumption that asset prices only reflect all historical and public information available. Lastly, the strong form efficiency believes that asset prices reflect all available private and public information. (Banda, Hall & Pradhan, 2019). The weak form and the semi-strong form efficiency states that it is impossible to beat the market through fundamental and technical analysis respectively whilst the strong form efficiency states that it is impossible to beat the market through any means, either public or private information (Banda et al., 2019). In the context of the formation of housing bubbles, according to Karasu (2015), the formation of asset price bubbles should not be regarded as a mispricing factor but instead should be regarded as a constituent of the price. In contrast to the EMH theory, Karasu (2015) asserted that explosive bubbles that have significant impacts on the economy may still form even if all market agents have the same information.

2.2.2. Behavioural finance (herding)

Following the formation of the EMH, traditional finance had attempted to use this assumption to explain that market participants are rational. Hence, any new information regarding the asset is fully reflected in the asset price, which results in markets being efficient. Behavioural finance refers to the study of the impact of psychology on the behaviour of investors and the subsequent influence on markets. The development of behavioural finance by Tversky and Kahneman (1974) is viewed as one of the major critics of the EMH, as the theory stated that market agents are not always rational and they rarely behave according to the assumption made by traditional

finance, hence, making markets inefficient (Kishore, 2004). The herding of behavioural finance refers to the susceptibility of investors to imitate the doings of other investors (Cakan, Demirer, Gupta & Uwilingiye, 2019). A study conducted by Cakan et al., (2019) investigated the influence of herding behaviour on the South African housing market. The study found no indication of herd behaviour in the South African housing market. However, through the use of a two-regime Markov Switching model, it was found that herding was only evident during the high volatility regime.

When examined in terms of the housing price market, Cakan et al., (2019) revealed that housing price bubbles such as the U.S. housing bubble and the Dot-com bubble served as evidence against the EMH and in turn supported by Keynes perspective on the psychological effect on the investment decision making. However, despite the inability of Cakan et al., (2019) to prove that herd behaviour, in particular, has a direct connection with the housing market, it can be concluded that the dynamics of the market can indefinitely be explained by behavioural finance theories. A study conducted by Sinai, Todd, and Souleles (2005) confirms the findings by Cakan et al., (2019). The study by Sinai et al., (2005) employed the standard cost model with proxies for behavioural theories of house price growth to examine the impact of behavioural finance theories on the housing market in the U.S. The study confirmed that behavioural finance theories indeed do play a significant role in the housing market.

2.2.3. Arbitrage pricing theory

The Arbitrage Pricing Theory (APT) was developed by Ross (1976). It is a theory of asset pricing that holds that an asset's return can be anticipated with the linear relationship of an asset's expected return and the macroeconomic factors that affect the asset's risk (CFI Education Inc, 2015). Ross (1976) further asserts that the APT considers that asset prices are determined by multiple factors. These factors can be variables from the economy such as inflation, GDP, or activity market domain indexes, or any other relevant factors (Ajao, 2012; Luthra & Mahajan, 2014; Biachi, Guidolin & Ravazzolo, 2017). Arte (2017) explained further that the housing property value is affected by these variables and other similar variables.

This then reveals that, theoretically, macroeconomic factors and country risk components connect with house prices. In the context of this study and based on the APT, country risk components are considered as Macroeconomic variables as most macroeconomic factors are components of economic risk and financial risk (Muzindutsi et al. 2020). In addition to this, the APT offers investors a multi-factor pricing model for assets based on the relationship

between an asset's expected return and its risk (Ross, 1976) and permits the inclusion or analyses of several factors whether country risk or macroeconomic factors. (Geambaşu, Jianu, Herteliu, & Geambaşu, 2014). According to Zaighum (2014), the theory uses macroeconomic factors as a proxy for determining risks.

Moreover, the APT seeks to identify the fair market price for an asset that may be temporarily mispriced. The theory assumes that the market is less than always perfectly efficient, and hence occasionally results in assets being incorrectly priced for some time. However, as stated by the APT, the market should eventually correct the situation, moving the asset price back to its intrinsic value. The APT is an alternative to the Capital Asset Pricing (CAPM) introduced by Sharpe (1963), Linter (1965), and Mossin (1966). The CAPM is a single-factor model that allows investors to measure the riskiness of a single asset in a portfolio based on a beta coefficient (single-factor variable).

However, the APT opposed such an assumption as it states that the riskiness of an asset was dependent upon the unexpected changes in macroeconomic risk factors (Roll & Ross, 1984). Unlike the CAPM that only takes into account a single factor of risk of the asset, the APT looks at several macroeconomic risk factors that, following the theory, determine the risk and return of a specific asset (CFI Education Inc, 2015). These macroeconomic risk factors provide risk premiums for investors to consider because the factors carry a systematic risk that cannot be eliminated by diversifying. These factors are considered as unexpected effects which cannot be observed by investors and are not examined by investors when determining expected returns and hence not included in the price of the asset (Ross, 1976).

Although investors cannot diversify away from the systematic risk, the APT states that investors can diversify their portfolios but they will choose their risk profile and return based on the sensitivity of macroeconomic risk factors and premiums. By following the APT and understanding the various systematic risk factors that affect an asset, investors protect themselves against risk factors to which the market is sensitive and can construct an optimal portfolio to achieve their desired risk profile and return (Ragheb, Sakr & Gebeily, 2016). Estimation of systematic risk factors such as macroeconomic risk factors is essential to both investors and policymakers as it allows them to identify specific factors affecting property prices and can therefore be used as the basis for decisions on approaches to be used in making investments decisions in the property market.

The point of applying the APT to the property market is to form a portfolio of investments that provides predictable returns to investors and allows them to understand factors that affect their investments in property. The APT shows that macroeconomic factors affect the property market through exogenous variables which are uncontrollable (Arte, 2016). This is because the risk connected with property investments is mostly systematic (country risk and macroeconomic factors) which cannot be diversified away (Berk, 2016).

The APT assists in examining the impact of country risk and macroeconomic factors on house prices. Compared to the CAPM, the APT replaces a single-factor that is the market changes with multiple influence factors, each with a different impact over the asset price. A beta coefficient is calculated for each factor, which shows the influence of that factor over the asset price (Geambaşu et al., 2014). The APT allows this study to decompose the effects of the economic changes in real influencing variables such as country risk and macroeconomic factors on housing prices. The application of the APT will assist investors in understanding the modification induced by the change in country risk components and macroeconomic factors over the evolution of housing market security included in their portfolio.

2.2.4. Modern portfolio theory

Country risk components and macroeconomic variables are other expect being examined in this study. Country risk can be referred to as the risk of an undesirable expected return in a foreign or cross-border investment that is not present in local investments (Meldrum, 2000). The components of country risk are economic risk, financial risk, and political risk. In light of the above, an underlying theory that links country risk components and macroeconomic factors with housing prices are the Modern Portfolio Theory (MPT). The MPT was established by Markowitz (1952) on the idea that a portfolio of assets can be formed to maximise expected returns given a certain level of risk in the market. Markowitz (1952) further states that investors who are risk-averse form portfolios to enhance anticipated returns. In addition to this, the MPT reveals that taking on a greater level of uncertainty results in greater returns (Markowitz, 1952). According to Smith (2021), one of the most conspicuous ways of diversifying a portfolio includes investing in different industries.

In support of this notion, Little (2020) states that a portfolio contains a combination of four types of assets, namely equities (stocks), bonds, money market, and cash equivalents instruments, and real estate. Little (2020) explains further that the inclusion of the four asset classes results in a well-diversified portfolio as it helps to minimise risk while maximising

returns. The property market is considered a solid market to invest in, contributing to investment structure diversification (Olaleya, 2011). Housing is mostly funded by mortgages which are particularly exposed to interest rates, default risks, and inflation rates (Olaleya, 2011). Due to such exposure, house prices are vulnerable to these risks and changes following these rates.

International investing has opened opportunities for investors to invest in international property as part of a diversified portfolio (Brumer, 2020). The MPT assists investors to choose different types of investments for diversification purposes and to form one portfolio by evaluating all investments opportunities. Further, the MPT is used as a standard tool for understanding how property market investments behave (Ali, 2006). Therefore, examining the effect of risk factors on housing prices will help investors in their choice of housing market security for inclusion in a portfolio of assets during a certain regime.

The application of MPT to the housing market helps in forming a portfolio of investments that produce expected returns and allows property investors to understand what to expect from their investment in property (Ali, 2006). In the context of this study, drawing from the MPT, both country risk components and macroeconomic factors are considered as risk factors to examine housing prices for investment in housing. In this study, this is where the connection between country risk components and macroeconomic factors is reiterated. Inflation rates and interest rates are sub-components of the financial risk component of country risk (Summers, 1985), and since these high risks form the basis of country risk, it can be concluded that housing prices are indefinitely indirectly influenced by country risk. Moreover, a macroeconomic variable such as money supply is linked to the level of housing demand in the economy as more households can buy houses due to an increase in the supply of money (Wen, 2010), and hence the housing market is influenced by macroeconomic factors.

Through the MPT, risk-averse investors can be informed about possible risks that have great potential to affect their investments so that strategic decisions are made to ensure a well-diversified investment portfolio is achieved. While the MPT aims to minimize risk, it does not eliminate it, indicating that there is always a limited amount of systematic and unsystematic risk present. A study by Brunnermeier, Rother, and Schnabel (2019) took this thought process further by investigating the relationship between systematic risk and asset price bubbles. The findings of their study showed that asset price bubbles are mainly connected with systematic risk. Their study further highlighted that loan growth rates increases financial institution's

vulnerability and, therefore, the financial system is linked to asset price bubbles, The MPT's attempt to diversify and decrease a portfolio's risk by investing in the property sector, increase the loan growth rate as the property market is financed with debt. Therefore, as a result, it increases the chances of a housing price bubble forming.

In addition, the MPT maintains that investors are known to take more risk only if compensated by higher expected returns. According to Lynn, Wang, Holbrook, Hedgcock, Organisciak, Sauer, and Hao (2009), in line with the MPT, it is possible to form a property portfolio that will generate the desired return at the lowest risk possible. With this being said, the MPT allowed this study to examine the different housing segments to form a portfolio that takes advantage of different behaviours of housing under different market conditions to achieve the desired return.

The notion of the APT and MPT had revealed that a relationship exists between assets and systematic risk factors which are country risk and macroeconomic factors. In spite of their long history and reputation, the APT and MPT and their extensions are not able to yield satisfactory empirical results. It was argued by researchers that this is because the modelling process ignored the impact of human behaviour in the asset market. Therefore, investor decision making is by definition imperfect primarily due to psychological biases, hence, investors would be able to derive better investment decision making processes.

It has been further argued in the literature of behavioural economics and finance that markets are not efficient and are influenced by investors' greed and fear which result in them adopting different plans and strategies to address variation based on the level of market predictability. Researchers share such views as studies have shown that asset markets, in particular, the property market experience changing market conditions (bullish and bearish regimes), which allowed market agents to either earn excess returns or less than expected returns. To provide theoretical explanations, Lo (2004) proposed the Adaptive Markets Hypothesis (AMH).

2.2.5. Adaptive market hypothesis

The Adaptive Markets Hypothesis (AMH) developed by Lo (2004), is an investment theory established on the idea that investors adopt different plans and strategies to address variation based on the level of market predictability. The basis of the hypothesis draws on the evolutionary fundamentals of behavioural economics such as competition, natural selection, reproduction, and mutation (Zhou & Lee, 2013). The argument presented by AMH was that the violations of rationality that are inconsistent with market efficiency (e.g., overconfidence,

overreaction, and loss aversion) are indeed consistent with an evolutionary model of individuals adapting to changes in an environment through simple heuristics (Zhou & Lee, 2013).

Under the AMH, it is the influence of evolutionary forces on market participants and financial institutions that determined the efficiency of markets and the performance of businesses, investments products, and industries. Although it is abstract and qualitative, AMH yields implications for financial activities. Concerning market efficiency, Lo (2004) reveals that there are two implications. The first implication is that market efficiency is not an all-or-none condition but is a characteristic that differs continuously over time. The second implication is that market efficiency is highly context-dependent, meaning that the degree of market efficiency is driven by market conditions.

Moreover, AMH also holds that market efficiency will be dependent on market situations such as the financial crisis, market crashes, and price bubbles (Lo 2004). Following the AMH, regarding market condition dependency, Phan Tran Trung and Pham Quang (2019) state that the market is efficient in times of market crashes and it is inefficient in times of crises. Thus, the most important key factor of the AMH is the ability of investors to adapt to the market's updated conditions. Following the AMH, investors in the housing market may overreact when it comes to country risk and macroeconomic factors in crisis (booms and bursts) market conditions because investors are irrational, but after a few months, they adapt to the prevailing regime.

The AMH theory explains fluctuations of asset prices/returns which makes it applicable to this study as it investigates the existence of bubbles in house prices. Thus, the AMH theory permits the examination of house price fluctuations over time and can reveal whether the house price fluctuations were regime-dependent. It is, therefore, reasonable to conclude that the AMH theory explains the adapting relationship between systematic risk factors (i.e.country risk and macroeconomic factors) and housing prices. This is because macroeconomic factors and country risk components have alternating influences under bullish and bearish market conditions. Hence, the impact country risk components and macroeconomic factors have on the house price of each segment in a bullish regime is not the same in a bearish market condition due to house prices reacting differently under each market regime.

Like all other markets, the period of efficiency and inefficiency in the housing market of each segment exists. The housing market will be said to be efficient for example, if movements in

macroeconomic factors (i.e., increase in money supply growth rate) cause an increase in housing prices due to a rise in demand for housing. This will reveal that housing prices incorporate all available and relevant information and that houses are not undervalued or overvalued. Both country risk factors and macroeconomic factors will be used as relevant information/factors affecting the house price fluctuations. Therefore, AMH implies that participants in the market can earn excess profits as markets are not always efficient because of the different behaviour of market participants and changing market conditions.

2.2.6. Conclusion

At the commencement of the theoretical framework section, this study proposed to identify theoretical justification surrounding housing price bubbles, country risk and macroeconomic factors. The theories that were identified were given to be the EMH, behavioural finance, APT, MPT and the AMH. The EMH was an essential theory when explaining how asset markets, in this case, the housing market was said to operate as it identified assumptions that dictated the efficiency of asset markets. The EMH provided three types of market forms, of which the semi-strong form efficient justified the evidence of linear relationship between housing price and country risk and macroeconomic factors. This justification by EMH is due to that, economic fundamentals such as country risk components and macroeconomic factors could be used to predict housing prices. However, the weak form efficient market revealed that is total opposite and in such as case, it was invertible that the connection between housing prices and country risk and macroeconomic factors was nonlinear.

Given the conflicting views, the debate surrounding the type of connection that existed between housing prices and country risk and macroeconomic factors still prevails. Thereafter, the behavioural finance theory determined the behaviour of market agents. As opposed to EMH, behavioural finance suggested that investors were not always rational as their investment decisions were not based on assumptions made by traditional finance, hence, they make the market inefficient. The inefficiency of the housing market gave rise to investors earning excess returns through studying systematic and unsystematic risk factors, of which country risk components and macroeconomic factors was one of them. Moreover, the existence of housing price bubbles can be explained by behavioural finance theories. As it has been revealed that housing price bubbles is influenced by psychological effects on the investment decision making, behavioural finance support the existence of bubble in the housing market.

Following this, the APT and MPT were elaborated upon to examine how risk and return of a single asset in this case, housing prices were determined. The APT focussed on the systematic risk factors as it contains multiple risk factors, therefore, the APT was known as the multi-risk asset pricing model. The systematic risk was also considered to be the country risk components and macroeconomic fluctuations as it was unobservable and contributed to the pricing of housing assets. However, it contained issues in the methodology surrounding the estimation of the model. According to the MPT, the application of the MPT to the housing market helps investors in forming a portfolio of investments that reduces risk. In this regards, country risk components and macroeconomic factors are considered as risk factors. Both APT and MPT assumptions has revealed that a relationship exists between housing prices and country risk and macroeconomic factors.

The finding from EMH, APT and MPT gave rise to the AMH. At the heart of the AMH lies the basic principle of revolutionary outlook concerning behavioural economics. The AMH which was supported by behavioural finance, revealed that market agents adapted to changes in an economic environment. This led to irrational behaviour, therefore, making markets inefficient, which contributed to the ability of investors to earn excess returns. The implications are such that it explained the adapting relationship between housing and country risk and macroeconomic factors. Given the basis of the AMH, it formed part of the essential theoretical justification needed to validate this study.

2.3. Empirical literature review

The global financial crisis of 2008 has led to more studies being conducted on the housing market. Research in the housing market has been conducted both internationally and locally on the subject of housing price bubbles, country risk and macroeconomic factors (Lee, 2006; Gupta et al., 2011, Yip et al., 2012; Sibanda & Mhlanga, 2013 Patterson & Skeenkamp, 2017; Grum & Govekar, 2016; Muzindutsi et al., 2020). However, the mentioned studies did not conduct the study on housing market under changing market conditions. Therefore, the following empirical literature review provides a detailed review of existing literature and demonstrates a gap and motivation for this study. International literature and local South African literature are reviewed followed by critical analysis to synthesize the empirical literature.

2.3.1. Housing pricing bubbles

International and local studies have been conducted to investigate whether housing price bubble is present in the housing market. Studies show that the existence of pricing bubbles differs according the segmentation and sizes of property. It has been also revealed that the occurrence of housing price bubbles is driven by economic factors. The following section outlines the approaches in the existing literature for the identification of housing bubbles. It presents a review of existing studies and discusses their methods. It starts with a review of international studies followed by a review of local studies concerning the identification of bubbles in the housing market.

2.3.1.1. International evidence on housing pricing bubbles

A rising concern in the identification of bubbles in the housing market has led to various studies being conducted to shed light on house price fluctuations. In this context, studies have highlighted the importance of identifying bubbles (Allen & Carletti, 2011; Geraskin & Fantazzini, 2013; Reed & Wu, 2010). Therefore, international research has been examined and has generated evidence of bubbles in housing prices. To mention researchers who present international evidence for the existence of housing bubbles, Case and Shiller (2003) investigated a study to identify bubbles in the United States housing market. The study used a questionnaire survey in 1988 and 2003 in four Metropolitan areas: Boston, San Francisco, Milwaukee, and Los Angeles. The 2003 survey was aimed to interview people who bought houses in 2002 in these areas and the 1988 survey was during the purported house bubble.

The survey results allowed comparison of the four metropolitan areas that have repeatedly gone through a housing bubble (Boston, Los Angeles, and San Francisco) with the one that has not, Milwaukee. Their study found that it is common that, in a housing price bubble, housing market participants view housing property as an investment opportunity. This is due to the expectations of the future price increase which motivates investors to buy a house. According to the study by Case and Shiller (2003), a bubble is defined in terms of people's expectations about future prices, their theories about the uncertainty of falling prices, and worries about being priced out of the housing market in the future if they do not purchase.

The overall results of the study provided strong evidence for some parameters of a theory that a housing bubble did exist in 1988. Homebuyers were influenced by a motive to invest and had strong expectations about future price changes in the housing market and they expected little risk. Moreover, responses to most questions on the survey revealed that casual word of mouth

and emotions played a significant role in home-buying decisions. Additionally, it was revealed that the U.S housing market has not been adequately studied in literature as it has been observed that home prices are sticky downwards. That is, according to Case and Shiller (2003), when there is excess supply in the housing market, prices do not immediately fall to clear the market. But instead, sellers have reservation prices below which they aim not to sell. The tendency not to accept price fall is linked with a belief that prices never fall, which are some of the parameters of thinking that determine a housing bubble.

To test for the existence of bubbles, another research was conducted in the U.S housing market by Arshanapalli and Nelson (2016) who investigated the housing bubble using a cointegration methodology developed by Engle and Granger (1987). Their study explored the presence of the housing price bubble by examining the cointegrating relationship between house prices and the economic factors that determine them. Arshanapalli and Nelson (2008) maintained that a relationship that becomes unstable during a period of increasing house prices is consistent with the existence of bubbles. Based on their study, it was concluded that the U.S housing market experienced a housing price bubble. It was further highlighted that the findings of their research are consistent with that of Case and Shiller (2003).

Kaizoji (2010), investigated the leading causes of housing pricing bubbles which resulted in a downturn in the U.S. economic growth since 2008. The household utility maximization model was employed to demonstrate the potential determinants of recent housing prices. The study found that government policymakers and the Federal Reserve Bank embraced different credit accommodative arrangements to advance house buying amongst lower-income and minority individuals with expensive subprime mortgage loans. These strategies made families vulnerable to foreclosure after the housing bubble burst and caused a decline in the U.S. economic growth.

A study was examined by Agnello and Schuknecht (2011) to identify booms and bursts in real estate prices in 18 industrialized countries: United States, Canada, United Kingdom, Australia, Norway, New Zealand, Sweden, Finland, Italy, Belgium, Netherlands, Denmark, Ireland, Spain, Japan, Switzerland, Germany, and France. In the identification of booms and bursts in the real estate market, the study utilised a triangular methodology which consists of five steps. The first step was a detrending of the existing house price series, the second step was to determine the potential set of turning points (peaks and trough in housing prices); the third step included the calculation of the persistence of the period from a trough to peak and from peak

to trough as well as the magnitude of the house price changes; the fourth step was the calculation of the cumulative changes in house prices during upswings and downturns using a triangular approximation method. The last step was the separation of booms and burst from normal house price cycles.

The results of the study found that most housing booms have been persistent and of a notable magnitude. It was further revealed that there is a solid correlation between the persistence and magnitude of booms and subsequent bursts. The study also found that interest rates and domestic credit have a significant impact on the probability of booms and bursts. Furthermore, the study disclosed that international liquidity plays a vital role in the existence of housing booms together with the banking crisis for bursts. Agnello and Schuknecht (2011) provided concluding remarks that the model used was successful in identifying booms and bursts in the housing market.

Yiu et al., (2012) conducted a study to test for the presence of housing price bubble in the Hong Kong housing property market. The study employed the Right-tailed Augmented Dicky Fuller by Phillips et al. (2011) to identify the house price bubbles. The results of the study revealed that there was a presence of bubbles in the housing market of Hong Kong. Moreover, the outcome of the study also revealed that house price bubbles in the Hong Kong housing market appeared to come mostly from the mass segments under the pressure of demand of end-users and the imposition of different macro-prudential policies by the SAR government. This was found to be effective in changing the dynamics of price changes, and in particular in the luxury segment.

A study by Gomez-Gonzalez, Ojeda-Joya, Rey-Guerra, and Sicard (2013) investigated the existence of house price bubbles in the Colombian housing market. In testing, identifying, and date stamping explosive bubbles in housing prices, their study used a method developed by Phillips, Shi, and Yu (2012) which is a Right-tailed Augmented Dickey-Fuller test. Their study found evidence of bubbles in the Colombian housing market. The empirical evidence of the study contrasts with the traditional bubble detection methods such as the unit root test which found no evidence of housing price bubble. In addition to this, the study found evidence of early bubbles in the late 1990s which is known to have triggered the financial crisis experienced by Colombia at that time. Gomez-Gonzalez et al., (2013) concluded that Columbia experienced a housing price bubble when the housing rent index and Consumer Price Index were used as deflators.

Arayici and Pitros (2016) conducted a study to identify housing bubbles in the UK. The study aimed to provide decision support for the diagnosis of housing bubbles in the UK. The study used a four staged method driven by the normal distribution theorem. The normal distribution theory was used through normality tests, descriptive statistics and bootstrap intervals, correlation analysis, bias-corrected and control limits, and accelerated bootstrapping. The study used case studies that included two housing bubbles that occurred in the UK from 1986 to 1989. The first stage of the housing bubble method was the identification and verification of the relevant variables; the second stage was to identify the main construct of the model; the third stage was to identify the model diagnostic rule; and lastly, the final stage was the tests and implementation on the bubble case studies.

The overall hypothesis of the model used in the study by Arayici and Pitros (2016) is the one in the events of housing bubbles. All speculative activities of market agents followed an approximate synchronisation, and hence, an irrational, synchronous, and periodic rise on a wide range of relevant variables had to occur to forecast the bubble component. The findings of the study revealed that methods used successfully identified the UK historical housing bubbles periods from 1983 to 2011. The study further revealed that house price fluctuations have the same weight as the debt-burden ratio when their velocity is positive. The study concluded that the model outputs fluctuate approximately in line with the phases of the UK housing cycle.

A study by Yip et al., (2017) examined the presence of bubbles in the Malaysian housing market. The main aim of the study was to examine the presence of bubbles in the Malaysian housing market. The study used the Right-tailed Augmented Dicky Fuller by Phillips et al. (2015) test techniques to test for the presence of bubbles. The results of the study showed that the Malaysian housing market experienced five positive bubbles and one negative bubble from 1988 to 2015. The study also revealed that some of the detected bubbles were preceded the local and global financial crisis.

A recent study by Asal (2019) aimed at investigating the presence of the housing bubble in the Swedish housing market by using different methodologies. The study used the cointegration methods to calculate the fundamental price which was compared with the actual house price to test for the existence of bubbles in the Swedish housing market. The study also applied the Right-tailed Augmented Dicky Fuller test procedure established by Phillips and Yu (2011) to test for bursting bubbles and to date stamp bubbles. The results of the study revealed that there is evidence of explosive bubbles in Sweden's housing market. Further to this, it was revealed

that the bubbles identified do not continuously diverge but rather periodically revert to their fundamental/intrinsic value. However, it was observed that the deviation is persistent and that without policy intervention, it takes several years for real housing prices to return to equilibrium.

On the other hand, Pan (2019) examined the study to identify the house price bubble in the Chinese housing market. The study employed the Right-tailed Augmented Dicky Fuller test and further used the generalized supremum Augmented Dicky Fuller and the supremum Augmented Dicky Fuller tests to investigate the presence of house price bubbles. The results of the study revealed the existence of bubbles in the housing market of China from 2005 to 2016. Moreover, it was also shown that most major towns in China experience explosive bubbles with the longest bubble period from 2015 until 2019.

In contrast to the above empirical studies, Joshi (2006) examined the existence of a price bubble in the housing market in India to evaluate the effect permanent shocks ascribed to income growth and monetary variables had on the housing market of India. The study employed Blanchard and Quah's (1989) structural vector autoregression model and concluded that the housing market in India is justly equipoised about the proximity of the actual and anticipated future housing prices. Hence, no housing bubbles within this market could be speculated. Furthermore, it was found that interest rate shocks have a more severe influence on house prices than shocks on credit growth. It was also found that monetary policy is seemingly an adequate judge of future growth within the housing market.

The above conclusion by Joshi (2006) is supported by Coskun, Alp, Ertugrul, and Seven (2015) and Coskun and Jadevicius (2017), who tested for the presence of housing bubbles in Turkey between June 2007 to December 2014 and 2010 to 2014, respectively. The studies concluded that there was no significant evidence of housing price bubbles in Turkey, only limited, infrequent, inconsistent instances of overvaluation, which self-correct to reduce deviations from fundamental value. Additionally, Coskun et al. (2015) conducted multiple unit root tests and used a Bounds test and Ordinary Least Squares (OLS) model, amongst others, to determine the long-term coefficients of the explanatory variables and examine whether house prices increased due to fundamental factors. The study revealed that rent and construction costs exhibited a positive relationship while real mortgage interest rates negatively correlated with housing prices in the long run.

A comparative study conducted by Hui and Yeng (2006), who tested for the existence of house price bubbles in Beijing and Shanghai in 2003 utilised the combination econometrics theories; Cointegration test, Granger causality, and Generalised impulse response function. According to the study by Hui and Yeng (2006), the correlation between house prices and market fundamentals is used to elucidate the existence of a bubble. The results showed that housing prices have abnormal interaction with market fundamentals, such as the Gross Domestic Product and disposable income in Shanghai. In addition, the findings further indicated that Shanghai experienced a housing price bubble in 2003, representing a sizeable 22% of the price, while in Beijing, there was no sign of a bubble. However, it is imperative to notice abnormal interaction, especially between housing prices and the vacant new residence.

2.3.1.2. South African evidence on housing pricing bubbles

Hutchings (2007) raised concerns that speculative price bubbles may have formed in the South African housing market. Hence, to address these concerns, Hutchings (2007) conducted a study to investigate house price dynamics in the South African housing market from 1976 to 2005. Using the error-correction models, the study revealed that fluctuations in medium to large house prices are linked with short-run changes in the real mortgage rate, economic growth, and sovereign risk. Furthermore, the empirical results also showed that real house prices of small housing are not linked with real mortgage rates in the short run. It was also revealed that house prices exhibit mean reversion in the longer run, although adjustment to long-run equilibrium is slow. Therefore, the slow rate of adjustment to long-run equilibrium is partly a function of the existence stagnation in house price changes. These findings by Hutchings (2007) were found to be consistent with the consensus that the South African housing market may be subject to speculative price bubbles.

A study by Luus (2005) provided an overview of the South African housing market with an attempt to reconcile the housing market indicators with other relevant macroeconomic trends. Based on the South African background history in the housing market, Luus (2005) found a housing bubble in the early 1980s. However, the author revealed that the housing market bubble crashed due to severe pressure on the balance of payments which sent bond rates soaring with a rise in political pressure from local and foreign sources. The study further highlighted that monetary policy is usually slow to respond or may even not respond at all to housing bubble formation and burst conditions. As a result, a fall-out property market crash may prove difficult to contain with existing monetary policy measures.

In a study investigated by Das et al., (2011), the research aimed to test for the presence of bubbles in the South African housing market. The study employed the bubble identification method developed by Phillips et al, (2011) which is the Right-tailed Augmented Dicky Fuller test. The method allowed the study to detect whether bubbles existed or not in the South African housing market and it further allowed them to see the corresponding date of emergence and end of the bubbles. For the sample period of 1969 to 2009, the results of the study showed the presence of bubbles in the entire South African housing market. In particular, bubbles were detected in the small, medium, and large houses and the aggregate of the middle segment of the South African housing market. However, there was no evidence of house price bubbles in the affordable and luxury segments. According to, Das et al., (2011), the results were expected as prices in affordable houses, in general, are controlled by the government, while demand in the luxury section of the housing market is known to be dominated by the most affluent in South Africa and also by foreign individuals, whose housing decisions are less likely to be influenced by pricing or other economic fundamentals.

Following a study by Das et al., (2011), Chang et al., (2016) examined a study to test for the presence of house price bubbles in the South African housing market in nine provinces (i.e., KwaZulu-Natal, Eastern Cape, Northern Cape, Free State, Western Cape, North West, Gauteng, Mpumalanga, and Limpopo). The study used the panel Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test with a Fourier function through the Sequential Panel Selection method, to test for the existence of explosive bubbles in the South African housing market using the housing price-to-income ratio. However, the results of the study indicated that there are no housing bubbles in the South African housing market. This however contrasts the evidence presented by Das et al., (2011).

Patterson and Steenkamp (2017) investigated a study to identify bubbles in the South African housing market of large, medium, and small house prices. The overall aim of the study was to detect periods of bubble-like behaviour in the three mentioned South African housing segments from January 2000 up to November 2016. To test for the presence of bubbles, the study employed a method by Phillips, Shi, and Yu (2013) which is the Right-tailed Augmented Dicky Fuller (Rtadf). As part of the Rtadf, the Generalised Supremum Augmented Dicky Fuller test produce provided evidence of bubbles/explosivity in the South African housing market.

Furthermore, the results of the study showed that there were five bubble episodes during the sample period. According to Patterson and Steenkamp (2017), this is due to the factors such as

a rise of black people middle class increased significantly while the country's economy was more stable and secured which allowed the economy to grow. The study also pointed out another reason for the explosive behaviour in the housing market, which was a huge rise as a result of a decrease in transfer duties on housing as well as an increase in housing finance to low households' income group. This however provided evidence that there are factors that are driving explosive behaviour in the housing market.

2.3.1.3. Conclusion on the review of housing price bubbles

It has been noted from the review of housing price bubbles literature that there is minimal research that has been conducted in South Africa to investigate the existence of price bubbles in the South African housing market. In international research, the subject of house price bubbles has been extensively investigated as opposed to South African studies, as international researchers understood the adverse effect of the housing price bubble and how it affects the economy. Concerning the literature on international studies, there is evidence that house price bubbles do exist in the housing market either at national, provincial, or town levels.

However, based on the existing international research in house price bubbles, there is still no consensus on the definition of bubbles as different authors present their view through theoretical framework as well as empirical methods. Hence, different bubble definitions yield different approaches to examining the presence of bubbles in the housing market. Moreover, there is no consensus reached regarding the optimal model to employ in testing for housing price bubbles. Based on the South African literature on housing bubbles, it was noted that academics have attempted to investigate the existence of bubbles in the housing market. South African studies examined different housing segments and revealed that the housing market in South Africa experienced bubbles. It was also noted in South Africa's literature that factors such as political pressure, bond rates, and balance of payment caused the housing bubble to burst. This then shows that the formation and bursting of bubbles in the housing market are influenced by economic and political uncertainties.

However, there exist conflicting results in the South African literature as Chang et al., (2016) found that house price bubbles do not exist in the nine provinces. Although research has been conducted to identify price bubbles in the South African housing market, there appears to be controversy in existing studies. Given the conflicting findings and limited research on the identification of bubbles in the South African housing market, the debate regarding the

existence of bubbles in the housing market still prevailed. It was, therefore, essential that more research be conducted in this regard to reach conclusive results.

In addition to the above mentioned, the review of empirical work conducted, had, however, left a few questions without specific answers. It was noted among international and South African literature that researchers had not attempted to examine the presence of bubbles in the context of country risk and other relevant macroeconomic factors. It is therefore unknown what is the impact of macroeconomic factors and country risk components on house prices given that there was a bubble or in different bubble conditions. It has been also noted in the literature that bubbles, as well as booms and bursts conditions, are influenced by driving forces which are economic factors. Hence, in this regard, there is a possibility that country risk components, as well as macroeconomic factors, can be driving factors of bullish and bearish market conditions leading to explosive price bubbles which may cause the housing market to burst.

This, however, served as a justification for the study to be examined in South Africa to test for the presence of bubbles in the housing market and examine the impact of country risk and macroeconomic factors in house prices in bull and bear market conditions. Most importantly, given that they exist no empirical work of this kind in South Africa, the study was unique, as it is the first study that has been considered in the South African context.

2.3.2. The effects of country risk components on the housing markets

Research on the housing market from a country risk perspective is a subject that is rarely approached by researchers both internationally and locally. However, country risk assessment is crucial in establishing an investment strategy in the property market. This section presents a detailed review of the literature and empirical methods used to examine the influence of country risk components on international and South African housing markets respectively.

2.3.2.1. International evidence on the effects of country risk on the housing markets

Austin (1996) asserted that the institutional characteristics of countries should be given more attention when making international property investment decisions. The study by Austin (1996) aimed at investigating the influence of government regulations on international property investments by employing the Correlation Matrix method. The study found that risk assessment variables, namely political, economic, credit, and financial risk were correlated and captured similar information. Furthermore, the study concluded that legal institutions are an essential factor to consider in international property investments. It was further revealed that in developing countries, there is high political risk, hence the level of property investment is low.

Therefore, the economic condition for citizens of such countries will remain weak until the institutional environment is more hospitable to economic investments and developments.

Lum (2002) examined the effects of economic factors and public policy factors on housing prices. The study used the Johansen cointegration method to examine the short and long-run house price dynamics. The findings of the study showed that the equilibrium house prices, in the long run, are determined by demand and supply fundamentals of economic factors. Moreover, it was found that changes in economic policy have a significant influence on house prices in the short run. It was further concluded that private housing prices are slow to adjust to economic shocks in the housing market in Singapore and this can result in disequilibrium in the long run.

Lee (2006) studied the effect of country risk on global property returns of 15 countries from 1998 to 2004. The study used pooled data analysis and the robustness of the results was examined by testing for structural stability. The research findings revealed that country risks have a significant and consistent influence on property returns. Furthermore, it was revealed that countries with the lowest financial, economic, and political country risk scores needed the most attention when analysing international property market investments. The study recommended that international investors should assess the country's risk before investing in the property of a foreign country.

A study conducted by Glindro, Subhanji, Szeto, and Zhu (2008) investigated the house price dynamics and the role of nine Asian-pacific countries from 1993 to 2006. To investigate the determinants of house price fundamentals, the study used the general-to-specific method by Capozza, Hendershot, Mack, and Mayer (2002) with panel data. Further to this, a long-run relationship between housing prices and the fundamental variables such as exchange rates, interest rates Gross Domestic Product, and real construction cost was examined. The results of the study revealed that housing prices have an impact on financial risk. It was also revealed that house price growth reflects an increase in the fundamental values of housing property, which is driven by financial and economic risk factors such as mortgage rates, income, and so forth. According to Glindro et al. (2008), the reason for such impact on financial risk is that the purchasing of houses is commonly financed by mortgage loans from financial institutions, and real estate is used as a major collateral asset for banks.

Yumei and Adnan (2011) examined the financial risk and precaution of real estate business by employing inductive method and factor analysis procedure. The study showed that the

imperfect advancement of the market framework combined with investments in large property organizations, long cycle, and high-risk characteristics caused many real estate companies to have high account receivables and bank loans. As a result, that restricted the real estate business exercises and adversely influence productivity which makes capital to the venture a high financial risk. To reduce the risk, Yumei and Adnan (2011) suggested possible risks in routine business in real estate organizations, such as financing multiplex, strengthening the recovery of all receivables, performing a logical and practical examination of investment projects, guaranteeing the trustworthiness of capital chain.

In addition to this, a different angle on the influence of financial risk on house price bubbles was examined by Xie (2016) who analysed the financial risk and its presence in and impact on the property market in China. It was revealed that the 1998 housing reform was a catalyst for the development of property in China, which bolstered the economy. This allowed for the development and urbanization of the real estate industry, which gave rise to the demand for housing – a cyclical procedure. It was also established that “property finance” – the culmination of the financial market and the property market – has supported property development while also improving capital fluidity. In conjunction with the benefits of the property market, there are risks, such as exchange rate risks, interest rate risks, liquidity risk and credit risk (Xie, 2016).

Gorzen-Mitka (2018) examined a study to investigate the relationship between country risk indicators and property market in European Union Baltic Sea region countries. The study employed a Multi-Objective Optimization by Ratio analysis and Full Multiplication Form Model (MULTIMOORA). The main aim of the study was to identify country risk components that had positive and negative influences on property market conditions by using the MULTIMOORA method procedure. The study used four groups of country risk: balance of payment, macroeconomic policy evaluation, and the property market (property price, property rights, and property rent). The study found that there is a positive connection between square meter price and per capita GDP, landlord and tenant law rating, and property right index as well as the per capita GDP. Moreover, the study revealed a negative connection between export of goods and services and square meter prices, the balance of trade and price change 5 years ratio, landlord and tent law as well as the unemployment rate. The overall results of the study revealed that property market conditions are dependent on country risk ratios.

A recent study conducted by Monfared and Pavlov (2019) investigated the effects of political risk on property markets in the European Union. In terms of country risk, the study only focused on political risk factors which is one of the country risk components. The study revealed that a relationship exists between the property market and political risk. Furthermore, it was found that areas with highly educated residents experienced a large decline in house prices. The findings of the study by Pavlov and Andrey (2019) showed that the property markets are segmented and are sensitive to a political decision as the market incorporate information quickly.

2.3.2.2. South African evidence on the effects of county risk on the housing markets

There is a dearth of studies conducted in terms of country risk influence on the South African housing market compared to international economies. Existing studies have focused on the effects of individual country risk components on the property market. To mention, a study conducted by Li and Ng (2012) stated that South African house prices are likely to decrease at a greater level than other African economies when the global interest rate increase in the future. Li and Ng (2012) also stated that rent deregulation could be a possible reason for the deferring rate of progress and may be viewed as a component of country risk. Such events arise because the South African government endorses a freely determined rental rate rather than allowing it to be determined by market forces (Li & Ng, 2012). Based on the vector error correction model, impulse response functions showed that the extent of both the balance sheet and wealth effect is greater in South Africa which contributes to higher interest rates thus, imposing a financial risk in the housing market.

Muzindutsi and Manaliyo (2016) investigated the impact of political risk on revenue in the tourism sector. The study employed the Autoregressive Distributive lag (ARDL) model to test for the short-run and long-run relationship between tourism revenue and political risk. Empirical results of the study showed that political risk has a negative long-run impact on tourism accommodation. Since tourism accommodation has been linked to the property market following Muzindutsi and Surujlal (2018), their research findings suggested that variations in political risk would influence housing prices.

A recent study by Muzindutsi et al. (2020) examined the influence of economic, financial, and political risk on different South African housing market segments using monthly housing prices from 1995 to 2015. The study used the linear and non-linear Autoregressive Distributive Lag (ARDL) models. The study found that there is a long-run connection between the housing

market in South Africa and country risk components. Moreover, the study showed that the three housing segments were more sensitive to political risk in the long run. Muzindutsi et al. (2020) also established that the large housing segment indicated a greater magnitude of the country risk influence in South Africa. The study further revealed that the housing price indices increase with both political and economic risk but decrease with financial risk.

Following Li and Ng (2012), Simo-Kengne, Balcilar, Gupta, and Aye (2014) investigated how economic shocks influence housing prices in South Africa. The study employed the dynamic factor model to examine the long-run effects. Furthermore, a Structural Vector Autoregressive (SVAR) model was employed to examine the monetary policy, portfolio, aggregate supply, and aggregate demand. The results of the study indicated that all shocks have a significant impact on housing prices with portfolio shocks having the greatest impact. The study by Simo-Kengne et al., (2014) further highlighted the importance of expectations as a function of housing price dynamics, so lower interest rates and greater volatility will lower housing costs and increase house prices. According to Simo-Kengne et al., (2014), this relationship suggests that a change in expectations results in economic risk affecting the housing market.

2.3.2.3. Conclusion on the effects of country risk components on the housing markets

On examination of the literature review on the effects of country risk components on the South African housing market, it has been observed that there is a dearth of studies conducted in the South African property market on the subject of country risk. However, examination of the effects of country risk components on the housing market is imperative due to economic and political uncertainties that arise in different economies (Lee, 2006). The reviewed literature such as a recent study by Muzindutsi et al. (2020) is the only study that provides insight that country risk components affect the South African housing prices of small, medium, and large houses. But there exists a gap in existing studies on how country risk components affect prices of the small, medium, and large houses under changing market conditions (bullish/bearish conditions).

According to Glindro et al. (2008), a bubble is mostly driven by fundamental factors which cause movements in house prices either below or above their intrinsic value (bubble). However, there is no evidence in the South African housing market that shocks in country risk components may result in bubble formations due to bullish market conditions (increasing prices). Hence, such knowledge must be known to investors and policymakers to mitigate housing price overvaluation driven by economic, financial, and political risk. Therefore, this

gap provides a basis that allowed for the exploration of the effects that economic risk, financial risk, and political risk have on the South African housing market of small, medium, and large houses under bullish and bearish market conditions.

2.3.3. The impact of macroeconomic factors on the housing markets

Research has been conducted on the effects of macroeconomic factors on the property market both internationally and locally. This provides a review of literature on the impact of macroeconomic factors on the housing market on the international and local South African property market.

2.3.3.1. International evidence on the impact of macroeconomic factors on housing markets

Antipa and Schalek (2010) empirically examined the effect of fiscal policy on residential property investments in France. The study used a vector error correction model (VECM). The results of the study implied that a long-term connection between subsidies and investment exist making subsidies an adequate measure to impact housing investment and the business cycle. Further, the study by Antipa and Schalek (2010) revealed that interest rates and tax subsidies are the most efficient fiscal measures that influence housing investments. Lastly, the interest rate was found to positively affect housing investment. It was also found that household borrowing capacity also affects investment in housing.

Research conducted by Post and Berkhout (2014) aimed at identifying macroeconomic risk factors that had an impact on the European housing prices. The research was conducted using questionnaires completed by 25 real estate companies and investors. The study by Post and Berkhout (2014) found that employment rate, average wage rate, GDP, inflation, and interest rate influence the European housing price levels. On the other hand, Oktay, Karaaslan, Alkan, and Çelik (2014) conducted a study to investigate the factors that affect the housing demand of individual households in Erzurum, North-eastern Turkey. Oktay et al., (2014) employed a questionnaire-based cross-sectional survey and estimated a binary logistic regression analysis to examine the impact. The study showed that public investment, employment rate, household income, availability of mortgage loans, GDP, and inflation rates influence housing prices and hence, influences housing demand.

Gasparėnienė, et al., (2016) assessed the impact of macroeconomic variables on Lithuanian housing prices. Their study employed correlation and regression analysis and Pearson's correlation coefficient were computed to examine macroeconomic variables that had the most

significant influence. The results of the study showed that inflation rate, GDP, availability of bank loans, and interest rate are major macroeconomic variables that influence housing prices. It was further revealed that changes in the interest rate and bank loan availability are macroeconomic factors that have the most significant effect on housing prices in Lithuania, and both variables explain changes in house prices in the country by 49.23 % and 79.03% respectively. On the other side, the inflation rate was shown to explain changes in house prices by 39.35%. Gasparėnienė et al, (2016) also revealed that GDP had an insignificant influence on housing prices in Lithuania.

A similar study by Grum and Govekar (2016) examined the effect of macroeconomic variables on property prices in France, Slovenia, Greece, Poland, and Norway was investigated. With the use of multiple regression models, their research study illustrated that the rate of unemployment, industrial production, GDP, and current account of country stock is connected to property prices. Furthermore, it was found that property prices and the selected macroeconomic variables are significantly correlated.

A study conducted by Yıldırım and İvrendi (2017) examined the dynamic connection between macroeconomic variables and property prices in Turkey. The study employed Structural vector Autoregressive models using both quarterly and monthly data from 2003 to 2016. The study showed that all variables are statistically significant and there is a significant connection between the variables. Furthermore, it was found that there is a positive connection between industrial production and housing permits. Yıldırım and İvrendi (2017) suggested that a rise in industrial production is a measure of growth in the economy, and this production leads to a rise in income, hence property prices increase due to increased demand in the property. The study also showed that a rise in mortgage rate leads to a rise in property prices and that change in the mortgage rate is the factor that mostly influences property prices.

A study conducted by Olatunji et al., (2017) examined the effect of macroeconomic variables on residential returns of property in Abuja, Nigeria. The study used both inferential and descriptive methods of data analysis and showed that employment rate, real GDP, inflation, interest rate, and exchange rate have a significant influence on returns of property. The research results imply that investors who invest in property experience a rise in returns on their investments whenever a positive policy in the macroeconomic environment is made to secure the entire economy.

2.3.3.2. South African evidence on the impact of macroeconomic factors on housing markets

A study conducted by Standish, Lowther, Morgan-Grenville, and Quik (2005) investigated the key determining factors of residential property prices in South Africa using eleven variables. The selected variables were the gross national income, real interest rates, nominal exchange rate, and household debt to income ratio, real effective rate, net migration, tourism, crime, foreign direct investment, and capitalization of the Johannesburg Stock Exchange. With the use of the Stepwise regression analysis, the results of the study showed that prices of property are sensitive to variations in these selected variables.

Following Standish et al., (2005), Clark and Daniel (2006) conducted a study to forecast South African housing prices using regression analysis. Their study revealed that South African property prices and the lagged variables namely interest rates, transfer costs, foreign exchange rate, stock market return, and GDP are the main determinants of the South African residential property sector. Moreover, the study showed that movements in the foreign exchange rate, transfer costs, and equity market affect the property sector within quarters while the property sector responds faster to movements in the rate of interest.

Kwangware (2008) examined the influence of macroeconomic and financial factors on the South African housing market performance. The study employed the Vector Autoregressive (VAR) model to analyse the study. The empirical results of the study revealed that the house price returns are affected by most of the financial and macroeconomic variables. In particular, interest rate spread, real effective exchange rate, and manufacturing production were found to positively affect house price returns. On the other hand, it was found that dividend yield, domestic interest rate, and expected inflation have a negative influence on house price returns.

Sibanda and Mhlanga (2013) study examined the interaction between returns on property and macroeconomic factors. The study employed a Vector Autoregressive model (VAR) and found that the growth in residential property prices is influenced by the inflation rate and short-term rates of interest in the shorter run. Moreover, the study revealed that in the long run, the growth in house property prices is mainly influenced by disposable income/household debt, inflation, short term, and longer-term interest rate differential, and by short term interest rates. Furthermore, the study concluded that changes in disposable income/household debt have a positive influence on returns of property in the short run and the long-run influence is a decrease

in property returns. Therefore, the authors revealed that variations in property returns attract increases in household income/debt in South Africa.

A study conducted by Simo-Kengne, Gupta, and Aye (2014) investigated the macroeconomic shocks that result in changes in South African house prices. To examine the study, Simo-Kengne et al., (2014) employed a dynamic latent factors model and a Structural vector autoregressive model. The results of their study revealed that changes in house prices are mainly driven by national macroeconomic components. Furthermore, the results of the study indicated that macroeconomic shocks are important sources of house price changes with monetary and portfolio policy playing its crucial roles.

Furthermore, Mwenje (2015) investigated the main macroeconomic factors that affect house prices in South Africa. The study adopted a Vector Autoregressive model procedure and found that macroeconomic variables have a positive influence in the long run. It was revealed that in household debt to disposable income, household net wealth to disposable income are leading factors in explaining house prices changes. The study further showed that in the short run, shocks to prime interest rates and exchange rates negatively affect house prices.

Mkhabela (2016) examined the drivers of direct commercial property returns in South Africa. The study aimed to investigate the most common macroeconomic variables and property performance factors that are known to be significantly connected with direct commercial property returns. The study was conducted to understand the dynamic performance of the South African commercial property market. Using Pearson's correlation analysis, the study found that economic growth and rental income growth are the main drivers of direct commercial property return in South Africa.

Furthermore, a study by Akinsomi, Mkhabela, and Taderera (2018) examined the role of macroeconomic variables in explaining direct commercial property returns in South Africa. The study used regression analysis methods and found that operating expenses, interest rates, vacancy returns, unemployment rates, inflation rates, and GDP all influence real estate returns. However, the study highlighted that the most significant variables that explain returns in all types of property and provinces in South Africa are interest rates and rates of unemployment.

Existing literature on the effect of country risk and macroeconomic factors on housing property market establish a relationship between country risk and housing prices a relationship between macroeconomic factors and housing prices. However, it does not directly analyse such impact and the formation or bursting of price bubbles, and this is clear with the overall housing market

as apposed to different sizes of housing. Furthermore, exiting studies did not take into consideration that that different house sizes react differently to the effect of country risk and macroeconomic factors depending on whether the housing market is in a bullish or bearish regime.

There is evidently no unanimity regarding the optimal model to employ in order to analyse the effects of country risk and macroeconomic factors on housing prices. Additionally, academic contribution has been minimal on this subject, more so in the South African context. This gap provides a basis that allowed the study to test for the existence of price bubble in the South African housing segments and the exploration of the impact of country risk components and macroeconomic factors on prices of small, medium and large houses in South Africa.

2.3.3.3. Conclusion on the impacts of macroeconomic factors on the housing market

On investigation of the literature review on the impact of macroeconomic factors on the housing market, it has been observed that authors, both international and local, examined the subject. However, researchers did not consider that macroeconomic shocks on the housing market differ according to whether the market is in a bullish or bearish market condition. But such knowledge is essential as most macroeconomic factors fluctuations can cause a bubble to form in house prices due to bullish conditions in the market. Hence, there exists a gap in the existing literature on how macroeconomic factors affect housing prices under bullish and bearish market conditions. Therefore, such knowledge is important to investors and policymakers. Hence, this gap allowed the study to examine the effects of macroeconomic factors on the South African housing market of small, medium, and large house prices in bullish and bearish regimes.

2.4. Summary of the chapter

The chapter commenced with a comprehensive discussion of the theories namely, the EMH, behavioural finance with specific reference to herding, APT, MPT, and the AMH. According to the EMH, country risk components and macroeconomic factors did influence house prices as market agents are known to be rational and house prices reflect all available information. Moreover, herding behavioural finance was introduced to show that investors may imitate the doings of other investors in terms of investment decisions in the housing market. Thereafter, the APT was presented to demonstrate how country risk components and macroeconomic factors theoretically affected housing prices. The theories considered country risk components and macroeconomic factors as risk factors in the model, which was unobservable, hence,

undiversifiable by investors. The MPT further showed that investors can diversify their investment portfolios by investing in property to mitigate such undiversifiable risks. The AMH theory was then presented which was found to be the basis of this study. The AMH showed that the effects of country risk components and macroeconomic factors are also linked to the changing market conditions in the housing market. The empirical review of the literature was then conducted based on international and South African studies on housing price bubbles, country risk and macroeconomic factors. Lastly, concluding remarks were presented.

CHAPTER 3: METHODOLOGY

3.1. Introduction

This chapter describes the data and methods employed herein in examining the impact of country risk components and macroeconomic factors in the housing market. For the first objective of testing the presence of bubbles in small, medium, and large housing segments, the right-tailed Augmented Dicky-Fuller test by Phillips et al., (2011) and Phillips et al., (2012;2015) was used. The second objective was to investigate the effects of country risk components on the housing segments in a bullish and bearish market condition, and a Markov regime-switching model was employed. Lastly, the third objective was to examine the impact of macroeconomic factors on the housing segments in a bull and bear market condition. This was achieved by using the Markov switching vector autoregressive (MS-VAR) model.

3.2. Data

The study used a time series analysis for a period starting from 01 January 1995 to 30 November 2016. The sample period was selected to cater for the significant effects of major events such as the opening of markets after the attainment of democracy in 1994 in South Africa, the Asian financial crisis of 1997, the Russian financial crisis of 1998, the 2000/01 dot com bubble, the global financial crisis of 2007 to 2008 and the euro-zone crisis of 2009 to 2012 (Luus, 2005; Patterson & Steenkamp, 2017; Muzindutsi et al., 2020; Simo-Kengne et al., 2014). These effects dictated how the housing market behaved with regards to decrease or increase in house prices, therefore, may have affected the formation of bull and bear market conditions as well as the formation of bubbles in the housing market (Luus, 2005; Patterson & Steenkamp, 2017). The study period was also limited to the availability of data.

Of note, the study period was deemed sufficient for the analysis as a longer sample period allowed for a better generalisability (Polit & Beck, 2010; Barnes, Canrad, Demont-Heinrich, Graziano, Kowalski, Neufeld, Zamora & Palmquist, 2021). Therefore, sound generalisability requires data of large sample size or longer period for producing broad generalisability (Barnes et al., 2021). Moreover, time series models or asset pricing test models work well when using longer sample periods (Brav, Lehavy & Michaely, 2005; Ferson, Nallaraddy & Xie, 2013). According to Sivapurapu (2020), an increase in the length of the study period, time series models, or asset pricing test models generalize the results well as asset prices correlate with economic variables in the longer run.

The use of monthly observations to investigate the presence of bubbles in the housing market is supported by Caspi (2016) and Patterson and Steenkamp (2017) who claimed that the existence of bubbles in the housing market tends to be more evident over a monthly horizon. In addition, the monthly frequency was also needed to ensure the correct identification of bullish and bearish market conditions and to capture the switching regimes. This is supported by Huang (2020) and Andre et al., (2017) who affirmed that the effects of economic variables in different market conditions tend to be more visible using monthly horizons. Moreover, Panagiotidis and Printzis (2016) asserted that monthly data in asset pricing models provide detailed and accurate results when examining the influence of macroeconomic factors on the housing market.

The variables used are not available in daily and intraday frequency. In addition, high-frequency data can be problematic. According to Per Gwilym and Sutcliffe (2012), this could be due to inaccurate times, non-synchronous prices, missing values, stale prices, inaccurate values, and market microstructure influences. Brigham and Ehrhardt (2013) also argued that daily data has many non-trading periods, and the full impact of new information does not immediately reflect in the prices of assets because of delays in price adjustments. Therefore, using daily or intraday data is ineffective because it introduces a substantial error that can bias the estimates (Bradfield & Munro, 2015). Quarterly and annual data could not be used in this study as the use of monthly data frequency prevents the underestimation of parameter values (Nhleko, 2014).

Therefore, this study employed a data frequency that is monthly to determine whether bubbles exist in the South African housing market using a right-tailed Augmented Dicky Fuller test technique. Furthermore, the influence of country risk components and macroeconomic variables on the housing market was examined using monthly data. The Markov regime-switching model and the Markov Switching Vector Autoregression (MS-VAR) model were employed to capture the periods of bullish and bearish market conditions. This results in 263 monthly observations for the full sample period. These data points were considered sufficient for the analysis as they captured the periods of bubbles formation and burst as well as bullish and bearish market conditions.

3.2.1. House price data

Monthly data on the South African Absa small, medium and large house price indices were obtained from, Bloomberg. These were determined by sizes of 80m² – 140m², 141m² – 220m² and 221m² – 400m², respectively (Absa, 2016). Each index was adjusted into real terms using the South African Consumer Price Index obtained from Statistics South Africa. Generally, it is the real term ($RHPI_t$) that is considered more important as it has been adjusted for inflation and reflects the true value (Khan Academy, 2019). Therefore, this was achieved for the three segments as:

$$RHPI_t = HPI_t / (1 + CPI_t) \quad (3.1)$$

The graphical trends over the sample period of each house price segment are discussed below based on the market price (not adjusted for inflation) and real value (adjusted for inflation). Figure 3.1 below illustrates the house price index of the small, medium, and large houses based on the market price. Figure 3.2 below demonstrates the house price index of each segment based on the real value. As can be seen in both Figure 3.1 and Figure 3.2, the graphs followed the same trends. As supported by Khans Academy (2019), the study focussed on Figure 3.2 as the real house value is considered to be more accurate than the nominal house value.

It can clearly be seen in Figure 3.2 that house prices of the three segments have been low from 1995 to 1999. From 2000 house prices of small, medium and large houses started to increase gradually until 2008 where it dropped. Prices of small houses reached their lowest level in mid-2008 and 2009. Between the years 2008 to 2012, the prices of small houses fluctuated. Both large and medium-sized houses have been increasing gradually throughout the sample period with minor fluctuations from 2007 to the end of the sample period. It can be seen in Figure 3.2 that house prices of the three segments increased in 2010. The observed findings were due to the events that occurred such as the housing bubble that formed in the United States from 2006 to 2007 and the housing bubble burst in 2008 (Wachter & Keys, 2018). According to McArthur and Edelman (2017), the housing bubble burst gave birth to the global financial crisis in 2008. The 2010 increase was encouraged by the 2010 FIFA World Cup (Global Property Guide, 2013). The observed decline in price as seen in Figure 3.2 was due to low economic growth and political disruptions (Global Property Guide, 2013).

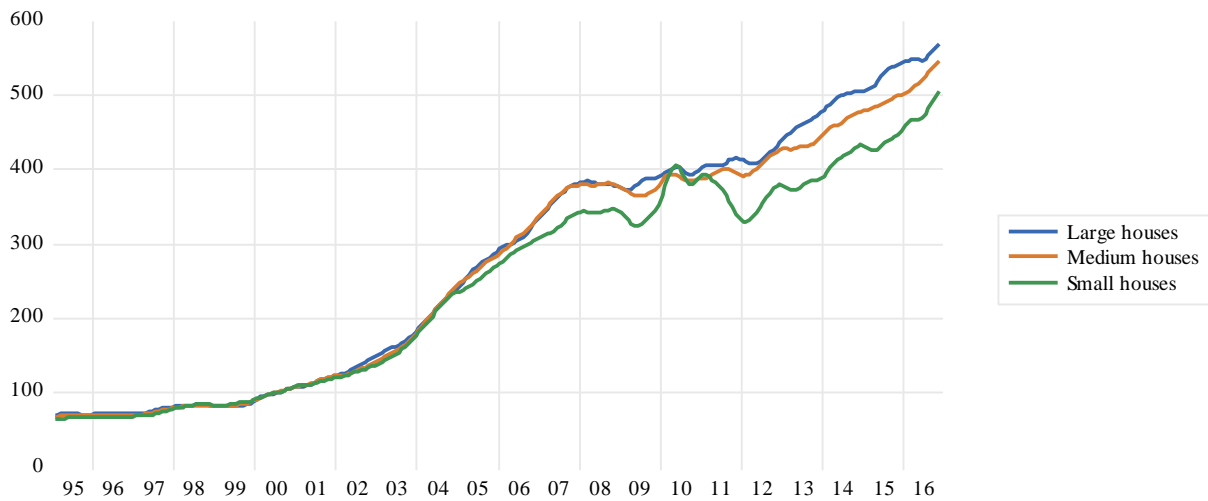


Figure 3.1: House Price Index based on market price (HPI_t).

Source: Own Compilation (2021)

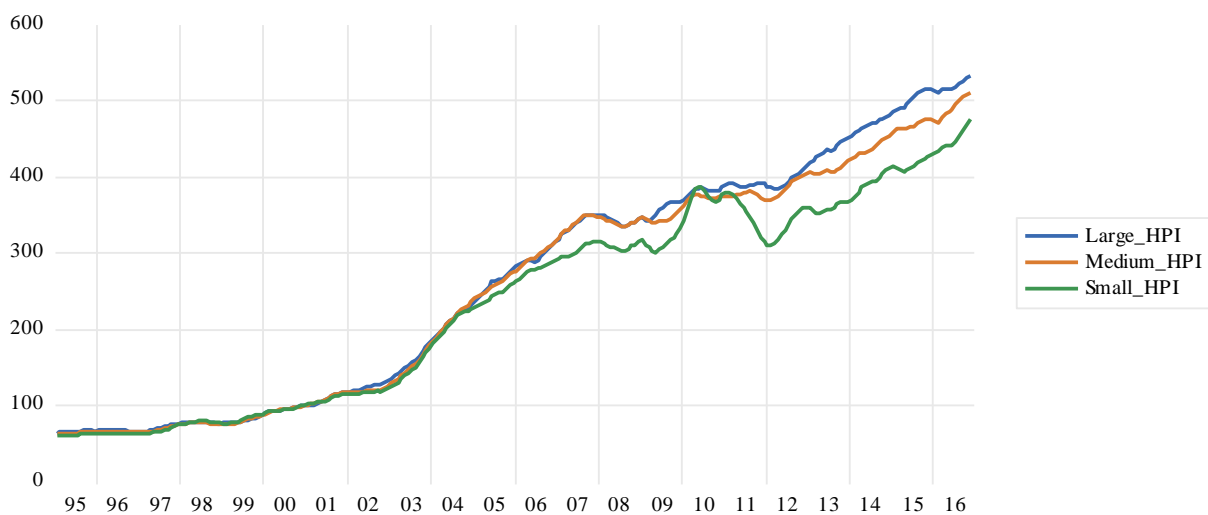


Figure 3.2: Real House Price Index by household ($RHPI_t$).

Source: Own Compilation (2021)

3.2.2. Country risk components

The examination of country risk components was based on the significant relationships identified under the empirical literature in Chapter 2. The monthly data on the South African country risk components, namely, economic, financial, and political, developed by the International Country Risk Guide, was obtained from the PSR Group (2020). Each country risk component and the respective graphical trends over the sample period are discussed below.

3.2.2.1. Economic risk

According to Howell (2013), this variable measures a country's economic strengths and weaknesses. Where a country's weaknesses outweigh its strengths, it will present a high economic risk rating and vice versa (Howell, 2013). Economic risk is linked to a country's macroeconomic conditions and development which may impact an investment locally or abroad (Bonatti, Ciacci & Ivaldi, 2021). In any investment type, economic risk is an important factor to consider and investors should only proceed if the potential economic risks are significantly outweighed by the likely benefits. This could explain its use in literature focusing on the housing market (Glindro et al., 2008; Simo-Kengne et al., 2014; Muzindutsi et al., 2020).

In the International Country Risk Guide, there are five variables used to measure economic risk which are termed economic risk components with a range of risk points assigned to each: annual inflation (0-10); GDP per capita (0-5); budget balance as a percentage of GDP (0-10); real annual GDP growth (0-10); and the current account balance as a percentage of GDP (0-15) (Howell, 2013; Hoti, 2003). The five economic variables are equally weighted to give a total score of 50 points (Hoti, 2003). The empirical literature revealed that an increase in economic risk causes a rise in housing prices. This is because when economic risk is high, investors move their funds into the housing market as it is considered a stable long-term investment (Muzindutsi et al., 2020).

Furthermore, high economic risk induces monetary policy authorities to adjust components that make up economic risks such as the interest rate to tighten the eroding impact of cheaper access to obtain bank loans and mortgage loans that causes an increase in housing prices (Williams, 2016; Greenlaw & Shapiro, 2018; Yan, 2019; Lei, Shang, Chen & Wei, 2019). Thus, economic risk has either a positive impact (Muzindutsi et al., 2020) or a negative impact (Andrews, 2010) on housing prices. Moreover, the economic risk might affect the housing market positively or negatively during economic expansion/ recession (Leung, 2004). Thus, the impact of economic risk has on housing prices varied when market conditions (i.e., bull and bear) were imposed.

Figure 3.3 below demonstrates the economic risk rating for the period 01 January 1995 to 30 November 2016 based on raw data. It was seen that economic risk reached its highest level of economic risk rating in 2007 to 2008 and the lowest level was in 2009. The figures were linked to the global financial crisis of 2007 to 2008 which was mutated from the bursting of the housing bubble in the United States to the global worst recession which caused a huge economic downturn in many countries and (Verick & Islam, 2010). It was also observed from

Figure 3.3 that during the 2007-2008 global financial crisis, South Africa had the highest economic risk score irrespective of the global crisis that prevailed. According to Muzindutsi et al., (2020), a higher risk score implies less risk within the country. Although the South African economy experienced sluggish economic growth during the global financial crisis, it was not significantly affected compared to other countries (Madubeko, 2010).

When the global financial crisis occurred, financial markets in South African were relatively healthy and well insulated by government regulations and supervision, and therefore were not severely exposed to toxic loans as their global counterparts (Madubeko, 2010). However, the severe effects of the crisis were felt later on in late 2008 to 2009 as South Africa experienced its first recession (Statsa, 2017). This can be seen in Figure 3.3 that Economic Risk decreased in 2009. This caused a decline in the South African financial markets and foreign exchange markets (Madubeko, 2010). Nevertheless, the South African economy slowly recovered as fiscal and monetary measures were implemented for the recovery from the global financial crisis which strengthened business confidence, household income started to rise and employment levels were stabilized (National Treasury, 2009). The global financial crisis provided fiscal and monetary policy authorities with opportunities to improve the efficiency of public national spending, expanding private sector investment opportunities as well as changing the economy into a more labour-intensive growth path (National Treasury, 2009). Following 2009, the economic risk increased gradually from 2010 and stabilized to 2016.

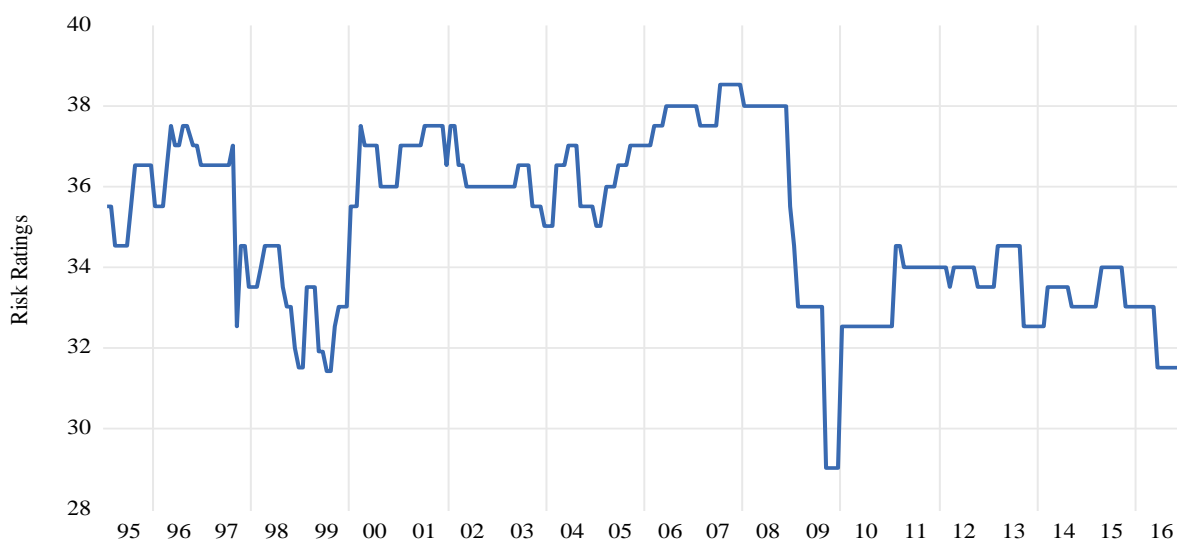


Figure 3.3: Economic Risk

Source: Own Compilation (2021)

3.2.2.2. Financial risk

Financial risk is the risk that a country may not be able to settle its foreign debts ranging from trade, official to commercial debts (Sissani & Belkacem, 2014; Kirikkaleli & Onyibor, 2020). Therefore, financial risk is an important country risk component as it measures the credibility and trust level of a country on financial aspects (Kirikkaleli & Onyibor, 2020). A high financial risk score means low risk and a low financial risk score means high risk within the country (Sissani & Belkacem, 2014). Following the International Country Risk Guide, the financial risk rating is based on the following financial variables: exchange rate stability (0-10); current account as a percentage of export on goods and services (0-15); foreign debt as a percentage of GDP (0-10); net liquidity as months of import cover (0-5); and foreign debt service as a percentage of export in goods and services (0-10). The five financial risk variables are equally weighted to give a total score of 50 points (Hoti, 2003).

The effect financial risk has on the housing market was said to be an empirical one. According to Glindro, Subhanij, Szeto, and Zhu (2008) financial risk had a significant influence on housing prices in nine Asian-Pacific countries. The reason for the significant impact was that the purchase of houses is mainly financed through mortgage loans from financial institutions and real property is used as a major collateral asset (Glindro et al., 2008). Muzindutsi et al., (2020) found that an increase in financial risk caused the house price indices to decrease. The housing price decrease is due to a decrease in housing demand. According to Han (2010), financial risk effects reduce demand. An increase in financial risk is associated with asset price uncertainty and makes that asset less desirable (Han, 2010). This negative influence on asset demand is likely to be significantly large for housing because house price risk is not readily diversifiable (Caplin, Chan, Freeman & Tracy, 1997).

In addition to this, the large transaction costs associated with each house sale make it almost impossible for individuals to make adjustments in response to price fluctuations (Haurin & Gill, 2002). Thus, the overall impact of financial risk on house prices was dependant on the extent to which it caused the house price of each segment to increase/decrease. The effects under changing market conditions vary with the market/economic condition (i.e., bearish/bullish) as the market's behaviour influences how financial risk variables perform (Woods & Dowd, 2008).

Figure 3.4 below illustrates the financial risk based on raw data. It was noted in 1998 that financial risk decreased. However, from late 1998 to 2000 financial risk increased and after

2000 it decreased until late 2002. In 2008, financial risk was at its lowest level and in 2010, it peaked at its highest level. The observed findings are due to the noted events that took place such as the Asian financial crisis of 1997/8, the Russian financial crisis of 1998, the 2002 dot com bubble, the global financial crisis of 2007 to 2008, and the euro-zone crisis of 2009. The highest peak observed in 2010 is due to the 2010 South Africa's FIFA world cup. From late 2010, the financial risk decreased. Monetary authorities implemented their monetary policy tools to alter the financial risk rise to ensure stability during the noted events.

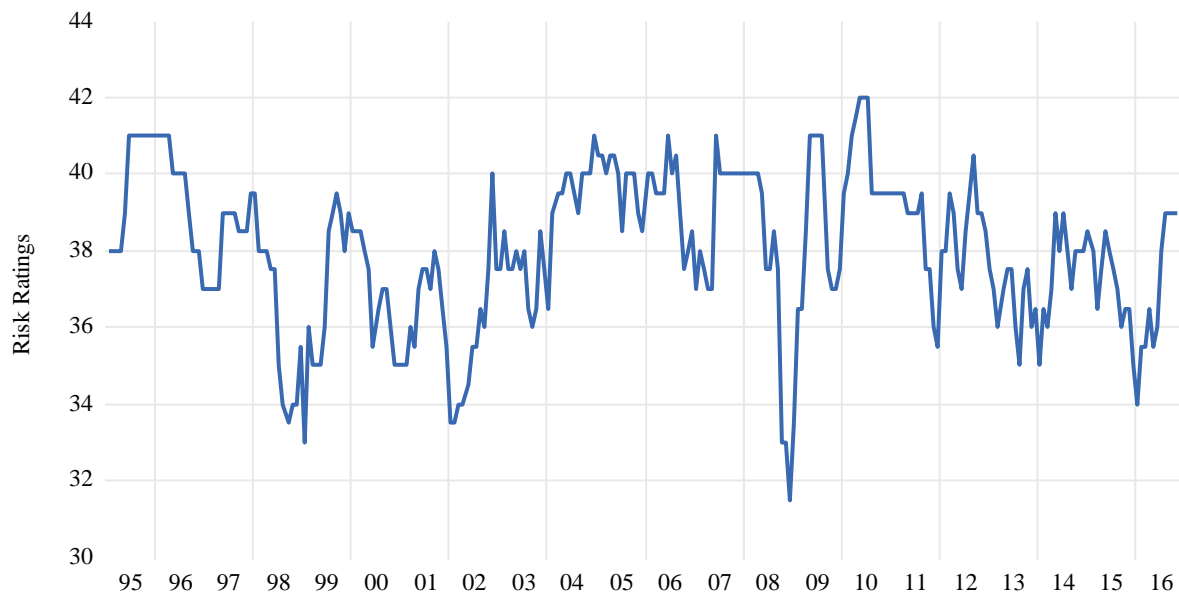


Figure 3.4: Financial Risk

Source: Own Compilation (2021)

3.2.2.3. Political risk

Political risk is an important determinant of a country's political climate. It is an evaluation of a country's political decisions that have the potential to result in unexpected losses to investors (Thakur & Vaidya, 2021). Specific events like protests, corruption, terrorism, and so forth, related to the politics of a country may arise due to changes in political climates which could result in a change in the government regulations of the country (Thakur & Vaidya, 2021). There exist different categories of political risk components in the International Country Risk Guide. It considers: internal conflict (0-12); government stability (0-12); investment profile (0-12); corruption (0-6); law and order (0-6); socio-economic conditions (0-12); ethnic tensions (0-6); external conflict (0-12); military in politics (0-6); bureaucracy quality (0-4); religious tensions (0-6); and democratic accountability (0-6) (Hoti, 2003). Each political risk component is given a score of up to 100 points. Political risk has the highest risk score of 100 points (Hoti, 2003).

The effect that political risk has on the housing market has been noted in the existing empirical literature. Chau (1997) and Monfared and Pavlov (2019) assert that the uncertainty in the future political scenario of a country affected house prices. Monfared and Pavlov (2019) found that political risk has a huge impact on the housing market. The huge effect was noted as political instability births instability and uncertainty in financial and economic policies (Muzindutsi et al., 2020). In addition to this, Muzindutsi et al., (2020) also found that the effect of political risk on small, medium, and large houses was bigger compared to financial and economic risk. Hence, housing prices are sensitive to political information and decisions. The sensitiveness depends on the type of political disturbance and how the market perceives it. The effect of changing market situations had changed with market conditions as the market's behaviour is influenced by the political climate which influences how financial and economic risk variables perform (Monfared & Pavlov, 2019; Muzindutsi et al., 2020).

It is seen in Figure 3.5 below that Political risk was high from 1995 and peaked at its highest level in 1998. There was a gradual decrease in political risk from 1998 to 2000. The next lowest peak was in 2001 and 2009. Political risk reached its lowest level in 2002 and 2016. The high level of political risk from 1995 to 1998 directly resulted from the post-apartheid era (Neethling, 2016). The findings observed in Figure 3.5 are due to the noted events such as the Asian financial crisis of 1997/8, the 2002 dot com bubble, the global financial crisis of 2007 to 2008, and the euro-zone crisis of 2009. The decline in political risk observed from 2013 to 2016 is a result of monetary and fiscal authorities implementing policies to improve that country's global investor confidence (Neethling, 2016).

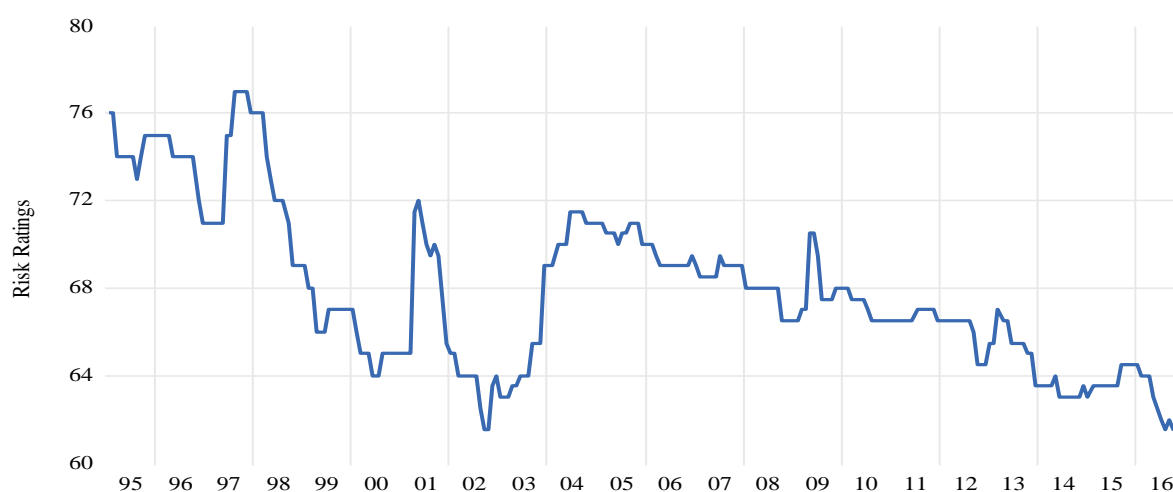


Figure 3.5: Political risk

Source: Own compilation (2021)

3.2.3. Macroeconomic variables

The selection of the three macroeconomic factors was based on their significant connections to housing markets identified in Chapter 2. Further, their selection was based on the realization that they are not accounted for in the country risk components. However, these variables were deemed to be relevant macroeconomic factors in examining the housing market (Duffy, Gerald & Kearney, 2005; Sibanda & Mhlanga 2013; Agnew & Lyons, 2018). The macroeconomic variables consist of employment levels, household debt to disposable income ratio, and money supply growth rate (M2). Each macroeconomic variable and the respective graphical trends over the sample period are discussed below.

3.2.3.1. Employment levels (total)

In accordance with the Organization for Economic Co-operation and Development (2020), employment is the number of the working population who are employed. A high employment level is known to have a positive influence on the economy (HRZone, 2020). It is evident from the literature (Schnure, 2005; Rupert & Wasmer, 2012; Valletta, 2013) that a significant connection exists between the level of employment and the property market. Agnew and Lyons (2018) found employment level to be correlated with the housing market. Duffy, Gerald & Kearney (2005) stated that a rise in employment results in increase demand for housing which causes house prices to rise.

In other words, as more people enter the labour market, it suggests a rising standard of living and more people can afford to enter the housing market. This then results in a rise in the prices of housing as demand increase. Therefore, employment level was hypothesized to have a significant effect on housing prices. Reichert (1990) found housing prices to be more sensitive to changes in employment. Employment data was obtained from the South African Reserve Bank. Employment data could only be obtained in quarterly figures. Therefore, employment data was extracted and converted in the EViews statistical software to obtain monthly observations.

Figure 3.6 below illustrates the visual representation of South Africa's total employment across the sample period. The above Figure 3.6 is based on raw data. It was noted between 1995 to 2002 that employment levels were low. In 2003, employment reached its lowest level. From late 2003 to 2008, employment increased and peaked in 2008. Thereafter, from late 2008 to 2010, there was a decline in employment. However, as depicted in Figure 3.6, there was a gradual increase in employment from 2010 to 2013 until it peaked at its highest level in 2014.

The findings observed from 1995 to 2002 were linked to new the economic order after the attainment of democracy as South Africa was recovering from the apartheid era (Mahadea & Simson, 2010).

The increase in labour in the labour force market from 2003 and 2008 was due to the government policies that were implemented to create jobs by creating more labour-intensive public works programmes (Mahadea & Simson, 2010). The observed decline from late 2008 to 2010 was linked to the global financial crisis which had a severe impact on South Africa’s economy which in turn caused employment levels to drop (Rena & Msoni, 2014). As seen in Figure 3.6, the increase in employment from 2010 to its peak level in 2014, was due to government job creation programmes which lead to more people entering the labour market in 2014 (StatSA, 2015).

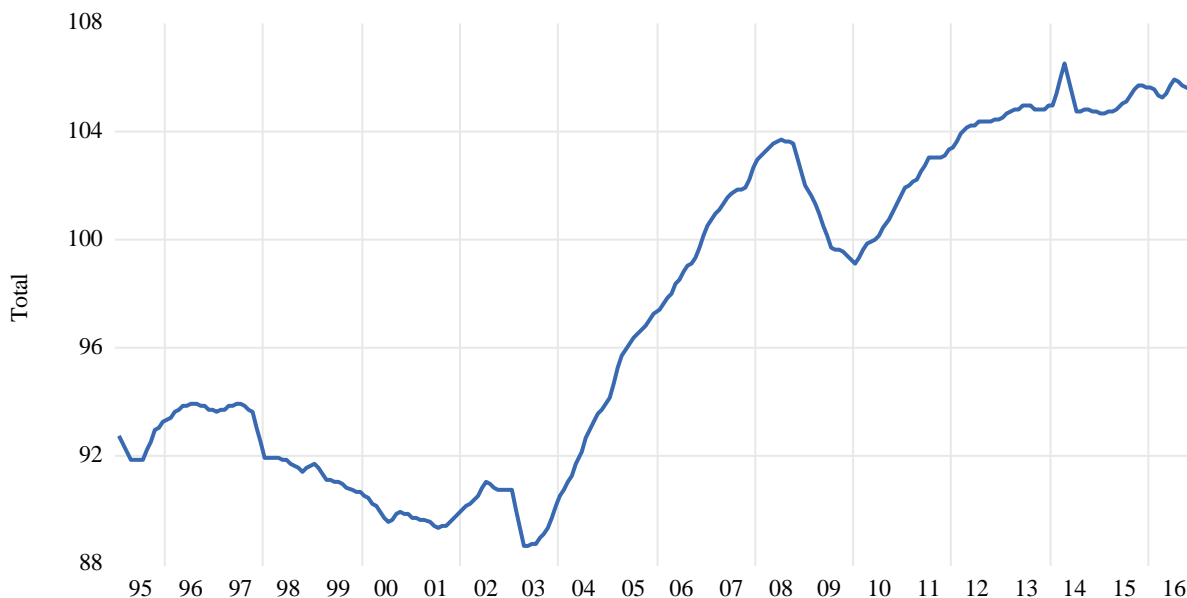


Figure 3.6: Total Employment

Source: Own compilation (2021)

3.2.3.2. Household debt-to-disposable income ratio

This is the ratio of household debts that arise from loans to the total disposable income earned by households (Eurostat Statistics Explained, 2018). Therefore, it measures the indebtedness of households concerning their capacity to settle their principal debt amount. A high ratio indicates a high household credit risk and a low ratio indicates a low household credit risk (CFI, 2015). Therefore, a high ratio is undesirable and risky as this will mean that households will be negatively affected by adverse changes in economic conditions (CFI, 2015). The household

debt to disposable income is monitored by the South African Reserve Bank monetary authorities as it is taken into consideration with current economic conditions (SARB, 2021).

The existing empirical literature showed that house debt-to-disposable income ratio has an impact on the housing market. According to Lai, Chan, Shum, and Zhou (2017), the household debt-to-disposable income ratio promotes growth in housing prices. This is due to individuals having excess loans that allow them to purchase houses. When this happens, demand rises and causes house prices to increase (Lai et al., 2017). Sibanda and Mhlanga (2013) found that household debt-to-disposable income contributes the largest to changes in house prices in South Africa. The effect of household debt-to-disposable income it has on the market varies with economic conditions (i.e., bearish and bullish) as noted by CFI (2015). Household debt to disposable income data was obtained from the South African Reserve bank. The data could only be obtained in quarterly figures. Therefore, household debt-to-disposable income data was extracted and converted in the EViews statistical software to obtain monthly observations.

Figure 3.7 below shows the representation of household debt-to-disposable income over the sample period. It can be seen in Figure 3.7 that household debt-to-disposable income has been low between 1995 and 2002 where it reached its lowest level in 2002. From 2004, household debt-to-disposable income increased until it reached its peak in 2008. From late 2008, household debt-to-disposable income decreased and continued to decline gradually to the end of the sample period. The findings observed from 1995 were due to the transition from Apartheid to democracy as the majority of South Africans were not eligible to take credit (Okurut, 2006). The lowest level in 2002 was due to the dot com bubble burst of 2000/01 (BusinessTech, 2016). The peak in 2008 was linked to the global financial crisis of 2007/08 as more and more South African took loans and the economy was booming driven by high consumer spending (BusinessTech, 2016).

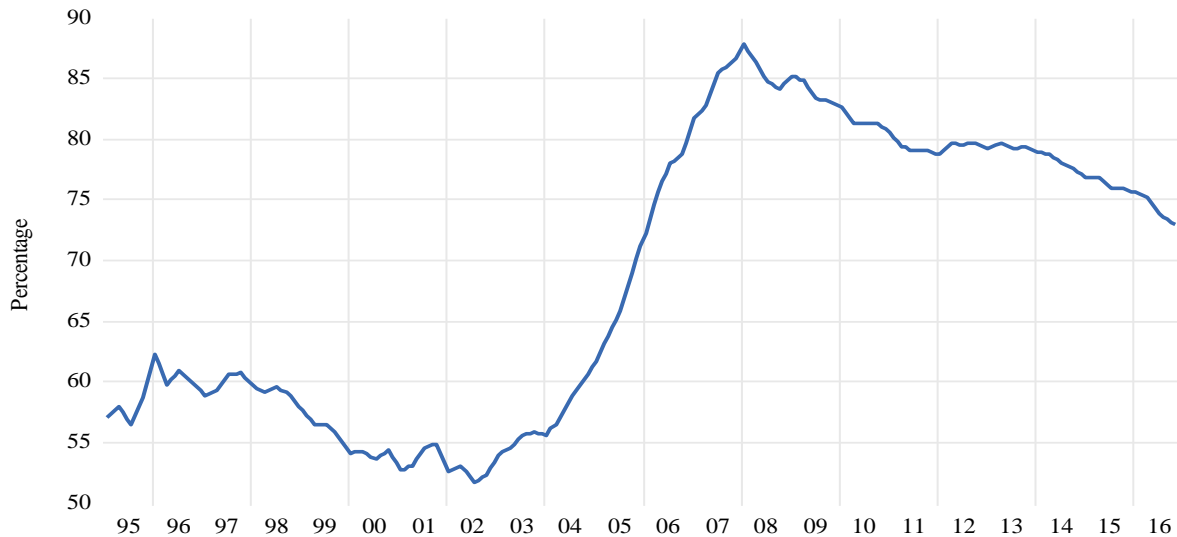


Figure 3.7: Households debt to disposable income

Source: Own Compilation (2021)

3.2.3.3. Money supply growth rate (M2)

According to the Board of Governors of the Federal Reserve System (2015), the money supply is the total amount of money which includes coins, cash, and bank account balances in circulation. It is a collective of safe assets that businesses and households can use to make payments or hold short-term investments. The money supply rate is an essential economic indicator as it contributes to economic developments and is used by the Reserve Bank's monetary authorities to ensure price stability (Mukherjee & Naka, 1995).

Money supply exists in different categories. However, the majority of studies supported the use of a broad money supply (M2) rate as it is considered to be a more accurate measurement of price stability (Zakaria & Shamsuddin, 2012; Tripathi & Kumar, 2016). According to Orphanides, Reid, and David (1994), the broad money supply (M2) is the measure of M1 (which includes bank deposits and cash) plus M2 (which includes market securities, mutual funds, saving deposits, and other time deposits). Therefore, it is measured in millions of Rands by the South African Reserve Bank, of which this study used the growth rate.

The influence money supply had on housing prices has been noted in existing studies. Mathenge (2017) found money supply to be the source of factors influencing house price level. According to Fengyun (2013), the money supply can impact the housing market directly as stated in the quantity of money theory that a rise in the money supply would inflate the price level of physical assets. This means that an increase in money supply encourages investments in the housing market, raising the demand for housing and, thus house prices increase

(Fengyun, 2013). Therefore, an increase in money supply has a positive effect on housing prices. The effects of the money supply on housing prices under changing economic conditions differ with market conditions (bullish/bearish/bubble period). Fengyun (2013) found money supply to have the most effects on housing prices during the bubble period. This is supported by Hilbers, Lei, and Zacho (2001) who stated that a booming economy with increased money supply levels increases the purchasing power capacity of households the induces demand for housing and thus leading to high prices. The money supply growth rate was obtained in monthly form from the South African Reserve Bank.

Figure 3.8 below illustrates the money supply growth rate across the sample period. It was seen that from 1996 to 2008, the money supply growth rate increased and reached its highest growth level in 1996. However, the money supply growth rate decreased from late 2008 where it reached its lowest negative growth from late 2009 to 2010. From late 2010, the money supply growth rate increased gradually above its lowest level. According to Mpofu (2011), the observed findings were linked to the Reserve Bank’s monetary authorities’ actions as they attempted to make alterations to the money supply rate to ensure price stability during the Asian financial crisis of 1996 and the 2007/08 global financial crisis.

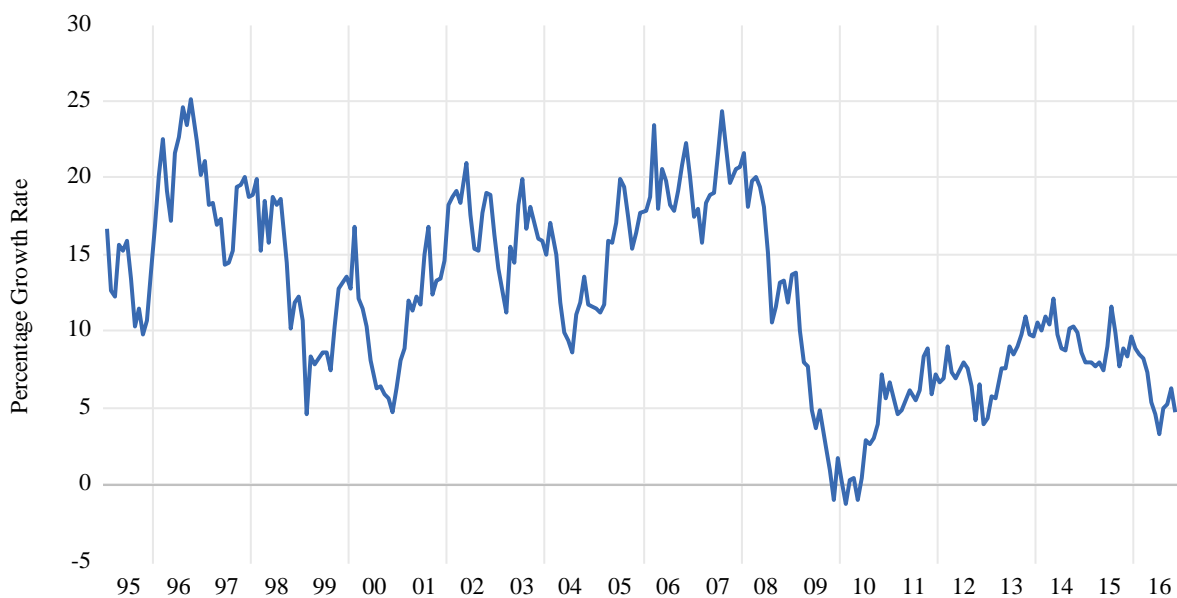


Figure 3.8: Money supply growth rate (M2)

Source: Own compilation (2021)

In this study, country risk components and employment value were logged. According to Mayr and Ulbricht (2007), logging data in time series regression and macroeconomic predictions is based on the normality assumption of the classical econometric approaches. Hence, the use of log-transformed data in the study aimed at limiting the negative influence of heteroscedasticity and skewness in the level data on estimation and testing results. Logging country risk components (economic, political, and financial risk) is consistent with the methods used by Muzindutsi et al., (2020). Log transforming data that are in percentage form is not necessary. Hence, household debt to disposable income and money supply growth rate were not logged as they are in percentage form (Changyong, Hongyue, Naiji, Tia, Hua & Ying, 2014).

3.3. Preliminary tests

Before any model estimation, this study employed preliminary tests in the form of unit root and stationarity tests with and without a structural break. Markov regime-switching model and the Markov Switching Vector Autoregression (MS-VAR) model used in this study required data to have stationary properties if structural breaks are present in the stationary series (Paliouras, 2007; Uzoma & Florence, 2016). Therefore, it was essential that the preliminary tests in the form of Augmented Dicky Fuller (ADF) test, the Augmented Dicky Fuller (ADF) with structural breaks test, Phillips and Perron (PP) test, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS), descriptive statistics, normality tests, correlations analysis, autocorrelation test, and heteroskedastic tests be conducted before the models were estimated, as it affected the validity of the estimated outputs. Therefore, these tests were necessary because the properties of the series influence the results and the conclusions were drawn from the analysis that incorporates that series (Brooks, 2019).

3.3.1. Unit root and stationarity tests

The beginning of the data examination required determining the stationarity of the House Price Index of small, medium, and large houses, country risk components, and macroeconomic variables under consideration. A stationary process consisted of constant autocovariance, variance, and mean for each lag of a series (Brooks, 2014). The stationarity test process was considered to be an essential test as it identified and prevented the emergence of autocorrelation in the residuals of regression as well as spurious results (Granger & Newbold, 1974). Brooks (2019) stated that the stationary autocorrelation process geometrically drops to zero in an autoregressive model. Moreover, when shocks were conducted to the process in a stationary process, the system caused the shocks to disappear over time (Brooks, 2019). However, Brooks

(2019) noted that in a non-stationary process, where the series contains a unit root, such shocks were persistent and did not gradually disappear over time.

The Markov regime-switching model and the Markov Switching Vector Autoregression (MS-VAR) model required the dependent and the independent variables incorporated within the estimated model to be examined for stationarity with and without structural breaks (Kuan, 2002; Paliouras, 2007; Uzoma & Florence, 2016). Then, only when the series was found to be stationary at level or $I(0)$, the Markov regime-switching model and the Markov Switching Vector Autoregression (MS-VAR) was estimated and the output was interpreted. A confirmatory examination technique was used such as the stationarity and unit root tests were conducted.

The unit root tests which were administered in this study were the Augmented Dickey Fuller (ADF) test and the Phillips and Perron (PP) test. The stationarity test which was conducted in this study was the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The Augmented Dickey Fuller (ADF) and the Phillips and Perron (PP) tests' accuracy was limited by the low power of these tests when a series was stationary, but with a root near the unit root circle (Brooks, 2019). Therefore, to eliminate such limitations, a confirmatory examination was conducted which is the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. Kwiatkowski, Phillips, Schmidt, and Shin (1992) support the use of unit root tests (PP and ADF) with stationarity test (KPSS).

Along with conducting the standard unit root and stationary tests, a test was conducted to determine if the dependent and independent variables were stationary in structural breaks. A structural break was characterized by rapid changes in time series data assigned to changes in the mean or other parameters of the series (Cassin & Perron, 2018). According to Vogelsang and Perron (1989), if a process is non-stationary in the presence of structural breaks, it indicated that the series did not revert around an identical mean for the sample period. Therefore, it resulted in the formulation of biased estimates and spurious estimations, which raises questions about the validity of the model interpretation.

3.3.1.1. The Augmented Dickey-Fuller (ADF) test

The Augmented Dickey-Fuller (ADF) test is a unit root test for stationarity and was established by Dickey and Fuller (1981). It is commonly used in analysing the stationarity of a series. When conducting the test, the first step was to determine the number of differencing required to make the series (in this case it is the small, medium, and large house price indexes, country risk components, and macroeconomic factors) stationary because the models employed in the

study would not be estimated on non-stationary time series data (Brooks, 2019). The test was conducted in EViews.

The ADF tests is based on the regression equation below:

$$\Delta y_t = \Psi_{y_{t-1}} + \mu + \lambda t + \sum_{i=1}^m \alpha_i \Delta y_{t-i} + \mu_t \quad (3.2)$$

Where Ψ was the unit root, μ was the intercept, λ denoted a coefficient on the time trend, t was the time trend, m represented the number of lags, y_{t-1} was the lagged level of the series, α_i was the coefficient on lagged variations, Δy_{t-i} was the lagged changes and μ_t is the error term. The ADF test was said to test the null hypothesis (H_0): Unit root series and the alternative hypothesis (H_1): Stationary series. Hence, the null hypothesis can be rejected in favour of the hypothesis when the test statistic is more negative (or less) than the critical values (at 1%, 5% and 10% significant level) of the estimated output. If the series contained unit roots, stationarity was induced by first differencing the data (Brooks, 2019).

3.3.1.2. Phillips-Perron (PP) test

The stationarity of each time series relating to the three house price indexes, country risk components and macroeconomic variables was examined using the Phillips-Perron (PP) unit root test. According to Escobari, Garcia and Mellado (2017) the main advantage of the Phillips-Perron (PP) test established by Phillips and Perron (1988) is that the test is more robust since it uses Newey-West (1987) heteroscedasticity and autocorrelation consistent standard errors. The PP tests was similar to the ADF test with the same hypothesis; null hypothesis (H_0): Unit root series and the alternate hypothesis (H_1): Stationary series.

The PP test followed the same procedure as the ADF test. The PP test equation was presented as follows:

$$y_t = \phi y_{t-i} + \mu_t \quad (3.3)$$

The series y_t was equal to the sum of the product of the unit roots ϕ and the lagged series y_{t-i} and the innovation term μ_t for $t = 1, \dots, n$. In this regard, the innovation term was assumed to be inconstant and stationary. According to Phillips and Perron (1988), if the PP tests statistic is less than the critical values (at 1%, 5%, and 10% significant level) of the estimated output, the null hypothesis is that the series has a unit root can be rejected. Hence, can be concluded that the series is stationary.

3.3.1.3. Augmented Dicky Fuller Structural Break test

The Augmented Dicky Fuller Structural Breaks test, also known as the ADF min-t structural breaks test was established by Enders and Lee (2012). The study used the Fourier Augmented Dicky Fuller (ADF min-t) test to demonstrate that the series was stationary with structural breaks in the data. Following Narayan and Smyth (2005), Augmented Dicky Fuller (ADF min-t) consist of two forms namely an innovation outlier (IO) and the additive outlier (AO). Both the innovation outlier (IO) and the additive outlier (AO) assumed that structural breaks occurred in stages or immediately and the structural breaks follow (or do not follow) the identical dynamic of the innovation. In this study, the innovation outlier was utilized. The method was utilised as structural breaks in time series data appeared in stages as it followed the innovations of the previous period. Thus, the innovation outlier method was better suited to determine the stationarity of time series data in the existence of structural breaks.

The ADF mint structural breaks test was represented by the following equation:

$$\Delta y_t = \Psi_{y_{t-1}} + \mu K_L + \lambda t + \sum_{i=1}^m \beta_i \Delta y_{t-i} + \mu_t \quad (3.4)$$

Where Ψ was the unit root, μ denoted the intercept, K_L and β_i denoted the breakpoint parameters, λ denoted a coefficient on the time trend, t was the time trend, m represented the number of lags, y_{t-1} was the lagged level of the series and μ_t denoted the white noise error term. The Augmented Dicky Fuller Structural Breaks test examined the null hypothesis (H_0): Unit root series with an unknown number of level breaks and the alternate hypothesis (H_1): Stationary series with an unknown number of level breaks. Hence, the null hypothesis can be rejected when the test statistic was more negative (or less) than the critical values (at 1%, 5% and 10% significant level) of the estimated output.

3.3.1.4. Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test

The Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test was established by Kwiatkowski, Phillips, Schmidt, and Shin (1992). The KPSS is used to test for the stationarity of time series data. In this study, the KPSS test was used to confirm the stationarity of the small, medium, and large house price indexes, country risk components, and macroeconomic factors. Like the ADF and PP test, the first step was to determine the number of differencing required to make the series stationary.

The KPSS equation is represented as follows:

$$y_t = \beta_t + \theta_t + \mu_t \quad (3.5)$$

Where β_t was the deterministic trend, θ_t denoted a random walk coefficient and μ_t denoted a stationarity error term for $t = 1, \dots, n$. In this regard, the stationarity error term was assumed to be inconstant and stationary.

$$\theta_t = \theta_{t-1} + v_t \quad (3.6)$$

From Equation 3.5, the random walk θ_t is defined as Equation 3.6, the sum of its lagged value θ_{t-1} and stationarity error term v_t that was assumed to be independent and equally distributed with a mean of zero and variance of $\hat{\sigma}_v^2$. The KPSS stationarity test to t was said have the null hypothesis (H_0): stationary series and the alternate hypothesis (H_1): unit root series. Hence, the null hypothesis can be rejected when the test statistic was larger than the critical values (at 1%, 5% and 10% significant level) of the estimated output.

3.3.2. Descriptive statistics

In this study, the descriptive statistics that were analysed are discussed below.

3.3.2.1. Mean

The mean value is the most commonly used measure of central tendency (Manikandan, 2016). Central tendency is the statistical measure that identifies a single value as representative of the whole sample/ distribution (Manikandan, 2016). Therefore, the mean is the average value of the entire sample. The mean value is computed by dividing the sum of the value of all observations by the total number of observations represented by the following equation:

$$\bar{X} = \frac{\sum fX}{n} \quad (3.7)$$

Where f denotes the frequency and X denotes the midpoint of the class interval and n represents the sample size (number of observations).

3.3.2.2. Standard deviation

The standard deviation is a commonly used measure for dispersion. Standard deviation measures the dispersion of the observations around its mean value (Manikandan, 2011). Therefore, the standard deviation is regarded as a measure of risk (Sumnicht, 2009). A low standard deviation indicates a lower level of risk meaning that the observations lie closer to the mean value. The standard deviation is calculated as follows:

$$\sigma = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}} \quad (3.8)$$

Where X denotes a random observation in the series, \bar{X} is the mean value of the data series and n denotes the total sample size.

3.3.2.3. Skewness

Skewness measures the asymmetry of a distribution of the data series (Von Hippel, 2005). It shows which side of the distribution has a longer tail. A series that is normally distributed is said to have a skewness value of zero. The skewness value is calculated as follows:

$$S = \frac{1}{n} \sum_{i=1}^n \left(\frac{X - \bar{X}}{\hat{\sigma}} \right)^3 \quad (3.9)$$

Where X denotes a random observation in the series, \bar{X} is the mean value of the data series and n denotes the total number of observations. In Equation 9 above, $\hat{\sigma}$ denotes an estimator of the sample's standard deviation based on the biased approximation of the variance, computed in the equation below:

$$\hat{\sigma} = \sigma \sqrt{\frac{(n-1)}{n}} \quad (3.10)$$

Where σ is defined in Equation 3.1.

3.3.2.4. Kurtosis

Kurtosis indicates how peaked or flat the data series distribution is (Meloun & Militky, 2011). The value of a kurtosis is calculated as follows:

$$K = \frac{1}{n} \sum_{i=1}^n \left(\frac{X - \bar{X}}{\hat{\sigma}} \right)^4 \quad (3.11)$$

Where X denotes a random observation in the series, \bar{X} is the mean value of the data series and n denotes the total number of observations (sample size). A series that is normally distributed has a kurtosis of 2. Therefore, a kurtosis value or less or greater than 3 indicates that the data series distribution is flat (peaked) (Meloun & Militky, 2011).

3.3.2.5. Normality tests

To test the normality of the data utilised in this study, descriptive tests statistics namely, the Jarque-Bera (JB), Shapiro-Wilk (SK) and Anderson-Darling (AD) tests were employed.

3.3.2.5.1. Jarque-Bera (JB) test

The Jarque-Bera (JB) test, established by Jarque and Bera (1987) was utilised in the study to examine the series departure from normality based on its skewness and kurtosis. It is commonly

used by academics in a testing departure from normality. The Jarque-Bera (JB) test statistic is presented as follows:

$$JB = n \left[\frac{s^2}{6} + \frac{(k-3)^2}{24} \right] \quad (3.12)$$

Where n denotes the sample size, S and K represents the parameter values given and are defined as skewness and kurtosis respectively. The Jarque-Bera test statistic follows a chi-square distribution with two degrees of freedom under the null hypothesis (H_0) of a normally distributed series. Moreover, the p-value associated with the Jarque-Bera test statistic can be utilised to determine whether the null hypothesis is rejected or not. Hence, if the p-value is greater than 5%, the null hypothesis (H_0) of a normally distributed series cannot be rejected, therefore, the data is normally distributed. Moreover, the null hypothesis of a normal distribution is said to be rejected when the JB test statistic of the specified significance level is greater than the associated critical value.

3.3.2.5.2. Shapiro-Wilk (SW) test

The Shapiro-Wilk (SW) test established by Shapiro and Wilk (1965) was used in the study to test if the series is normally distributed. The Shapiro-Wilk (SW) test statistic is presented below:

$$SW = \frac{(\sum_{i=1}^n \beta_i x_{(i)})}{\sum_{i=1}^n (x_i - \bar{x})} \quad (3.13)$$

In Equation 7 above, $x_{(i)}$ represent the sample statistic for order $i = 1, \dots, n$, where the sample size n is normally distributed. The sample size mean \bar{x} and β_i are the constants. The latter is acquired from the statistical properties, such as the variance and mean of the statistics from sample n . The null hypothesis (H_0) of the SW test is that the data (series) is normally distributed. If the SW test statistics is greater than the associated critical value at a specified significant level, the null hypothesis that the series is normally distributed can be rejected in favour of the alternative hypothesis (H_1) that the data is non-normal. Hence, it can be said that other the data is not normally distributed. On the hand, if the p-value is greater than 5%, the null hypothesis (H_0) that the data series is normally distributed cannot be rejected, hence it can be concluded that the data is normally distributed and vice versa.

3.3.2.5.3. Anderson-Darling (AD) test

The Anderson-Darling (AD) Test established by Anderson and Darling (1954) is used to detect the departure of data series from normality. This test is useful as it is sensitive to the tails of

the distribution. As highlighted by Herbert, Ugwuanyi and Nwaocha (2018) that non-normal behaviour is shown at the tails of the distribution and is it more often for emerging economies as they are characterised as having heavier and longer tails. Hence, for this study, the Anderson-Darling (AD) test was employed as presented below:

$$AD^2 = -n - \frac{1}{n} \sum_{i=1}^n (2i - 1) [\ln F(Y_i) + \ln(1 - F(Y_{n+1-i}))] \quad (3.14)$$

In Equation 8 above, F denotes the cumulative distribution function of the specified distribution of the ordered data series Y_i for $i = 1, \dots, n$ of which n denotes the size of the sample. The AD test statistic is a one-sided test that follows a specified distribution. If the p-value is greater than 5%, the null hypothesis (H_0) that the data series is normally distributed can be rejected against the alternative hypothesis (H_1) that the data does not follow the normal distribution, hence, the data series is normally distributed and vice versa.

3.3.2.6. Correlation analysis

According to Schober, Patrick, Boer and Schwarte (2018), the Pearson correlation coefficient measures the linear relationship between variables. In correlated data, a change in the magnitude of one variable is related to a change in the magnitude of another variable either positive correlation or negative correlation (Schober et al., 2018). Therefore, to investigate the correlation between variables, this study calculates the Person correlation coefficient as follows:

$$P_{x,y} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}} \quad (3.15)$$

Where n denotes the number of observations, x_i denotes the i th observation of the x variable, y_i denotes the i th observation of the y observations. The Pearson correlation coefficient ($P_{x,y}$) ranges from -1 to +1. Therefore, a positive correlation between two variables suggests that the variables move in the same direction, that is, as one variable increases/decreases, the other variable also increases/decreases. Contrarily, a negative correlation between two variables implies that the variables move in opposite directions. This means that as one variable increases/decreases, the other variable decreases/increases. Contrarily, if the movements in the variables have no relationship, the correlation coefficient is equal to zero.

3.3.2.7. Autocorrelation

Autocorrelation also referred to as serial correlation is the extent of correlation of the same variables between two successive periods (Corporate Finance Institute, 2021). In other words,

it measures how the lagged version of the value of a variable is correlated to the original version of it in time-series data (Corporate Finance Institute, 2021). Regime switching models had over the past years revealed the existence of long memory in the covariance, parameters, or models simulations (Diebold & Inoue, 2001; Dufrénot, Guegan & Peguin-Feissolle, 2005; Guegan & Stephanie, 2005). According to Guegan and Stephanie (2005), these models' autocorrelation functions decayed regularly over time which implied long memory and short memory characteristics. Hence, there existed the probability of a quick and slow decaying autocorrelation function with significant spikes after model estimation. This was demonstrated by Diebold and Inoue (2001), Guegan and peguin-Feissolle (2005), Guegan and Stephanie (2005) in their application of regime-switching models. Thus, this study examined the presence of autocorrelation. Therefore, to support whether the variables examined in this study are serially correlated, the Breusch-Godfrey test and the Durbin Watson (DW) test were employed.

3.3.2.7.1. Breusch-Godfrey test

The Breusch-Godfrey test was established by Breusch (1978) and Godfrey (1978). According to Mantalos and Shukur (2005), the Breusch-Godfrey test is one of the most important tests for autocorrelation. The Breusch-Godfrey test statistic for autocorrelation at lag order h is calculated by running an auxiliary regression of the residuals ε_t on the original right-hand regressors and the lagged residuals ε_{t-1} where the missing first h values of ε_{t-h} are equal to zero (Charemza & De Adman, 1997). The R^2 from the auxiliary regression is then used to calculate the LM test statistic as follows:

$$LM = (T - h)R^2 \quad (3.16)$$

In Equation 3.16, T denotes the number of observations in the series, h is the number of lags of the error term and R^2 represents the coefficients of determination from the auxiliary regression. According to Brooks (2002), the LM test statistic follows the chi-square distribution, and hence, the null hypothesis of no autocorrelation at lag h is rejected when the LM test statistic is greater than its critical chi-square value.

3.3.2.7.2. Durbin Watson (DW) test

The Durbin Watson (DW) test was established by Durbin and Watson (1951). Like the Ljung-Box (LB) test, the DW test has the null hypothesis (H_0) that there is no autocorrelation within the time series and an alternative hypothesis (H_1) that autocorrelation is present within the time series. The Durbin Watson (DW) test statistic is presented below:

$$DW = \frac{\sum_{i=2}^n (r_i - r_{i-1})^2}{\sum_{i=1}^n r_i^2} \quad (3.17)$$

If the above computed DW test statistics lie between 1.5 and 2.5, the null hypothesis (H_0) that there is no autocorrelation within the time series cannot be rejected. This is often the rule of thumb mostly used. Moreover, if the computed DW test statistics lies outside the interval of the values 1.5 and 2.5, the DW diagram is used.

The computed DW test statistics is compared to the relevant critical values. The DW test consist of two critical values, an upper critical value d_u and a lower critical value d_L and there is also an intermediate region the null hypothesis (H_0) that there is no autocorrelation can either be rejected nor not be rejected (Brooks, 2019). The study used the regions (rejection, non-rejection and inconclusive) from the DW diagram found in Brooks (2019). The relevant critical values were selected with respect to the number of observations and the number of independent variables excluding the constant of the regression equation. If the DW test statistic is less than the lower critical value, the null hypothesis (H_0) that there is no autocorrelation is rejected and presence of positive autocorrelation is presumed. If the DW test is greater than 4 minus the lower critical value, the null hypothesis is rejected and the presence of negative autocorrelation is presumed. If the DW test is between the upper and 4 minus the upper limits, the null hypothesis (H_0) that there is no autocorrelation cannot be rejected and no significant autocorrelation (Brooks, 2019).

3.3.2.8. Heteroskedasticity test

Heteroskedasticity refers to when the variance of error terms differs across the sample period over time (Statistics Solutions, 2021). The White test by White (1980) is employed to test for heteroskedasticity in this study. According to Simo-Kengne, Balcilar, Gupta, Reid and Aye, (2013), the regression utilised in the test regresses each cross product of the error terms (residuals) on the cross products of the regressors. Furthermore, the joint significant of the regression is tested. The regressors for the test's regressions incorporates the levels and squares of the original independent variables as well as constant term when the no cross-term option is employed. The LM chi-square test statistic illustrated in Equation 3.18 below for the joint significance of all regressors in the system is presented in EViews.

$$LM = (T - l)R^2 \quad (3.18)$$

Where T denotes the sample size, l is the number of lags of the error terms (residual) and R^2 is the coefficient of the determination from the auxiliary regression. The LM test statistic follows a chi-square distribution with the null hypothesis (H_0) of no heteroskedasticity. The next section provides a detailed identification of each empirical model as per the study objectives with benefits and limitations associated with each model. Thereafter, the mathematical derivation of each model is presented.

3.4. Empirical methods

In theory, the behaviour of market agents was said to dictate the type of relationship that housing prices take which consisted of either symmetrical or asymmetrical changes (Sibanda & Mhlanga, 2013; Simo-Kengne et al, 2012; Muzindutsi et al., 2021). When changing market conditions are considered in the form of bullish and bearish regimes, the relationship was asymmetrical as these market conditions occur at different periods in the housing market (Brooks et al., 2013). Hence, changing market conditions significantly impact housing prices. Moreover, the behaviour of market participants also results to the formation housing price bubbles (Luus, 2005; Patterson & Steenkamp, 2017). Such behaviour of market participant is mostly influenced by economic factors such that changes in interest rates either encourages or discourages market participants to buy more housing property (Luus, 2005). Therefore, empirically testing for the presence of pricing bubbles and examining the effects of economic fundamentals such as country risk components and macroeconomic factors in bullish and bearish market conditions was considered in this section.

3.4.1. Methods to test for the presence of bubbles in the housing market

Given the devastating effects of historical housing bubbles that have collapsed such as the 2008 housing bubble, several studies have been conducted to investigate the presence of bubbles in the assets market. One of the most commonly employed methods for testing an asset bubble established by Campbell and Shiller (1987) and Diba and Grossman (1988) in the existing literature is the right tail unit root test and cointegration test respectively. However, Evans (1991) noted a limitation that these methods fail to test for the presence of explosive bubbles when the sample data includes bubbles that are collapsing frequently. To overcome these restrictions, Phillips, Wu, and Yu (2011) introduced the Supremum Augmented Dicky-Fuller (SADF) test which significantly improved the power of the right-tailed unit root and cointegration tests.

As recommended by Phillips et al., (2011), the SADF provides an advantage of identifying the initial starting date and final date of an asset bubble. While Phillips et al., (2011) positively improved upon the original and cointegration test methods by Campbell and Shiller (1987) and Diba and Grossman (1988), it presented significant limitations. The method was established to analyse a single bubble and failed to correctly estimate the duration of an asset bubble in the sample data set if the duration of a second bubble in the sample data set was shorter than the first asset bubble. Moreover, Taipalus (2006) criticized the method by Phillips et al., (2011) of being unable to identify negative asset bubbles.

To overcome such limitations, Phillips, Shi, and Yu (2013) proposed the generalized SADF (GSADF). The GSADF test can test and detect numerous and frequently collapsing asset bubbles. The main difference between SADF and the GSADF test is that the GSADF allows the start and endpoints to vary and the starting point is not kept fixed Phillips et al., (2013), numerous different forward expanding sequences are utilised instead (Diakoumi & Christou, 2015). Earlier methods employed to test for the presence of assets bubbles were the West's Two-Step established by West (1987) and the Variance Bound test method by Shiller (1980). However, in this study, the method employed is the generalized SADF (GSADF) by Phillips et al., (2013). This method was recommended in this study as it allowed a flexible moving average sample test process to efficiently and correctly identify the period, from starting point to end where the house price series contained a unit root that exceeded unity. The technique proposed by Phillips et al., (2013), is the test method that recursively executes an ADF-type regression using a rolling window process.

Suppose that the following random walk process with an asymptotically negligible drift:

$$Y_t = cT^{-\eta} + \vartheta y_{t-1} + e_t, \quad e_t \sim N(0, \sigma^2), \quad \vartheta = 1 \quad (3.19)$$

Where c denotes a constant term, η denotes a localizing coefficient that controls the magnitude of the drift as the size of the sample T reaches infinity and e_t is the error term. Suppose that the rolling window interval start with the fraction r_1 and ends with a fraction r_2 of the total sample, the size of the window is given as follows:

$$r_w = r_2 - r_1 \quad (3.20)$$

Then the empirical regression model is:

$$Y_t = a_{r_1, r_2} + \phi_{r_1, r_2} y_{t-1} + \sum_{i=1}^n \delta^i_{r_1, r_2} \Delta y_{t-1} + \varepsilon_t \quad (3.21)$$

Where Y_t denotes the variable in question (in this case, the housing price of each segment), a is an intercept, n denotes the lag order and ε_t denotes the error term. a , ϕ and δ are parameters estimated by OLS. Therefore, testing for an explosive behaviour (bubble) is based on a right-tailed variation of the standard Augmented-Dicky Fuller unit root test where the null hypothesis (H_0) is a unit root and the alternate hypothesis (H_1) is of an explosive series (bubble) based on Equation 3.20 as:

$$H_0: \varphi = 1,$$

$$H_1: \varphi > 1.$$

The number of observations used in the regression Equation 3.21 is $T_w = [Tr_w]$, where $[\cdot]$ denotes the integer component. The ADF test statistic based on this regression is denoted by $ADF_{r_1}^{r_2}$ where:

$$ADF_{r_1}^{r_2} = \frac{\Pi_{r_1, r_2}}{s.e(\Pi_{r_1, r_2})} \quad (3.22)$$

Note that, r_1 and r_2 on the parameters to be estimated denote fractions of the total size of the sample representing the starting point and ending point of a sub-sample period. Not only the estimates, but the error term variance also depends on r_1 and r_2 . Based on Equation 3.22, if $r_1 = 0$ and $r_2 = 1$, the standard form of the ADF test statistics is obtained. Phillips et al (2011) developed a recursive procedure on the estimation of $ADF_{r_1}^{r_2}$ using different sub-samples of data to identify the occurrence of bubbles (or explosive behaviour). Therefore, following Phillips et al (2011), the SADF test by Phillips et al., (2013) employed in this study extended the approach by Phillips et al (2011), by formulating a backward Sup ADF (SADF) test approach where the beginning point of the window size r_w expands from an initial fraction r_0 to r_2 , where r_0 is the smallest sample window (which was selected to ensure estimation efficiency) and r_2 is the largest sample window (which is the total sample size).

According to Phillips et al., (2013), the starting point r_1 of the sample is fixed at 0. However, in most applications in the study, r_1 will be set to start with a sample fraction of reasonable size. So, the ending point of each sample r_2 is equal to r_w , changing from r_0 to 1. The ADF test statistic for a sample size that runs from 0 to r_2 is presented by $ADF_0^{r_2}$. Therefore, SADF test statistic is denoted as follows:

$$SADF(r_0) = \sup_{r_2 \in [r_0, 1]} ADF_0^{r_2} \quad (3.23)$$

As presented in Equation 3.23 above, the null hypothesis of unit root is rejected in favour of the alternate explosive series when the SADF test statistic surpasses the right tail critical value. The SADF test method can identify exuberance that can arise from different sources such as mildly explosive behaviour that can be caused by changing fundamentals such as time preferences. Moreover, with the SADF test, the starting point is fixed as the first observation of the sample. Hence, as stated earlier, the SADF test only works well in identifying a single bubble in a series and may not constantly identify the origin and ending when multiple events of exuberance are present.

Hence, to deal with numerous occurrences of bubble episodes in one series, the GSADF technique was employed. The GSADF does not only changes the initial observation of the subsamples than r_1 , but also changes the endpoint r_2 . The GSADF also allows the beginning point r_1 to change within a feasible range of windows which is from 0 to $r_2 - r_0$. In other words, the subsamples used in the recursion in the GSADF test are more extensive, meaning that it covers a larger number of subsamples than those of the SADF test. The flexibility of the GSADF on the window estimation results in substantial power gains in comparison to the SADF. In this study, the GSADF tests statistic is defined as the largest ADF statistic over the feasible ranges of r_1 and r_2 denoted as:

$$GSADF_{r_0} = \sup_{\substack{r_1 \in [0, r_2 - r_0] \\ r_2 \in [r_0, 1]}} ADF_{r_1}^{r_2} \quad (3.24)$$

In Equation 3.24 above, if the $GSADF_{r_0}$ statistic exceeds the right tail critical value, then we reject the null hypothesis in favour of the explosive alternate hypothesis. The GSADF test performs well when there are multiple bubble episodes occurring and thus overcomes the weakness of the SADF test (Philips et al., (2013)). The initial minimum point in Equation 3.24 where $r_w = r_0$, is arbitrary selected, thereafter the sample window is extended forward until $r_w = r_1 = 1$. The recursive ADF test is defined as ADF_{rk} , for all $k \in (r_0, r_1$. Similar to the SADF test procedure, if the null hypothesis of unit root (no bubble) is rejected in the GSADF test, the second step is implemented to consistently data-stamp the starting and ending points of this/these bubble(s).

According to Avans (1991), it is conceivable that the data may include a number of bubble events within a series, therefore, the ADF tests for explosive events may find a pseudo stationary behaviour and is usually unsuccessful in identifying subsequent bubbles. The beginning point of a bubble is defined as the date, denoted as T_{fs} (in fraction terms), at which

the backward supremum ADF (BSADF) sequence crosses the corresponding critical value from below. Similarly, the ending point of a bubble is defined as the date, denoted as T_{fe} (in fraction terms), at which the backward supremum ADF sequence crosses the corresponding critical value from above. Thus, to date stamp the origin and ending of the bubble, this study followed the method by Phillips et al. (2015) which relies on applying the Backward SADF (BSADF) statistic presented as follows:

$$BSADF_{r_2}(r_0) = \sup_{r_1 \in [0, r_2 - r_0]} ADF_{r_1}^{r_2} \quad (3.25)$$

The distributions of the $BSADF_{r_2}(r_0)$ and $GSADF_{r_0}$ test statistics in Equations 3.23 and 3.24 are non-standard, meaning that the Monte Carlo simulation is performed to get the critical values. The BSADF improves the bubble identification accuracy by allowing for a flexible window in the double recursion. The starting date of the bubble as the first observation in which the BSADF test statistic is greater than the corresponding value is given by:

$$\hat{r}_e = \inf_{r_2 \in [r_0, 1]} \{r_2 : BSADF_{r_2}(r_0) > scv_{r_2}^\alpha\} \quad (3.26)$$

Similarly, using N as the total sample size, the ending date of a bubble is computed as the first observation after $\hat{r}_e + \frac{12}{N}$ where the BSADF is below its critical value,

$$\hat{r}_e = \inf_{r_2 \in [\hat{r}_e + \frac{12}{N}, 1]} \{r_2 : BSADF_{r_2}(r_0) < scv_{r_2}^\alpha\} \quad (3.27)$$

In Equation 3.27, we have $scv_{r_2}^\alpha$ that denotes the $100(1 - \alpha) \%$ critical value of the SADF based on $[r_2 N]$ observations and also at a significance level α . Notation $[\cdot]$ represents the floor function that gives the integer part of $r_2 N$. $\frac{12}{N}$ in Equation 3.27 is chosen arbitrarily to make sure that explosive/bubble events last at least for twelve weeks. The $BSADF_{r_2}(r_0)$ for $r_2 \in [r_0, 1]$ is the backward supremum ADF statistic that relates to the GSADF statistic by noting that:

$$GSADF_{r_0} = \sup_{r_2 \in [r_0, 1]} \{BSADF_{r_2}(r_0)\} \quad (3.28)$$

So, to see if a bubble (explosive behaviour) exists, if both SADF and GSADF test statistics exceeds the right tail critical values corresponding to a particular confidence interval (i.e at 5%), we reject the null hypothesis of a unit root at 5 %, hence there is evidence of explosive behaviour. The SADF statistics reveal evidence that there is at least one explosive event (bubble) whereas the GSADF statistics give us evidence of numerous events of explosive behaviour.

3.4.2. Markov switching models

In economic theory, the behaviour of market participants is said to dictate the type of change that asset prices take, which consists of either positive or negative changes (Saylor Academy, 2012; Feldman & Leporo, 2016). The rapid rise in house prices in the early 2000s stated that large proportions of market participants were disillusioned by equities and shifted their investments to the housing market (Farlow, 2005). This caused the United State house prices to increase. Seslen (2004) found that individuals are more likely to trade when assets prices have been increasing or are anticipated to increase (bull), and less likely to trade when assets prices have been declining or are expected to decline (bear). This is also true to the housing market. Salzman and Zwinkels (2013) future house price movements (increase/decrease) can be predicted by individuals' expectations and behaviours.

As stated by Farlow (2004), investor behaviour in the housing market is mostly influenced by economic fundamental factors such as income, credit availability, and interest rates. Therefore, changes in these factors have an impact on house prices (Farlow, 2004). When changing market conditions occur in the form of bullish and bearish markets, there is an asymmetric house price fluctuation which may lead to booms or bursts in the housing market (Dufrenot & Malik, 2012). These market conditions do not occur at the same time but different periods in the housing market. This is referred to as the housing cycle (Ferrara & Koopman, 2010). Hence, changing market conditions significantly influence house prices. In empirically examining the asymmetry, measures were considered that identified when the housing market was in a bullish market (an upper market condition) or a bearish market (a lower market condition, the period the housing market remained in the respective market condition, and the degree of accuracy market participants regarded the housing market as either being in such a market condition.

The Markov regime-switching model was established by Hamilton (1989). The model is known as the regime-switching model, and is one of the most used nonlinear time series models in the literature. The model includes multiple structures (equations) that characterizes the time series behaviour into different regimes (Hamilton, 1989). The stochastic Markov regime-switching model was first implemented in 1989 to model economic growth and the rapid changes of a business cycle. Ever since, it had been the preferred model among the existing empirical literature for examining bullish and bearish markets and the switching conditions of a business cycle (Kaun, 2002; Chang, McCurdy & Song, 2012; Choi & Park, 2014; Song & Wozniak, 2020).

According to Chu, Liu, and Rathinasamy (2004), one of the advantageous factors of the model is that over some time the variable in question, which is the correct measure of the markets conditions is considered to inherit a probability of switching across numerous regimes. In the event of changing market conditions, bullish and bearish market conditions are considered as two regimes respectively. This means that market conditions switch between high growth and low growth regime, as illustrated by the Adaptive Market Hypothesis. Moreover, the estimation of the probability regime occurrences in each sample period provides the possibility for correct interpretations of the parameters associated with specific regimes combined with the corresponding regime probabilities, as well as for correct forecasting performance based on persistent regimes and parameters characterizing them (Song & Wozniak, 2020).

There exist different types of developments of the Markov regime-switching model, which include the ARCH Markov regime-switching model, the Markov Switching Vector Autoregression (MS-VAR), Markov regime-switching model of conditional mean, and the duration dependent Markov regime-switching model (Hamilton & Susmel, 1994; Gray, 1996; Krolzig, 1997; Kuan, 2002; Ozun & Turk, 2009). Given the four types of models, the study employed the Markov regime-switching model of conditional mean with constant transition probabilities and the Markov Switching Vector Autoregression (MS-VAR). Therefore, to examine the impact of country risk components and macroeconomic factors on housing prices under changing market conditions, nonlinear models such as the Markov regime-switching model and the Markov Switching Vector Autoregression (MS-VAR) model were needed to cater for regime-switching.

Hence, this study employed the Markov regime-switching model and the Markov Switching Vector Autoregression (MS-VAR) model to account for the study's objectives, such as switches between bull and bear market conditions. The choice of the two models was based on its suitability and superiority in examining how the housing market behaves in different regimes (bull/bear) under the influence of various economic factors (Feng & Li, 2011; Simo-Kengne, Balcilar, Gupta, Reid & Aye, 2013; Huang, 2019).

3.4.2.1. Markov regime-switching model

To achieve objective 2, to examine the effects of country risk components on small, medium, and large housing prices in different regime conditions, the Markov regime-switching model was employed. According to Kuan (2002), the Markov regime-switching model employs several structures to explain how time series data behave in different regimes and can show

regime-specific connections between the variables. The model consisted of multiple equations that ordered the time series behaviour into different regimes, which allowed for the observation of complex dynamic patterns (Kaun, 2002; Liu & Maheu, 2018). These dynamic patterns consisted of discrete shifts with their dynamics, hence, was known as a Markov regime-switching process. It is this characteristic of the model that makes it suitable for explaining distinct dynamic patterns in data during different periods (Kuan, 2002).

The model employs the probabilities transition matrix to control the probability of a switch from various bullish and bearish conditions. According to Hamilton (1989), an important distinction between the Markov regime-switching model and other models is that the switching mechanism of the Markov regime-switching model is conducted by an unobservable state factor, which follows a first-order Markov chain. This suggests that the current value of the state factor is dependent on its previous value, hence a pattern may be observable for a period, thereafter, it is replaced by another structure as switching takes place (Hamilton, 2016). The Markov regime-switching model also differs from other models of structural changes as it allows for frequent changes at random time points and the latter acknowledges only occasions and exogenous variations (Kuan, 2002).

The Markov regime-switching model did not need information on the dates of when the housing market was in each regime or the size of the growth rate of the market conditions. Preferably, the probability of being in a bullish or bearish market condition was obtained from the data. The Markov regime-switching model consisted of structural changes as it allowed constant and non-constant variations at the different periods (Kaun, 2002; Camacho, Perez-Quairos & Poncela, 2018). As with the advantage of employing the Markov regime-switching model of conditional mean with constant transition probabilities, the model was therefore recommended as suitable for describing correlated time series data that exhibited distinct dynamic patterns during different time horizons (Kuan, 2002).

There are also limitations to the model as highlighted by Hamilton (1989). The model assumes that the data series only consists of stationary properties in the presence of structural breaks. Hence, if the time series data is non-stationary in the presence of structural breaks, then the model estimates are said to be biased and inefficient. According to Paliouras (2007), this is due to the transition properties of the model being constant throughout the period, which did not accommodate for non-stationary properties with structural breaks. With that being said, this limitation did not affect the study as structural breaks tests were conducted for the stationary

series and when the study found the data to be stationary with structural breaks, the Markov regime-switching model of conditional mean with constant transition probabilities was estimated.

3.4.2.2. Model specification

To examine how country risk components influenced the house price index of the small, medium, and large house under changing market conditions, it was essential to subject the housing market to a regime-switching model that catered for switching parameters, where the South African housing market $RHPI_t$ was assumed to follow a process that was determined by an unobservable state variable S_t . The occurrence of a regime was divided into N states in period t where $S_t = N$, where $N = 1,2,3,\dots,N$. The Markov regime-switching model of conditional mean allowed each regime with an alternative regression model, hence, such a model that consisted of a switching intercept, error variance and regressors were given by the following equation:

$$RHPI_t = \alpha_{s_t} + \delta_{s_t} LER_t + \beta_{s_t} LFR_t + \theta_{s_t} LPR_t + \varepsilon_{s_t} \quad (3.29)$$

Where $\varepsilon_{st} \text{ i.i.d } (0, \sigma_{s_t}^2)$, $\sigma_{s_t}^2$ is the regime dependent variance of the house price index. Based on the above Equation 3.29, the variance and mean of the housing prices of each segment change while accounting for country risk components that could explain the changes in house prices in bull and bear market. $RHPI_t$ is the real house price index of each segment (small, medium and large houses), α_{s_t} represents the switching intercept or the state dependent intercept (mean), LER_t denotes the log of economic risk, LFR_t is the log of financial risk, LPR_t is the log of political risk, S_t denotes the state variable (0; 1) that shows two regimes (bear (0) and bull (1)). α_{s_t} , δ_{s_t} , β_{st} and θ_{st} are coefficients that depend on the regime variable s_t and ε_{s_t} is the regime dependent error term. A regime condition with higher volatility, as estimated by the standard deviation is regarded as a bearish market whereas a regime with a low standard deviation as a bull market (Hammerschmid & Lohre, 2018). The hypothesis of the second objective was constructed as follows:

H0: Country risk components do not have a significant influence on South African house prices of small, medium and large houses in a bull/bear market condition.

H1: Country risk components has a significant influence on South African house prices of small, medium and large houses in a bull market condition.

H2: Country risk components has a significant influence on South African house prices of small, medium and large houses in a bear market condition.

To examine if the influence was statistically significant under each market condition, the p-values corresponding with the country risk components' coefficient were examined at 1%, 5% and 10% significant level. If the p-value fell within the statistical significance levels, the null hypothesis (H_0) that country risk components had an insignificant influence on prices of small, medium, and large houses was rejected of the alternate hypothesis (H_1) that country risk components had a significant influence on prices of small, medium and large houses. Therefore, Equation 3.24 was estimated three times to cater for each house price index (small, medium and large). The three models were estimated as follows:

$$RHPIs_t = \alpha_{s_t} + \delta_{s_t} LER_t + \beta_{s_t} LFR_t + \theta_{s_t} LPR_t + \varepsilon_{s_t} \quad (3.30)$$

$$RHPI m_t = \alpha_{s_t} + \delta_{s_t} LER_t + \beta_{s_t} LFR_t + \theta_{s_t} LPR_t + \varepsilon_{s_t} \quad (3.31)$$

$$RHPI l_t = \alpha_{s_t} + \delta_{s_t} LER_t + \beta_{s_t} LFR_t + \theta_{s_t} LPR_t + \varepsilon_{s_t} \quad (3.32)$$

Each regime was given to follow a first Markov chain process illustrated by the transition probability matrix. Under the first order Markov process, the probability of being in a specific regime was dependent on the most recent state, which was illustrated as follows:

$$Pro(S_t = i | S_{t-1} = k) = Pro_{ik}(t) \quad (3.33)$$

Where ik was the probability of switching from a regime denotes I in a time period denotes $t - 1$ to a regime k in a specific period (t) where the probability was given to be constant for all periods so that $Pro(t) = Pro_{ik}$. Therefore, the matrix for a two-regime model was given as follows:

$$Pro(S_t = 1 | S_{t-1} = 1) = Pro_{11} \quad (3.34)$$

$$Pro(S_t = 2 | S_{t-1} = 1) = 1 - Pro_{11} \quad (3.35)$$

$$Pro(S_t = 2 | S_{t-1} = 2) = Pro_{22} \quad (3.36)$$

$$Pro(S_t = 1 | S_{t-1} = 2) = Pro_{21} \quad (3.37)$$

The equations above were simplified into a single equation as follows:

$$P = \begin{bmatrix} \text{Pro}(s_t = 1|s_{t-1} = 1) = p_{11}, & \text{Pro}(s_t = 1|s_{t-1} = 2) = p_{21} \\ \text{Pro}(s_t = 2|s_{t-1} = 1) = p_{12}, & \text{Pro}(s_t = 2|s_{t-1} = 2) = p_{22} \end{bmatrix} = \begin{bmatrix} p_{11} & p_{21} \\ p_{12} & p_{22} \end{bmatrix} \quad (3.38)$$

Where p_{11} is the probability that the house price index was in a bearish state regime, given that it was in a bearish condition in the preceding period, and p_{22} is the probability that the house price index was in a bullish state regime given it began in a bullish state regime. Hence, p_{12} denotes the probability that the house price index began from a bearish state regime and ended in the bullish state regime and p_{21} denotes the probability that the house price index began in a bullish state regime and ended in a bearish state regime (Brooks, 2019). The probability of staying in each regime was generated and compared across the different segments of housing (small, medium and large). A logit model followed with the probability of changing from regime i to k . Hence, the transition matrix rows above consisted of a full set of conditional probabilities. The logit model was determined for each row of the transition matrix as follows:

$$\text{Pro}_n(G_{t-1}, d_j) = \frac{\text{exp}(G_{t-1}, d_{ik})}{\sum_{s=1}^N \text{exp}(G_{t-1}, d_{is})} \quad (3.39)$$

Where $k = 1, \dots, N$ and $i = 1, \dots, N$ with the normalisation $d_{iN} = 0$. The Markov regime switching models were normally and generally specified with constant probabilities so that the G_{t-1} consisted only a constant. Equations 3.34 to 3.37 were estimated to determine the impact of country risk components (Economic, financial and political risk) have each house segment (small, medium and large) under changing market conditions. The estimates from Equation 3.33 identifies bullish and bearish states and provided the total number of months each house price index stayed in bullish and bearish regimes. The transition probabilities and the constant anticipated duration of each regime were compared across the housing segment to identify how each segment shifted between bullish and bearish regimes.

3.4.2.3. Markov switching vector autoregression (MS-VAR) model

The MS-VAR was employed in this study to achieve objective 3 of examining the effects of macroeconomic factors on housing prices of small, medium, and large houses in different regimes. The model was initially proposed by Goldfield and Quandt (1973). Later on, it was developed by Hamilton (1989) and Krolzig (1998) by integrating the Markov switching model with the vector autoregression to establish a Markov switching vector autoregressive model which was well structured to characterize fluctuations in macroeconomic factors in the presence of regime changes. According to Chowdhury and Maclennan (2014), the application

of the model in the housing market is most common and has been employed to model house price cycles. Its main benefit is that it can be used to examine the feedback of housing prices on other variables in the system (Chowdhury & Macleannan, 2014). In order to model the asymmetric effect of macroeconomic factors on the prices of small, medium, and large houses the study employed a model similar to Simo-Kegne, Balcilar, Gupta, Reid, and Aye (2013).

For this study's analysis a special case of MS-VAR also known as MSIAH(m)-VAR(p) model was used in which all parameters in the model, including the autoregressive terms, variances, and intercepts, can change between regimes. Hence, in line with Ehrmann, Ellison, and Villa (2003), the joints dynamic of the four variables of each segment is given by the following general form MSIAH-VAR specifications:

$$Y_t = \begin{cases} \alpha_{1,st} + \beta_{1,st}Y_{t-1} + \dots + \beta_{n1,st}Y_{t-n} + A_{p1}\mu_t, & \text{if } S_t = 1 \\ \alpha_{2,st} + \beta_{2,st}Y_{t-1} + \dots + \beta_{n2,st}Y_{t-n} + A_{p2}\mu_t, & \text{if } S_t = 2 \end{cases} \quad (3.40)$$

In Equation 3.40 above, Y_t are the vectors of four endogenous variables – house prices of each housing segment (small, medium, large), employment, household debt to disposable income ratio and the money supply growth rate. μ_{st} denotes the basic residuals that are unrelated to all lead and lags and their variances are set to unity to ensure the identity variance-covariance matrix. In the above Equation 3.40, each residual is pre-multiplied by a switching matrix A_p (regime dependent matrix) for it to be regime dependent. Therefore, Equation 3.41 below illustrates how as a result, the variance-covariance matrix Σ_n of the residuals $A_p\mu_{st}$ will also be regime dependent:

$$\Sigma_n = E(A_p\mu_t\mu'_t A'_p) = A_p E(\mu_t\mu'_t) A'_p = A_p I_k A'_p = A_p A'_p \quad (3.41)$$

In Equation 3.39, the variable S_t denotes the bullish and bearish periods corresponding to the high mean and low volatility of macroeconomic variables and low mean and high volatility of macroeconomic variables respectively. The following study will estimate the MS-VAR using the maximum likelihood technique. To determine the appropriate lag length, information criteria techniques was employed. The appropriate lag length (p) was determined in this study by employing the following criteria and p is selected to be the order that minimizes the criteria denoted as:

$$AIC_{(p)} = \ln|\hat{Z}_{(p)}| + \frac{2}{T}PK^2 \quad (3.42)$$

$$SIC_{(p)} = \ln|\hat{Z}_{(p)}| + \frac{2\ln T}{T}PK^2 \quad (3.43)$$

$$HQIC_{(p)} = \ln|\hat{Z}_{(p)}| + \frac{2\ln\ln T}{T}PK^2 \quad (3.44)$$

Where \hat{Z} is the predicted covariance matrix and T is the number of observations of the Akaike Information Criterion (AIC); Schwarz Information Criterion (SIC); and the Hannan and Quinn Information Criterion (HQIC). Then, lastly, the lag length (p) that is correlated with the minimum AIC, SIC and HQIC values from a set of AIC, SIC and HQIC values is chosen as the acceptable lag length (p) for the VAR model.

3.4.2.4. Regime-dependent impulse response functions

The MS-VAR uses regime-dependent Impulse Response Functions which can be employed to examine the cyclical changes in the responses of variables to an innovation/shock. This is one of the benefits of employing MS-VAR (Chowdhury & Macleannan, 2014). The mathematical definition of responses of the regime-dependent Impulse Response Function for regime m is illustrated as follows:

$$\pi_{km,h} = \frac{\Phi E_t Y_{t+h}}{\Phi^{\mu_{k,t}}}, S_t = S_{t+h=m} \quad \text{for } h \geq 0 \quad (3.45)$$

Equation 3.45 traces the anticipated path of variables that are endogenous at time $t + h$ following a one standard deviation shock/innovation to the k -th initial disturbance at time t , conditional on regime m (Ehramann et al, 2003). To make structure inferences, restrictions are imposed on A_p . Restrictions are then imposed on the parameter estimates to construct the structural form for each regime, from which regime-dependent Impulse Response Functions are then calculated. A recursive examination strategy based on the approximated variance-covariance matrix $\hat{\Sigma}_j$ obtained by Choleski decomposition will be employed to matrix \hat{A}_j . Based on the standard bootstrapping technique, \hat{A}_j is integrated with the parameter estimates of the unrestricted Vector autoregressive to derive the response vectors.

The regime-dependent Impulse Responses helped us investigate the influences of macroeconomic factors on the South African housing prices under booms and bursts conditions. Therefore, the regime-dependent Impulse Response Functions traced how house prices responded over time to shocks in each macroeconomic variable during boom and burst market conditions. The cyclical nature of the impulses determined whether it is bullish or bearish period. This study was then able to examine if macroeconomic variables (e.g., employment) impact on house price shocks was larger in bullish conditions compared to bearish market conditions.

3.5. Summary of the chapter

The study aimed to investigate the presence of bubbles in the South African housing market and examine the impact of country risk components and macroeconomic factors on the prices of small, medium, and large houses in bullish and bearish market conditions. The study's first objective was achieved by employing the Supremum ADF test and the generalized Supremum ADF tests (Phillips, et al., 2011 & Phillips et al., 2012;2013;2015). A Markov regime-switching model of conditional mean was used to examine the influence of country risk components on prices of small, medium, and large houses. The third objective to investigate the impact of macroeconomic factors on housing prices of the three segments was achieved by employing the Markov regime-switching vector autoregressive model (MS-VAR). However, before any model estimation, preliminary tests were conducted in the form of unit root tests with and without structural breaks, descriptive statistics, correlation analysis, normality tests, stationarity tests, autocorrelation tests, and heteroskedasticity tests. The next chapter provides the estimated results and interpretation of the empirical statistical model and econometric tests.

CHAPTER 4: EMPIRICAL RESULTS AND DISCUSSION

4.1. Introduction

The following chapter seeks to achieve the objectives of this study by analysing the results obtained from the estimations of the empirical methods which were outlined in Chapter 3. Prior to the analysis of the results obtained from the estimated models, a preliminary data analysis is presented to ensure that the data employed was suitable for this study. This was followed by a discussion of the empirical results. Specifically, the results from the bubble test methods are discussed in order to determine whether bubbles were present in the South African housing market (research objective 1). Thereafter, the results of the Markov regime-switching model of the conditional mean are presented to examine the effects of country risk components on the three housing segments in a bullish and bearish market condition (research objective 2). The latter part of Chapter 4 presents results obtained from the estimated Markov switching vector autoregressive model in an attempt to investigate the impact of macroeconomic factors on the three housing segments under changing market conditions (research objective 3).

4.2. Preliminary tests

This section includes the analysis of unit root and stationarity tests followed by descriptive statistics tests of the three house price indexes, country risk components, and the macroeconomic variables. Correlation analysis between dependent and independent variables was examined to determine the correlation between the two sets of variables. Lastly, the nature of the house price indexes, country risk components, and the macroeconomic variables was investigated by employing normality, autocorrelation heteroskedasticity tests.

4.2.1. Unit root and stationarity tests

The unit roots tests were conducted using the ADF test and PP test and the stationary tests were given by the KPSS. Moreover, the ADF min-t breakpoint unit root test with an innovation outlier was conducted to determine if the data were stationary with structural breaks. The standard ADF and the breakpoint ADF tests were conducted with a maximum of 15 lags as given by the Schwarz Information Criteria.

Table 4.1 below illustrate the ADF, PP, KPSS, and the ADF mint-t breakpoint tests statistics associated with its levels of significance (presented by the subscripts*) of all variables. All variables were non-stationary at level using ADF, PP, KPSS, and the ADF mint-t breakpoint tests. Therefore, to eliminate the unit root properties in the RHPI data series, the ADF, PP, KPSS, and the ADF mint-t breakpoint was conducted at first difference. The p-values of both the ADF and PP tests of the RHPI of the small, medium, and large houses was less than 0.01, and therefore, the null hypothesis that the series contained a unit root was rejected at a 1% level of significance. This being so, the alternate hypothesis that the series is stationary was accepted for all the RHPI series. To verify the stationarity of the RHPI, the LM test statistics for the KPSS for all RHPI segments was less than the critical values at 1%, 5%, and 10%. Therefore, the null hypothesis that the RHPI time series is stationary could not be rejected.

Thus, the study accepted the null hypothesis that the RHPI series was stationary. For the RHPI of all segments, the ADF and PP tests were conducted at 1st difference with an intercept. However, the KPSS test for small and medium houses was stationary at 1st difference with exception of the large house price index which was stationary at 2nd difference with an intercept. The breakpoint unit root test confirmed the stationary of the RHPI in all segments in the presence of structural breaks with p-values less than 0.01. The null hypothesis of a unit root was therefore rejected in favour of the alternative hypothesis of stationary series as the test statistic was more negative than the critical values at a 1% level of significance. Therefore, for all RHPI segments, the ADF, PP, KPSS and the ADF min-t tests confirmed stationarity.

For the country risk components, the test statistics of the ADF and PP were more negative than the critical values at 1%, 5%, and 10% levels of significance. Therefore, the null hypothesis that the South African country risk components series contain a unit root was rejected in favour of the alternate hypothesis that the South African country risk components series are stationary. The stationarity test of KPSS confirmed the findings of ADF and PP tests for all country risk components. The LM-test statistic of each country risk component was less than the critical values at 1%, 5%, and 10% level of significance. Hence, the study failed to reject the null hypothesis that the country risk components series are stationary.

Moreover, the breakpoint unit root test as illustrated in Table 4.1 below confirmed the stationary of the South African country risk components in the presence of structural breaks. The null hypothesis that the South African country risk components series contain a unit root was rejected in favour of the alternate hypothesis that the series is stationary as the test statistic

was more negative than the critical values at a 1% significance level. All the ADF, PP KPSS, and the breakpoint test were conducted at 1st difference with an intercept. The study concluded that the South African country risk components time series were stationary at 1st difference as well as when structural breaks were present. Moreover, in Table 4.1, the ADF and PP test statistic of the macroeconomic variables was more negative than the critical values at 1%, 5% and 10% level of significance. This allowed the null hypothesis that all the macroeconomic variables contain unit root to be rejected.

Therefore, the alternative hypothesis that the macroeconomic data series is stationary was accepted at all levels of significance. The KPSS stationary test confirmed the stationarity of the macroeconomic variables as the LM-statistic was less than the critical values at 1%, 5%, and 10% significance levels. Therefore, the study concluded that all macroeconomic variables were stationary at 1st difference. The breakpoint unit root test confirmed the stationary properties of the macroeconomic variables at the first difference in the presence of structural breaks. Therefore, the null hypothesis that the macroeconomic variables contain a unit root in the presence of structural breaks was rejected in favour of the alternate hypothesis of stationarity as the test statistic was more negative than the critical values at 1%, 5%, and 10% levels of significance.

Table 4.1: ADF, PP, KPSS and ADF min-t tests

Variables	ADF test	PP test	KPSS test	ADF min-t test
RHPIS	-6.2444***	-4.4199***	0.1625	-6.6741***
RHPIM	-5.9257***	-5.9583***	0.3365	-6.4587***
RHPIL	-6.2170***	-5.9743***	0.1382	-6.8346***
ER	-16.9348***	-17.0828***	0.0678	-18.1030***
FR	-16.4894***	-16.9362***	0.0251	-17.2618***
PR	-14.3552***	-14.3552***	0.0557	-16.5442***
EMP	-4.2263***	-6.2425***	0.1962	-6.1957***
HDI	-3.8725***	-5.6387***	0.3028	-6.0269***
MS2	-6.9108***	-17.5010***	0.0368	-17.5464***

Note: ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Source: Own estimations (2021)

4.2.2. Descriptive statistics

Table 4.2 below demonstrates the common sample descriptive statistics of the South African house price index of small, medium, and large housing, the South African country risk components, and the South African macroeconomic variables. The common sample descriptive statistics are shown in Table 4.2 with the sample mean, median, maximum, minimum, standard deviation, skewness, kurtosis, Jarque-Bera statistics, number of observations, Shapiro-Wilk statistics, and the Anderson-Darling statistics of each variable. The large and medium house price indexes attained the highest average price for the sample period, whereas the small house price index demonstrated the lowest average price. This indicated that the large and medium house price indexes were over-performing with reference to the overall housing market and that the small house price index was underperforming with reference to the aggregate housing market. This suggested that property investors were investing more in large and medium houses.

In the sample period, the large-sized house prices increased more than those of medium and small-sized house prices (Luus, 2005). Moreover, the large-sized house price index had the highest maximum prices and the highest minimum prices. In Table 4.2, it is evident that variables with the highest mean tend to present high standard deviation while variables with low mean values tend to present low standard deviation. Therefore, the large house price index is highly volatile as it attained the highest standard deviation. Risk-averse investors should not consider investing in the large housing market as it is risky compared to other housing segments. The medium and small-sized house prices contained low risk (standard deviation) and small fluctuations (maximum and minimum) in prices.

As noted in Section 3.3.2.3 and 3.3.2.4 a normally distributed series contains a skewness value of 0 and a kurtosis value of 3. Except for the small house price index, the medium and large house price indexes contained positive skewness values, thus, suggesting that the series were rightly skewed and positively distributed. On the contrary, the small house price index showed a negative skewness that the series was skewed to the left and negatively distributed. With regards to the kurtosis values, all the house prices of the small, medium, and large houses had a positive kurtosis value of less than 3, and therefore, the series followed a leptokurtic distribution which was a peaked distribution that contained heavy tails.

The final value that was important when determining whether a variable was normally distributed was the Jarque-Bera test statistic. For all the house price index segments (denoted as RHPIS, RHPIM, and RHPIL), the Jarque-Bera test statistics were significant at a 5% significance level since the p-values (presented by subscripts *) are less than 0.05. The significance Jarque-Bera test statistic rejected the null hypothesis of a normally distributed series, hence, suggesting that the house prices of the small, medium, and large houses were non-normally distributed. Furthermore, to support that the three house price indexes were non-normal, the Shapiro-Wilk and the Anderson-Darling tests were employed. Since the p-values of Jarque-Bera, Shapiro-Wilk, and the Anderson-Darling tests were all less than 0.05, the null hypothesis that the South African house price index of the three segments follow a normal distribution was rejected in favour of the alternative hypothesis that South African house price indexes of all segments were non-normal.

Therefore, it was concluded that the South African house price indexes of the three segments did not follow a normal distribution. This is common in the housing market literature that the house prices do not follow a normal distribution (Rusakov & Laskin, 2017). According to Ohnishi, Mizuno, Shimizu, and Watanabe (2011), the house price indexes were likely to follow a lognormal distribution. A lognormal distribution refers to a continuous distribution of series whose natural logarithm is normally distributed (Kissel & Poserina, 2017). However, despite this, given such findings, among the house price indexes and the study's large sample size (263 observations), the violation of the normality assumptions of the housing market was the least of the academic's concerns.

Furthermore, based on the results presented in Table 4.2 below, political risk attained the highest average whereas, the average value for economic and financial risk was relatively low. The findings for political risk are due to the fact that political risk has the highest risk score up to 100 points whereas economic and political risk scores have the lowest risk point up to 50 points. Moreover, Political risk had the highest maximum, minimum, and standard deviation. The high maximum and minimum illustrated that political risk fluctuated extensively, therefore attaining the highest standard deviation. Economic risk had the lowest maximum and minimum from the rest of the country risk components. The low maximum and minimum values suggested that economic risk did not fluctuate extensively during the sample period. Financial risk attained the lowest standard deviation compared to economic and political risk, therefore, making it less volatile. Economic risk had the second-lowest standard deviation.

These low values associated with financial and economic risk indicated that the monetary policy that was imposed by the South African Reserve Bank in the market was robust and adequate for the South African economy. As indicated in Section 3.2.2.1 and 3.2.2.2, this is due to the South African Reserve Bank policies that were put in place which prevented the South African economy to be affected by the 2008 global financial crisis with the highest economic and financial risk scores compared to other countries. Except for political risk, economic and financial risk skewness values were negative suggesting that economic risk and financial risk variables were skewed to the left and negatively distributed. In contrast, political risk illustrated positive skewness indicating that the series was skewed to the right and positively distributed. The kurtosis values of all the country risk components series contained in Table 4.2 were less than 3 and positive and therefore, the components of country risk followed a leptokurtic distribution.

The Jarque-Bera statistics for all country risk components were significant at a 5% level of significance as the p-values were less than 0.05. The significant Jarque-Bera statistics rejected the null hypothesis of a normally distributed series, hence, indicating that all the country risk components series were not normally distributed. In conclusion, the skewness values, kurtosis values, and the Jarque-Bera test statistics show that all the country risk variables are non-normally distributed. The Shapiro-Wilk and the Anderson-Darling tests were employed to support that country risk components do not follow a normal distribution. The p-values of Jarque-Bera, Shapiro-Wilk, and the Anderson-Darling tests were all less than 0.05, hence, the null hypothesis that the South African country risk components are normal was rejected in favour of the alternative hypothesis that the South African country risk components were not normally distributed.

With regards to the descriptive statistics for macroeconomic variables presented in Table 4.2, employment attained the highest average value with household debt-to-disposable income ratio having the second-highest average value. The money supply growth rate had the lowest average values compared to the rest of the macroeconomic variables for the sample period. Employment attained the highest maximum and minimum values whereas the money supply growth rate attained the lowest maximum and the lowest negative minimum. The negative lowest minimum value of the money supply growth rate is a direct result of the global financial crisis of 2008 which affected the money supply flow due to high-interest rates. However, the South African Reserve Bank implemented policies to lower interest rates to increase the money

supply growth rate to stimulate economic activities as a result of the negative effects posed by the crisis (Mpofu, 2011).

The household debt-to-disposable income ratio had the second-highest maximum and minimum values, therefore, indicating that the household debt-to-disposable income ratio fluctuated as it attained the highest standard deviation compared to other macroeconomic variables. With an exception of the money supply growth rate, employment and household debt-to-disposable income ratio attained positive skewness values indicating that both series were skewed to the right and were positively distributed. On the other hand, the money supply growth rate showed a negative skewness value indicating the series was skewed to the left and distributed negatively. With regards to the kurtosis values in Table 4.2, all macroeconomic series had kurtosis values that were less than 3 and positive, therefore, the series followed a leptokurtic distribution. The Jarque-Bera test statistics were significant at a 5% significance level as the p-values were less than 0.05.

The significant Jarque-Bera test statistics rejected the null hypothesis that the macroeconomic variables were normally distributed, hence, suggesting that the variables were non-normally distributed. This was supported by the respective skewness values, kurtosis values, and the Jarque-Bera test statistics that all macroeconomic variables were not normally distributed. To support that the macroeconomic variables were not normally distributed, the Shapiro-Wilk and the Anderson-Darling tests were conducted. The p-values of Jarque-Bera, Shapiro-Wilk, and the Anderson-Darling tests were all less than 0.05. Therefore, the null hypothesis that the macroeconomic variables were normally distributed was rejected in favour of the alternative hypothesis that the macroeconomic variables were not normally distributed. The study then concluded that the macroeconomic variables did not follow a normal distribution.

Table 4.2: Descriptive statistics of all variables

	RHPIS	RHPIM	RHPIL	ER	FR	PR	EMP	HDI	MS2
Mean	233.0216	251.5951	259.5782	35.0174	38.0247	67.9145	97.3023	68.7422	12.3069
Median	260.8108	274.2278	279.0541	35.0000	38.0000	67.0000	97.2000	71.2000	11.8000
Maximum	474.4841	510.7880	533.3021	38.5000	42.0000	77.0000	106.5000	87.8000	25.1800
Minimum	59.3066	62.1350	63.9599	29.0000	31.5000	61.5000	88.6000	51.7000	-1.2400
Standard deviation	130.3994	146.8868	155.2976	2.0948	1.9977	3.7288	5.9370	11.8099	5.8452
Skewness	-0.0015	0.0238	0.1046	-0.2963	-0.4649	0.5366	0.0558	0.0028	-0.0271
Kurtosis	1.4869	1.4666	1.5419	2.4134	2.8771	2.5827	1.3904	1.3287	2.1856
Jarque-Bera	25.0900***	25.7918***	23.7794***	7.6203**	9.6380***	14.5281***	28.5271***	30.6115***	7.3008**
Observations	263	263	263	263	263	263	263	263	263
Shapiro-Wilk	0.8926***	0.8842***	0.8912***	0.9537***	0.9740***	0.9585***	0.8822***	0.8670***	0.9804***
Anderson-Darling	10.5380***	11.4086***	10.0430***	3.9765***	1.8993***	2.9579***	11.3198***	14.6462***	1.8162***

Note: ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Source: Own estimations (2021)

4.2.3. Correlation analysis

Table 4.3 below depicts the correlation coefficients of the South African House Price Index and the country risk components. Table 4.4 displays correlation coefficients of the South African House Price Index and the macroeconomic factors. The correlation analysis was conducted to determine whether the South African House Price Index had a significant, insignificant, positive, or negative relationship with the country risk components and the macroeconomic variables. It was essential to investigate if a relationship existed between these sets of variables as it served as confirmation to commence with the empirical model estimation of the Markov regime-switching model and the Markov regime-switching vector autoregressive model. The correlation test was conducted using the ordinary method and probability test statistics.

In Table 4.3 below, the coefficient associated with economic risk and the large house price index was negative and was statistically significant at all levels of significance. This suggested that there exists a significant negative relationship between economic risk and the large house price index. Thus, such findings were consistent with the empirical work by Muzindutsi et al., (2020). The coefficient associated with financial risk and the large house price index was positive and statistically insignificant at all levels of significance, hence, indicating a positive insignificant association between the two variables. This outcome was consistent with the hypothesised association on empirical literature between housing prices and financial risk components (Bank for International Settlements, 2012; Canepa & Khaled, 2018).

The coefficient associated with political risk and the three housing segments was negative and statistically significant at 1%, 5%, and 10%, indicating a significant negative association between the variables. These findings were consistent with empirical work by Monfared and Pavlov (2017) and Muzindutsi et al., (2020). Moreover, the coefficient associated with the small house price index and economic risk was negative and statistically significant at all levels of significance. This indicated that there exists a negative significant association between the variables. Lastly, the coefficient associated with the small house price index and financial risk was positive and statistically insignificant at all levels of significance. These mixed findings seen for small house price index is an empirical one and were consistent with work by the Bank for International Settlements (2012).

It was noted in Table 4.4 that the coefficients associated with the large house price index and employment, the large house price index, and the household debt-to-disposable income ratio were positive and statistically significant at all levels of significance. These findings indicated that there is a positive significant relationship between the respective variables. The findings are in line with that of Sibanda and Mhlanga (2013) and Agnew and Lyons (2018). Furthermore, it was seen in Table 4.4 that the coefficients associated with money supply growth rate and the large house price index, and the medium house price index is depicted as negative and statistically significant at all levels.

This indicated a negative significant association between the variables. These findings were consistent with the empirical work by Mathenge (2017). The coefficient associated with the small house price index and employment and money supply were positive and statistically significant at 1%, 5%, and 10%, indicating a positive significant association. This is supported by Sibanda and Mhlanga (2013) and Agnew and Lyons (2018). In contrast, the coefficient associated with the small house price index and the money supply growth rate is negative and statistically significant at all levels of significance. This was consistent with the hypothesised association evidenced in empirical literature by Mathenge (2017).

Table 4.3: Correlation analysis for RHPI and country risk components

	ER	FR	RHPIL	RHPIM	PR	RHPIS
ER	1.0000					
FR	0.1115*	1.0000				
RHPIL	-0.3830***	0.0422	1.0000			
RHPIM	-0.36161***	0.05842	0.9986***	1.0000		
PR	0.2954***	0.3890***	-0.5583***	-0.5475***	1.0000	
RHPIS	-0.3683***	0.0806	0.9938***	0.9963***	-0.5469***	1.0000

Note: ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Source: Own estimations (2021)

Table 4.4: Correlation analysis for RHPI and macroeconomic variables

	EMP	HDI	RHPIL	MS2	RHPIM	RHPIS
EMP	1.0000					
HDI	0.9138***	1.0000				
RHPIL	0.9366***	0.8473***	1.0000			
MS2	-0.3703***	-0.3012***	-0.4789***	1.0000		
RHPIM	0.9366***	0.8616***	0.9986***	-0.4705***	1.0000	
RHPIS	0.9188***	0.8549***	0.9938***	-0.4864***	0.9963***	1.0000

Note: ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Source: Own estimations (2021)

4.2.4. Autocorrelation

The study employed the LM test and the Durbin-Watson for serial correlation. These tests were conducted to ensure that the estimated models which are analysed in this study are unbiased and reliable. The LM test for serial correlation with up to 2 lags was conducted. The Durbin-Watson tests were only employed to test for autocorrelation between the large house price index and country risk components, and macroeconomics variables. Hence, autocorrelation detection between the large house price index and country risk components, and macroeconomics variables was conducted in the first order using the Durbin-Watson test statistic. On the other hand, the test for the presence of autocorrelation in small and medium house price indexes with country risk components and macroeconomic variables was conducted using a higher-order technique which is the LM test.

Tables 4.5 and 4.6 below depict the results of autocorrelation. The tables have been presented as per the study's objectives. Hence, autocorrelation tests have been conducted between each dependent variable (i.e., small house price index, medium house price index, large price index) and the independent variables (i.e., country risk components and macroeconomic variables). Table 4.5 depicts the LM test for autocorrelation with up to 2 lags results. Since the p-values of the F-Stat. and the Observed R-Squared of the LM tests were greater than 0.05, the null hypothesis that there is no autocorrelation within the small and medium house price indexes, country risk components, and macroeconomic variables was not rejected at 5% level of significance. Table 4.5 shows that the null hypothesis that autocorrelation was absent within the small house price index and macroeconomic variables was not rejected at a 1% level of significance.

Tables 4.6 illustrate the results for the Durbin-Watson tests. Since the DW test statistics fall within the non-rejection region of between 1.5 and 2.5, the null hypothesis that autocorrelation is absent between the large house price index, country risk components, and the macroeconomic variables could not be rejected. To achieve such results, the three house price indexes were first differenced with an exception of the large house price index which was second differenced. Moreover, the house price indexes were logged following a study by Muzindutsi et al., (2020). Furthermore, all country risk components were first differenced and logged. Logging of country risk components also followed the study by Muzindutsi et al., (2020). Macroeconomic variables were first differenced and were not logged as highlighted in Section 3.5.

Table 4.5: LM test

	RHPIS and CRC	RHPIM and CRC	RHPIS & MV	RHPIM and MV
F-Stat	2.5654*	2.2374	3.8086**	1.8323
Obs R-Squared	5.1679*	4.5184	7.5992**	3.7121

Note: ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Source: Own estimations (2021)

Table 4.6: Durbin -Watson test

	RHPIL and MV	RHPIL and MV
DW- Stat	2.1760	2.1407

Source: Own estimations (2021)

4.2.5. Heteroskedasticity

Heteroskedasticity in this study was examined using the White test and the results for the tests are presented in Table 4.7 below with significance levels associated with the observed chi-squared. In Table 4.7 the probability values associated with the chi-square statistic were greater than 0.05. Thus, at a 5% level of significance, the null hypothesis of a no heteroskedasticity could not be rejected. This being so, the models employed in this study (RADF, Markov regime-switching model, and the MS-VAR) did not exhibit heteroskedasticity since their errors were homoskedastic at a 5% significance level. In Table 4.7, the probability value associated with the chi-square statistic was greater than 0.01.

Hence, the null hypothesis that there is no heteroskedasticity in the models could not be rejected at a 1 % level of significance. Given this, the residuals of the Markov regime-switching model and the MS-VAR model estimated for research objectives two and three did not exhibit heteroskedasticity. Overall, the results of the tests conducted suggested that the estimated models for research questions one, two, and three were unbiased and reliable since the errors of these models did not display autocorrelation and heteroskedasticity.

Table 4.7: Heteroskedasticity test

	Obs R-Squared
RHPIS and CRC	8.9980
RHPIM and CRC	11.2853
RHPIL and CRC	16.4955**
RHPIS and MV	19.8363
RHPIM and MV	11.7690
RHPIL and MV	15.1722*

Note: ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively

Source: Own estimations (2021)

4.3. Empirical results

In this section, for research objective 1, the presence of bubbles in the South African housing market was examined in Section 4.3.1 using the right-tailed ADF test techniques which are the SADF and GSADF. For research objective 2, the impact of country risk components on the South African housing market in bullish and bearish market conditions was investigated using the Markov regime-switching model of conditional mean in Section 4.3.2. For the last research objective 3, the effect of macroeconomic factors on the South African housing market under changing market conditions was examined using the Markov vector autoregressive model in Section 4.3.3.

4.3.1. Right-tailed ADF tests

Table 4.8 depicts the empirical results for both the SADF and the GSADF tests of each real house price index. The study found that based on both the SADF and the GSADF, the null hypothesis that there is a bubble in the South African housing market of the small, medium, and large houses were rejected in favour of the alternative hypothesis that there is an explosive behaviour/bubble in the South African housing market. Phillips et al., (2013) revealed that the moving sample GSADF diagnostic was superior to the SADF test based on an expanding sample size in detecting explosive behaviour in multiple bubble episodes and does not give false results, even in relatively modest sample sizes. The reason was that the GSADF test covers more subsamples of the data series. Therefore, based on this argument, the study concluded that there is evidence of multiple bubbles in the South African housing market of small, medium, and large houses.

To locate specific bubble periods, the study compared the backward SADF statistic sequence with the 95% SADF critical value sequence which was obtained from the Monte Carlo simulation with 1000 replications. The official starting point for each real house price index was 1995:01 to 2016:11. The study used an initial window size of 32 to start the recursive estimation. Figures 4.1 to 4.2 shows results for the date-stamping strategy over the sample period for small, medium, and large house price index respectively. The starting of a bubble was estimated at the date when the GSADF-t-statistic (the blue line) exceeded its corresponding critical value of the right-tailed unit root test illustrated by the red line. The end of an explosive bubble was determined at the first period when the GSADF-t-statistic was below the aforementioned critical value.

Based on Figure 4.1 to 4.2 for each housing segment, it was seen that there was evidence of multiple housing bubbles over the sample period. Firstly, in all three housing segments, it was seen that there is evidence of bubble episodes from 1997 to 1998. The presence of bubble episodes around this period was explained by the new democratic order of 1994 as confidence was restored with a rise in housing demand as more black middle class supported the demand for housing in previously white-only residential areas and allowed the economy to grow (Luus, 2005). Moreover, more skilled professionals and policymakers during this period served to keep the housing market under pressure with lower interest and inflation rates, higher economic growth, and a more improved fiscal policy (Luus, 2005).

Another reason for the huge increase in house prices was the decrease in transfer duties on housing as well as a rise in housing finance to the lower-income households (Patterson & Steenkamp, 2017). Unfortunately, in 1998, contagion effects from the Asian crisis of 1998 caused a huge decline in the South African rand value which in turn caused interest rates to rise by 7% points during 1998. Therefore, as illustrated in all three segments, the bubble burst as house prices decreased drastically. However, from late 1999 to 2000 the house price boom resumed as can be observed in the large and medium house price indexes as the situation stabilised. The lowest bubble burst in 2002 in all three segments was explained by the 2000/01 dot com bubble and the recession that followed.

However, despite this, a bubble was detected from late 2002 to 2005 in all three housing segments as house prices had nearly doubled in both nominal and real terms from their 1998 values (Luus, 2005). According to Simo-Kengne et al., (2012), this was a result of higher inflation and interest rates set by the monetary policy committee. The evidence of bubble

during the global financial crisis of 2008 was detected in the study on all three housing segments. However, the huge explosive behaviour in the three housing segments ended following the implementation of the National Credit Act of 2008. This limited the funds that could be borrowed to South African households along with a rise in interest rates and the slowing economic growth due to the global financial crisis (The Banking Association South Africa, 2021). During 2010 and 2012, following the global financial crisis, the housing market recovered very well which resulted in the formation of bubbles. The presence of bubbles detected in this period was linked to the 2010 FIFA world cup as South Africa was receiving attention from foreign investors allowing the economy to grow significantly (Bond & Cottle, 2011).

The study noted that the South African large and medium house price indexes rose above the small house price index throughout the sample period. With this being said, more significant bubble episodes were detected from the medium and large house price indexes. From 2008 throughout the end of the sample period, mortgage growth rates were decreasing to less than 5% and house prices continued to increase, hence, bubble episodes were detected. However, the South African monetary authorities increased interest rates to discourage households from borrowing funds to finance their houses (Luus, 2005). This then lowered housing demand as it is illustrated in Figure 4.1 to 4.2 bubble episodes were declining in all three housing segments. In conclusion, the findings above provide a reasonable basis for concluding that housing bubbles emerge in near-simultaneous patterns across the three segments.

Table 4.8: SADF and GSADF tests

RHPI	SADF	GSADF	Start and end dates of housing bubbles based on GSADF	Highest peak of housing bubbles
RHPIS	3.0777***	3.7294***	1997/09-1998/07; 2002/10-2002/11; 2003/05-2005/04; 2005/04-2010/07; 2010/07-2016/11.	1997/12; 2003/12; 2008/07; 2009/05; 2010/03; 2012/01
RHPIM	3.0911***	3.9518***	1997/09-1998/07; 2000/03-2000/07; 2003/04-2016/11	1998/02; 2003/11-2004/04; 2008/04; 2009/04; 2012/02
RHPIL	2.5143***	3.8463***	1997/08-1998/05; 2000/01-2000/06; 2001/06-2001/12; 2003/04-2016/11	1997/11; 2000/03; 2004/04; 2006/06; 2008/08; 2012/03

Note:

1. ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively
2. Null hypothesis: Contains unit root/no bubble,
Alternative hypothesis: Trend stationary/explosive behaviour(bubble).

Source: Own estimations (2021)

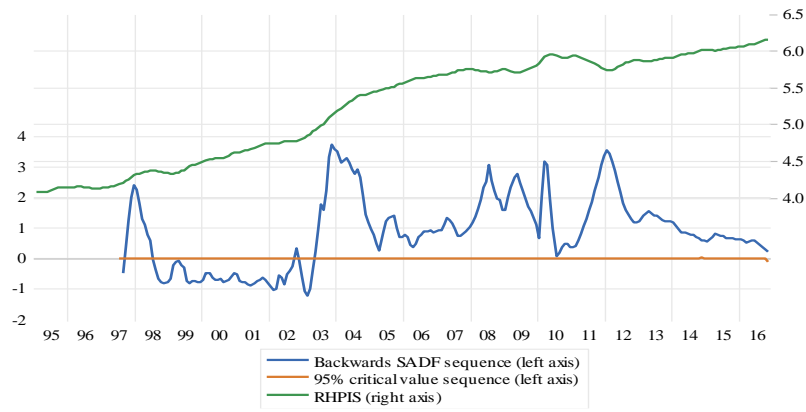


Figure 4.1: RHPIS GSADF

Source: Own compilation (2021)

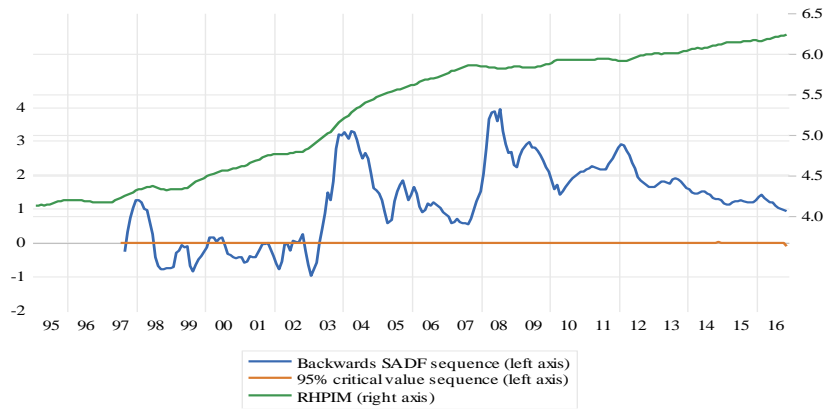


Figure 4.2: RHPIM GSADF

Source: Own compilation (2021)

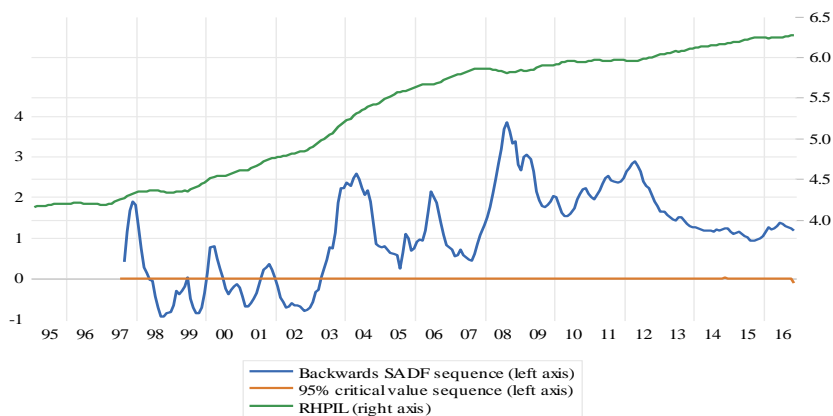


Figure 4.3: RHPIL GSADF

Source: Own compilation (2021)

4.3.2. Markov regime-switching model of conditional mean

The study estimated the empirical model and presented it in this section as it allowed for the examination of objective 2. Therefore, the estimated output of the empirical model and the normality test were analysed. Table 4.9 below comprise three panels. Panel 1 and 2 are the state regimes, that being, a bullish and bearish market condition, whereas panel three is the normality test for each model as per housing segment. Hence, a is the mean of the logged price of housing for each segment in each respective regime. RHPIS is the real house price index for the small segment, RHPIM real house price index for the medium segment, RHPIL is the real house price index for the large segment, and LOG(SIGMA) is the error variance.

In Table 4.9, intercept a represent the mean logged price of each RHPI segment in each regime. In a bullish market condition, the small house price index attained an intercept of 0.0081 which was higher than that of the bearish market condition of 0.0076 which implied that the average price of small houses was higher in a bullish market. This is what distinguishes the bull and bear regimes respectively. Moreover, both regime-specific intercepts were significant at a 1% level of significance. Correspondingly, the error variance represented by LOG(SIGMA) associated with the bullish and bearish market conditions of the small house price index was significant at a 1% significance level. Furthermore, the error variance showed that, in a bullish market, there was high volatility in the small house price index as expressed by the LOG(SIGMA) of -5.2080 while the bearish market maintained an error variance of -4.0932. This implied that homeowners in the small housing market were compensated for assuming risk.

Moreover, in Table 4.9, panel one, the coefficients associated with economic risk (ER), financial risk (FR), and political risk (PR) were positive in a bullish market. The economic risk was found to be statistically significant at a 1 % level of significance whereas the financial and political risk was not significant in all levels of significance. Therefore, the financial and political risk did not affect the small house price in a bullish market condition. The findings indicated that economic risk had a significant positive impact on the small house price index in a bullish market condition. Hence, in a bullish market condition, a 1 percent increase or decrease in economic risk will cause an increase in the small house price index by 0.3%, *ceteris paribus*.

In panel two of Table 4.9, in a bearish market condition, the coefficients associated with economic risk were negative whereas the coefficient associated with financial risk and political risk was positive. The coefficients associated with economic, financial, and political risk scores did not prove to be statistically significant in a bearish market implying that the price of small houses was not determined by country risk components in a bearish market condition. When a comparison was conducted between the bullish and bearish regimes, the coefficient associated with economic risk was positive and statistically significant in a bullish market regime. However, in a bearish market regime, the coefficient associated with economic risk was negative and statistically insignificant. The findings suggested that economic risk affected the small house price index differently in upper and lower market conditions. This confirmed the AMH theory, as alternating efficiency and effects were presented in the small house price index (Lo, 2004). In answering research objective two, the small house price index was significantly positively affected by economic risk in a bullish market.

In Table 4.9, panel 3, the Jarque-Bera test for normality for RHPIS was presented with the Jarque-Bera statistic and its significance level (*). It was evident that the Jarque-Bera statistic was insignificant as the p-value was 0.1039. This allowed for the non-rejection of the null hypothesis that the residuals were normally distributed in favour of the alternate hypothesis that the residuals were not normally distributed at all levels of significance. The study confirmed that the residuals presented by Equation 3.30 were normally distributed.

In panels one and two of Table 4.9, the medium house price index attained a higher intercept (a) of 2.4766 in a bullish market regime and a lower intercept of 0.0795 in a bearish market respectively. Therefore, this means that the average price of medium housing was higher in a bullish market. Moreover, both intercepts of the bullish and bearish market conditions were statistically significant at a 1% significance level. The bull market appeared to be more volatile (0.9034) than the bear market condition (-0.2812) indicating that similar to the small house price index, residential property investors in the medium housing were compensated for risk. All coefficients associated with the economic risk, financial risk, and political risk were positive.

In a bullish market condition, economic, financial, and political risks were statistically insignificant. Furthermore, in a bearish market condition, the economic risk was also found to be statistically insignificant. However, financial and political risks were found to be statistically significant at a 5% level of significance in a bearish regime. Therefore, in a bull market,

economic, financial, and political risk was found to have no impact on the prices of medium houses. In addition, the economic risk was found to have no impact on medium house prices in bear market conditions. The medium house price index was significantly positively affected by financial risk in a bearish market condition. Hence, if the financial risk score was said to fluctuate, the medium house price index will increase by 2.64 percent, *ceteris paribus*. Additionally, the political risk score had a positive impact on the medium house price index in a bear market condition. This means that the medium house price index will increase by 3.20 percent when the political risk score changes, *ceteris paribus*.

The findings depict that the coefficient of economic, financial, and political risk scores was positive in both bull and bear market conditions. Furthermore, where financial and political risk was insignificant in a bullish regime, it was significant in a bearish regime. This showed that the effects of country risk components on medium housing prices were regime-dependent and varied according to the market conditions. Hence, the notion proposed by AMH of alternating efficiency and inefficiency was presented in the medium house price index (Lo, 2004). In panel 3, the Jarque-Bera normality test for RHPIM was presented together with the Jarque-Bera statistic. It was evident that the p-value associated with the Jarque-Bera statistic was 0.00. Therefore, the null hypothesis that the residuals were normally distributed was rejected in favour of the alternate hypothesis that the residuals were not normally distributed at a 1 percent significance level. The study confirmed departure from normality in the residuals of the estimated model presented by Equation 3.31.

In a study by Campbell (2002), the normality assumption with regards to regime-switching models was inconsistent. It was found that when there existed a two-state regime with a high volatility state, the normality assumption was violated. According to Campbell (2002), this was owing to the volatile regime containing a distribution that was negatively skewed and leptokurtic regarding the normal distribution. Therefore, the departure from normality in a two-regime model with a high volatile regime was evident and did not affect the efficiency of the output. Given that the bearish market condition was categorised by a decrease in prices (contain negative prices), it was negatively skewed.

The study considered such a regime as a highly volatile regime, as it was found above that the bearish market condition error variance (LOGSIGMA) was more volatile than the bullish market condition. Further to this, a study conducted by Maheu and McCurdy (2002) and Cunado, Gil-Alana, and de Gracia (2009) considered the bearish market condition as a volatile regime. Hence, if the Jarque-Bera normality test found departure from normality in the estimated residuals, such an explanation was relevant.

On the last part of Table 4.9, panels one and two, the intercepts α in both the bull and bear market conditions are statistically insignificant. The bullish market condition appeared to be less volatile (-0.6642) than the bearish market condition (0.6280) denoting that the large house price index was more volatile in a bearish market regime. Moreover, the error variances of the bull (-0.6642) and bear (0.6280) market conditions were statistically significant at a 1 percent level of significance. In panel one, the coefficient associated with economic risk was negative and statistically insignificant. Financial risk was statistically significant at a 1 percent significance level and was associated with a positive coefficient. This meant that a 1 percent increase or decrease in economic risk caused the large house price index to decrease by 8.68 percent in a bullish market, *ceteris paribus*.

Moreover, in the first panel, the coefficient associated with political risk was positive and statistically significant at a 10 percent significance level. Thus, a 1 percent increase/decrease in political risk caused the large house price index to increase by 6.14 percent in a bullish market, *ceteris paribus*. In Table 4.9, panel two, coefficients associated with economic, financial, and political risks were positive and statistically insignificant. It was found that the coefficient of economic risk was negative in a bull market condition and was positive in a bear market condition. Also, Financial and political risk scores were found to be significant in a bullish regime and insignificant in a bearish regime. Thus, AMH was confirmed by these results as country risk components influenced the large house price index differently under changing market conditions. Therefore, in answering objective 2, the large house price index was significantly positively affected by financial and political risk in a bullish market condition.

In Table 4.9, panel 3, the Jarque-Bera normality test for RHPIL was presented together with the Jarque-Bera statistic. It was evident that the p-value associated with the Jarque-Bera statistic was 0.00. Therefore, the null hypothesis that the residuals were normally distributed was rejected in favour of the alternate hypothesis that the residuals were not normally distributed at

a 1 percent significance level. The study confirmed the departure from normality in the residuals of the estimated Equation 3.32.

Table 4.9: RHPI Markov regime-switching model of conditional mean

Regime 1: Bullish market condition			
Independent Variable	RHPIS	RHPIM	RHPIL
a_{s_t}	0.0081***	2.4766***	0.0278
ER	0.0030***	0.1508	-0.0868
FR	0.0004	0.0457	0.2142***
PR	0.0004	0.0073	0.0953*
LOG(SIGMA)	-5.2080***	0.9034***	-0.6642***
Regime 2: Bearish market condition			
a_{s_t}	0.0076***	0.6355***	0.0264
ER	-0.0005	0.0795	0.1766
FR	0.0016	0.1925**	0.0091
PR	0.0021	0.1568**	0.2021
LOG(SIGMA)	-4.0932***	-0.2812***	0.6280***
Jarque-Bera (Normality)	4.5278	19.9162***	54.2922***

Note: ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively

Source: Own estimations (2021)

4.3.2.1. Regime-specific transition probabilities and expected duration

The transition probabilities and constant expected duration were estimated to compare the levels of bullish and bearish market conditions across the three housing segments. Table 4.10 below provides the transition probabilities and the constant expected duration associated with each housing segment. The first, second, and third panels of Table 4.10 present the regime probabilities and the constant expected duration associated with each house price index. The results for the small house price index indicated that the probability of a bullish regime remaining in a bullish regime is 0.9490 higher than the probability of starting in a bearish regime and remaining in a bearish regime in the next period which is 0.9334. The transition probabilities were closer to 1. This suggested that the small house price index spent more time in a bull market condition as opposed to the bear market condition.

This was further confirmed by the constant expected duration as the small house price index spent approximately 19 months in a bullish regime and 15 months in a bearish regime. Moreover, for the medium house price index, the probability of a bullish regime remaining in a bullish regime of 0.9894 is higher than the probability of starting in a bearish regime and

remaining in a bearish regime 0.9859 in the following month. Thus, this suggested that the medium house price index has a tendency of remaining in the bullish market for the next month. This result was consistent with the constant expected duration as the medium house price index was expected to remain for approximately 94 months in a bullish regime and approximately 70 months in a bearish regime.

Unlike the small and medium house price indexes, the results for the large house price index show that the probability of a bearish regime remaining in a bearish regime is 0.9959 higher than the probability of starting in a bullish regime and remaining in a bullish regime of 0.9945 in the next month. This indicated that the large house price index stayed longer periods in bear market condition as the transition properties were between 0.9959 and 0.9945, which was very close to 1. This was confirmed by the constant expected duration that indicated that the large house price index spent approximately 244 months in a bearish regime and approximately 183 months in a bullish regime.

Having discussed the findings of each house price index individually, the study conducted a comparison. The first clear sign presented herein is that the large house price index stayed the longest in a bullish market condition (183 months) when compared to the small and medium house price index. This was followed by the medium house price index (94 months) and the small house price index (19 months). In contrast, the study found that the large house price index remained the longest in the bearish regime (244 months) compared to other house price indices. This was followed by the medium house price index (70 months) and the small house price index (15 months).

The findings of the large house price index in a bull and bear market condition were in line with their transition probabilities as both regimes moved from a bullish regime to a bearish regime and from a bearish regime to a bullish regime condition faster than other house price indices. Furthermore, the study found that of the two market conditions (bullish and bearish conditions), the bullish market condition was more persistent among the house price indices as the medium house price index and the small house price index stayed the longest in a bullish regime as opposed to a bearish regime.

Table 4.10: Markov transition probabilities and expected duration

RHPIS		
Transition Probability	Regime 1	Regime 2
Regime 1	0.9490	0.0510
Regime 2	0.0666	0.9334
Constant Expected Duration	19.5946	15.0120
RHPIM		
Regime 1	0.9894	0.0106
Regime 2	0.0141	0.9859
Constant Expected Duration	94.1343	70.8551
RHPIL		
Regime 1	0.9945	0.0055
Regime 2	0.0041	0.9959
Constant Expected Duration	183.0444	244.4353

Source: Own estimations (2021)

4.3.2.2. Smooth regime probabilities

This section focuses on the interpretation of smooth regime probabilities graphs as it enabled the identification of the changes in house prices of each segment with reference to the prevailing market conditions. Thus, the graphical presentation of the smooth regime probabilities of each house price index and the interpretations are contained in this section.

In Figure 4.4, the smoothed regime probabilities graph associated with the small house price index indicated that the small house price index entered a bull or bear market condition and it tended to remain in the respective regime for a long period. This was seen as the small house price index remained in a bullish regime from 1995 to 1996, 1996 to 1997, 1997 to 1998, 1999 to 2002, 2004 to 2008, 2012 to 2015, and from 2015 to 2016. This finding was supported by the high transition probabilities and the constant expected duration of the small house price index given in Table 4.10. The period that the small house price index remained in a bearish regime was in line with the contagion effects of the Asian financial crisis of 1966-1997, the Russian financial crisis of 1998, the 2000/01 dot com bubble, the global financial crisis of 2007/08 and the euro-zone crisis of 2009 to 2012.

The market events saw a decrease in the global house prices due to negative effects associated with the events. These market events lead to a fall in the rand value with a significant rise in interest rates, thus discouraging housing activities in the respective bearish periods (Simo-Kengne et al., 2012). It was said, once the housing market entered a bearish regime, categorised by decreasing prices, the small house price index immediately entered into a bullish regime, categorised by increasing house prices. Hence, after the bear periods, the bull period took place.

According to the smoothed regime probability graph for the medium house price index in Figure 4.5, house prices started in a bearish regime from the start of the sample period 1995 to 2002, after which it switched to a bullish regime from 2002 to 2010. In 2010, the medium house price index remained in a bearish market condition after which it started a bullish regime in 2011 and remained in it till the end of the sample period in 2016, reinforcing the idea that when the medium house price index switches regimes, it remains in the new regime for a long period. This suggests that the medium house price index stayed longer in a bullish regime as it has been confirmed by the constant expected duration presented in Table 4.10. The bearish period from 1995 to 2002 and 2010 was associated with the effects of the South African new democratic order that started in 1994 post-apartheid, the Asian financial crisis of 2007, the 1998 Russian financial crisis, the 2000/01 dot com bubble, the pre-post 2008 global financial crisis and the euro-zone crisis of 2009 to 2012.

In Figure 4.6, the smoothed probability graph for the large house price index, it is evident that house prices in the large housing segment started in a bullish regime from the start of the sample period in 1995 to 2002 after which it switched to a bearish regime till the end of the sample period in 2016. This suggested that the large house price index remained in a bearish regime for a longer period than it remained in a bullish regime. This was confirmed by the higher constant expected duration of remaining in a bear regime in Table 4.10.

The bullish regime was associated with the opening of markets in South Africa after the attainment of democracy post-apartheid in 1994 which allowed more people into the housing market as previously disadvantaged people were allowed to buy houses in the large house segment. However, for the bearish period from 2001 to 2016, the bearish regime was associated with the contagion effects of the 2000/01 dot com bubble, the pre-post 2008 global financial crisis, and the euro-zone crisis of 2009 to 2012. These effects explained how the housing market reacted with regards to a decrease/increase in house prices, therefore affecting the formation of bullish and bearish regimes.

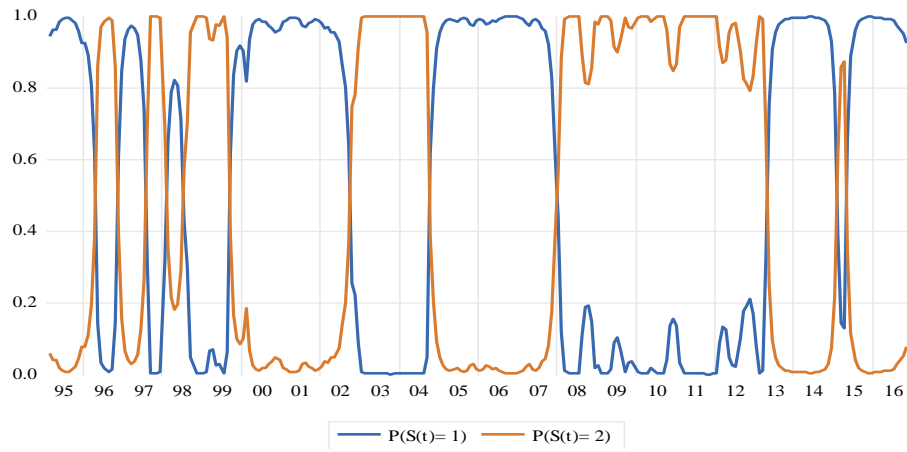


Figure 4.4: RHPIS smoothed regime probability

Source: Own compilation (2021)

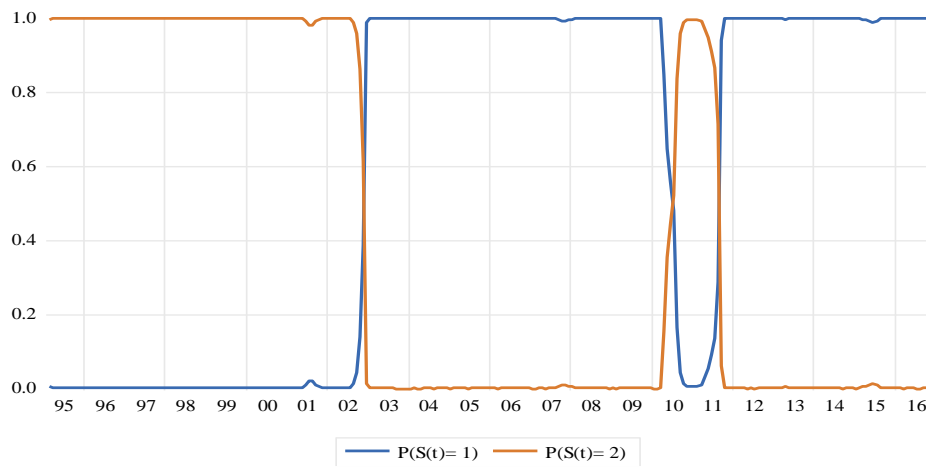


Figure 4.5: RHPIM smoothed regime probability

Source: Own compilation (2021)

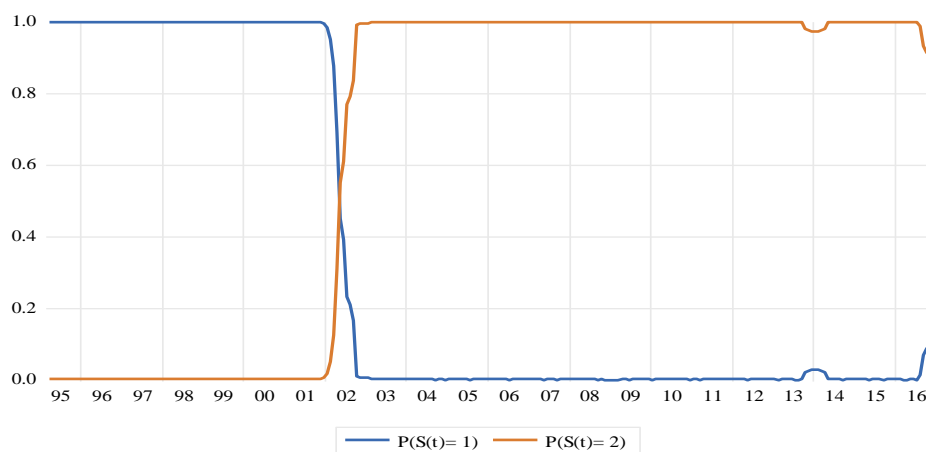


Figure 4.6: RHPIL smoothed regime probability

Source: Own compilation (2021)

4.3.3. Markov switching vector autoregressive (MS-VAR) model

After the macroeconomic variables and house price index data were found to be stationary, the Markov switching vector autoregressive model was estimated to achieve objective 3 which was to examine how the selected South African macroeconomic variables namely employment, household debt-to-disposable income ratio, and money supply growth rate affected the South African house prices of small, medium and large houses. The MS-VAR model had been estimated to cater for two states regimes, namely a bullish market condition which is regime 1, and a bearish market condition which is regime 2. Moreover, the MS-VAR model has been estimated for each housing segment. Therefore, each MS-VAR model was run with an optimal lag length of 12 lags as given by the Akaike Information Criterion and the Schwarz Information Criterion.

To test for the stability of the MS-VAR model with 12 lags, the study used the AR Roots Graph and the AR Roots Table. The inverse roots of the characteristic AR polynomial revealed that all estimated MS-VAR models in this study were stable as the roots had a modulus of less than one and were inside the unit circle (Lutkepohl, 1991). The results of the AR Roots Graphs are presented in Appendix c. The estimated results of each MS-VAR model are presented in tables in Appendix A. The results for the MS-VAR model for the small house price index are presented in Table A1 of Appendix F. It was evident from Table A1 that the value of the intercept, coefficients, and most importantly the variance of the variable represented by SIGMA vary significantly between the two regimes.

In Table A1 of Appendix A, the variance of the small house price index equation represented by SIGMA is lower in a bullish market compared to a bearish market. This was expected as the bullish market was associated with lower volatility compared to the bearish market condition. Moreover, the variance of the money supply growth rate equation was lower in a bullish market condition compared to a bearish market condition. On the other hand, the variance of employment and household debt-to-disposable income ratio was higher in regime 1 compared to regime 2. In Table A1 of Appendix A, the intercept for the small house price index in regime 1 was much higher than the intercept in regime 2.

This was expected as the bullish market was associated with increasing prices compared to a bearish market which is associated with decreasing prices. The intercept for employment, household debt-to-disposable income ratio, and money supply growth rate was lower in a bullish market than in a bearish market condition. When a comparison was conducted between

the bullish and bearish market conditions for Equation 3.40 the intercepts, variances were switching between the two regimes, thus confirming the AMH theory as alternating efficiencies were present.

In Table A2 of Appendix A, the intercept for the medium house price index in regime 1 was lower than the intercept in regime 2. The intercept for employment, household debt-to-disposable income ratio, and the money supply growth rate was lower in a bullish market than in a bearish market condition. Further to this, the variance of the medium house price index equation represented by SIGMA was lower in a bullish market condition compared to a bearish market condition. The low variance in the medium house price index equation means that there was lower volatility in the middle housing segment in a bull market condition compared to the high volatility in the bear market condition. Moreover, the variance of the employment equation was lower in regime 1 and higher in regime 2. The variance for the household debt-to-disposable income ratio and money supply growth rate in a bullish regime was significantly lower in a bearish regime. It was noted that for Equation 3.40, the intercepts and variances were switching between the two regimes. This confirmed the AMH theory as alternating efficiencies were present.

In Table A3 of Appendix A, the intercept for the large house price index was much lower in a bullish regime compared to a bearish regime. The intercept for employment, household debt-to-disposable income ratio, and money supply growth rate was higher in regime 1 compared to regime 2. The variance for the large house price index equation was higher in a bull market and lower in a bear market condition. Furthermore, the variance for employment equation, household debt-to-disposable income ratio equation, and money supply growth rate equation was lower in a bullish regime and higher in a bearish regime.

Table 4.11 below presents the estimated transition probabilities and the expected duration of the respective two regimes for each MS-VAR model. For the first MS-VAR model as presented by RHPIS, the chance of remaining in a bearish market given that the market was in a bearish market condition in the previous period was approximately 75%. There was approximately 88% chance of switching from a bearish regime to a bullish regime, whilst there was approximately a 25% chance of switching from a bullish regime to a bearish regime. Moreover, there was approximately an 11% chance of remaining in a bullish market condition given that the market was in a bullish market condition in the previous period. The constant expected duration of regime 1 and regime 2 were approximately 1.13 and 3.99 months respectively.

For the second MS-VAR model represented by RHPIM, the transition probability of being in regime 1 given that the market was in regime 1 in the previous period was 0.877 (approximately 88% chance). There was approximately 81% chance of being in a bearish market condition given that the market was in a bearish market condition in the previous period. In addition, there was approximately a 12% chance of switching from a bearish regime to a bullish regime, whilst there was approximately a 19% chance of switching from a bullish regime to a bearish regime. The constant expected duration for the bullish regime was approximately 8.13 months whilst it was approximately 5.28 for the bearish regime.

In Table 4.11, on the third MS-VAR model represented by RHPIL, there was approximately a 19 % chance of being in a bearish regime provided that the market was in a bearish regime in the previous period. Moreover, there was approximately a 70% chance of being in a bullish regime given that the market was in a bullish regime in the previous period. There was approximately a 30% chance of switching from a bearish regime to a bullish regime, whilst there was an approximately 81% chance of switching from a bullish regime to a bearish regime. The constant expected duration of both the bull and bear market conditions were approximately 3.31 and 1.24 months respectively.

Table: 4.11: MS-VAR transition probabilities and constant expected

RHPIS		
Transition Probability	Regime 1	Regime 2
Regime 1	0.1139	0.8861
Regime 2	0.2509	0.7491
Constant Expected Duration	1.1285	3.9856
RHPIM		
Regime 1	0.8770	0.1230
Regime 2	0.1892	0.8108
Constant Expected Duration	8.1309	5.2842
RHPIL		
Regime 1	0.6974	0.3025
Regime 2	0.8095	0.1905
Constant Expected Duration	3.3049	1.2353

Source: Own estimations (2021)

4.3.3.1. MS-VAR smoothed regime probabilities

Figure 4.7, Figure 4.8, and Figure 4.9 below present the estimated smoothed probabilities of being in a bullish and bearish market condition respectively. Looking at the smoothed probability graph in Figure 4.7, it seems that the market has been highly volatile and impersistent. This is supported by transition probabilities and expected duration in the RHPIS. According to Simo-Kengne (2012), the two regimes are persistent with transition probabilities lying between 0.87 and 0.89. Therefore, in the case of Figure 4.7, the market moved quickly from one regime to another. This was supported by the low average expected duration of each regime. However, it was noted that in Figure 4.7, the market started from a bearish regime in 1996. Moreover, in 2002 and 2006, the market was in a bullish regime. In 2008, the market was in a bearish regime.

In Figure 4.8 for RHPIM, it seems that the bullish market was the prevailing market throughout the sample period between of periods of 1996 to 2003, 2004 to 2008, 2009 to 2010, from late 2010 to 2014, and in 2015. These periods coincide with some important socio-political conditions and economic features that prevailed in South Africa such as the opening of markets after the attainment of democracy in 1994 which allowed more people from different races to participate in the market. The market was in a bearish condition in 2003, 2008 to 2009, 2015, and at the beginning of 2016. The first downturn period matched the market events such as the 2000/01 dot com bubble and the 2008 global financial crisis. The global events have contributed to the slowdown of the South African economy due to contagion effects. The last two downswings of 2015 and the beginning of 2016 were partially attributed to the economic downturn associated with low employment in the South African economy (The World Bank, 2018).

The smoothed probabilities presented in Figure 4.9, appeared to be more volatile and impersistent. This was supported by transition probabilities and the constant expected duration presented by the RHPIL. Hence, the market did not stay for longer periods in each regime. However, it was observed in Figure 4.9 that the market commenced in a bullish regime at the beginning of the sample period and was in a bullish regime in 2008, 2012, and 2016.

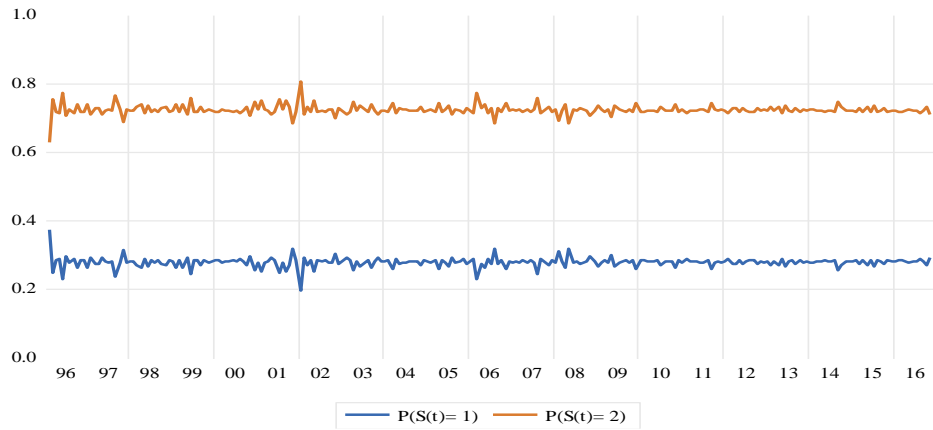


Figure 4.7: MS-VAR RHPIS smoothed regime probability

Source: Own compilation (2021)

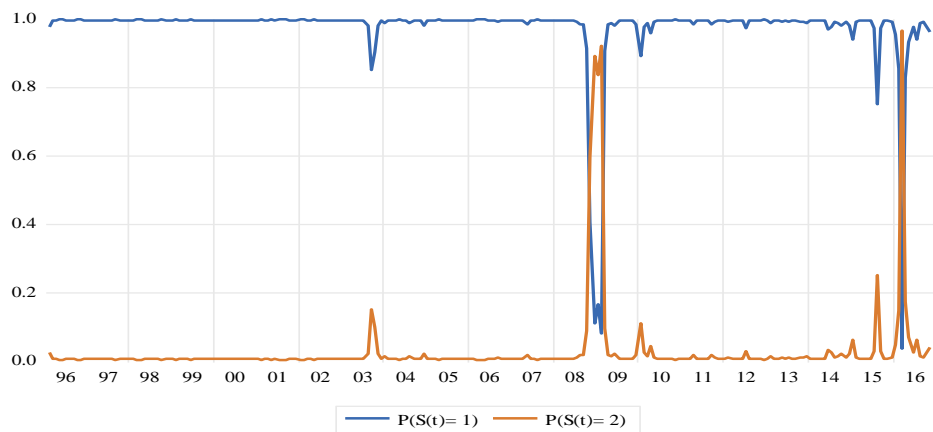


Figure 4.8: MS-VAR RHPIM smoothed regime probability

Source: Own compilation (2021)

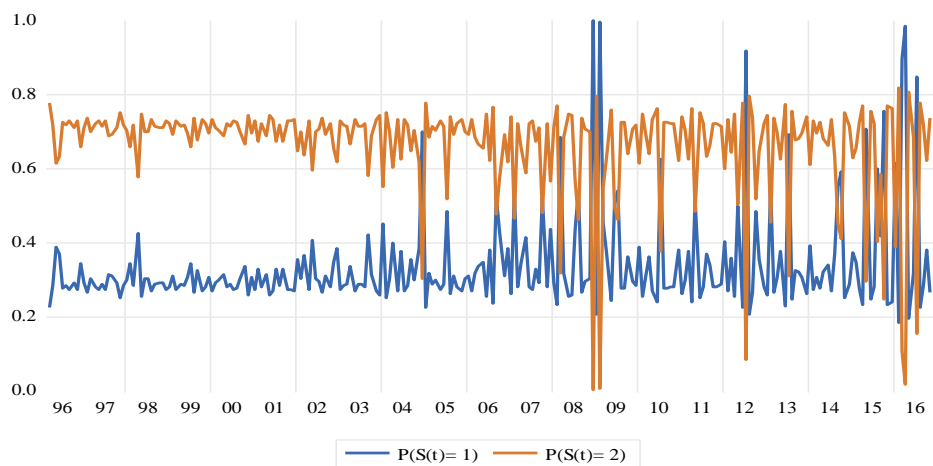


Figure 4.9: MS-VAR RHPIL smoothed regime probability

Source: Own compilation (2021)

4.3.3.2. Regime dependent impulse response functions

Firstly, the study analysed Figure 4.10 below depicting the response of the small house price index to shocks in the selected macroeconomic variables in a bullish regime and a bearish regime. In regime 1, a one standard deviation shock to employment initially decreased the small house price index from the first period until it reached -0.0001% in the second period. This negative response started to increase from the second period where it goes beyond the steady-state level and becomes positive until it reaches the highest peak of 0.0003% in the third period and remains in the positive region up to the fourth period. After the fourth period, a one standard deviation shock to employment decreased the small house price index until it declined below its steady-state value (0.0000) and remained in the negative region.

In a bullish market condition, a one standard deviation shock to household debt-to-disposable income ratio initially increases the small house price index from the first period until period two where it is 0.0020% . After the second period, a one standard deviation shock to household debt-to-disposable income ratio decreases the small house price index until period five where it reached 0.0027% . There was a noticeable increase in the small house price index from the fifth period to the sixth period where it reached 0.0030% . A one standard deviation shock to household debt-to-disposable income ratio had no noticeable impact on the small house price index from period six to period eight. However, from period eight to period nine, the small house price index increased until it reached a maximum percentage variation of 0.0033% in the ninth period. Beyond period nine, the small house price index declined above the steady-state level and remained in the positive region.

In regime 1, a one standard deviation shock to money supply growth rate decreased the small house price index below its steady-state level from the first period until it reached -0.0028% in the second period. The small house price index started to increase within its negative region from the second period to the third period and reached -0.0001% due to a one standard deviation shock in the money supply growth rate. Furthermore, from the third period, a one standard deviation shock on the money supply growth rate decreased the small house price index to -0.0003% in the fourth period. After period four, the small house price index started to increase within the negative region to -0.0001% in period five and then declined sharply from period five to the sixth period and reached -0.0006% . From period six, the response of the small house price index increased gradually below the steady-state level and remained in the negative region.

In a bearish market condition, the response of the small house price index to a one standard deviation shock on employment was initially negative from the first period to the second period where it was -0.0002%. It started to rise below its steady-state level from the second period and reached -0.0001% in the third period and then declined further to -0.0002% in the fourth period. There appeared to be no noticeable effect of a one standard deviation shock on employment to small house price index as the values remained at -0.0002% from period four to period five. However, from period five, there was a sharp decline in the small house price index to period six where it reached -0.0005% as a result of a one standard deviation shock in employment. From period six, the small house price index increased gradually until period nine where it reached -0.0004%. Beyond period nine, the small house price index declined sharply and remained in the negative region.

The response of the small house price index to a one standard deviation shock to household debt-to-disposable income ratio was positive and above the steady-state level in regime 2. Initially, a one standard deviation shock to household debt-to-disposable income ratio increased the small house price index from the first period to 0.0005% in the second period. From the second period, there was a gradual increase in the small house price index until period four where it reached 0.0007%. A one standard deviation shock to household debt-to-disposable income ratio decreased the small house price index from period four to period five where it was 0.0005% and then started to increase to period six and reached 0.0007%. After period six, the response of the small house price index gradually declined until period nine and then began to decline sharply beyond period nine.

A one standard deviation shock to money supply growth rate decreased the small house price index below the steady-state level from period one to period two where it was -0.0005% and then started increasing to the third period to -0.0002%. After period three, there was a decline in the small house price index to period four where it reached -0.0005% and then increased to period five. There was a sharp decline in the small house price index from period five to period six due to a one standard deviation shock in the money supply growth rate. After period six, there was no noticeable impact of a one standard deviation shock on the small hour piece index to period seven. Beyond the seventh period, the small house price index increased below its steady-state level and remains in the negative regime.

Secondly, the study analysed Figure 4.11 that shows the response of the medium house price index to a one standard deviation shock on the selected macroeconomic variables in regime 1 and regime 2. On the first impulse response function in regime 1, the response of the medium house price index to a one standard deviation shock on employment was not noticeable from period one to period two as it was at the steady-state level (0.0000). From the second period, the response of the medium price index gradually increased above the steady-state level until it reached 0.0309% in period three and then declined until it passed through the steady-state level to the fourth period where it reached -0.0116%. Beyond period four, the medium house price index decreased below its steady-state value until period six and reached -0.1357%. After period six, a one standard deviation shock to employment increased the medium house price index above its steady-state level and remained in the positive region.

In a bullish market condition, a one standard deviation shock to household debt-to-disposable income ratio increased the medium house price index above its steady-state level from period one to period two where it reached 0.2714%. From the second period, the medium house price index's reaction to a one standard deviation shock to household debt-to-disposable income ratio was not noticeable until period three. However, after the third period, the medium house price index increased until it reached 0.3984% in period four. Beyond period four, the medium house price index declined gradually and remained in a positive region.

Moreover, in a bullish regime, a one standard deviation shock to money supply growth rate decreased the medium house price index below its steady-state level from period one to period two where it was -0.0446%. The medium house price index continued to increase below its steady-state value from period two to period three where it reached -0.0219% and then declined in period four and reached -0.1186%. From the fourth period, the medium house price index increased until the period where it reached -0.0503%. Beyond period five, a one standard deviation shock to money supply growth rate decreased the medium house price index until period eight where it reached its lowest negative value of -0.1222%. From period eight, the medium house price index rose below the steady-state level and remained in a negative region.

In a bearish market condition, a one standard deviation shock to employment initially increased the medium house price index above its steady-state level from period one to period three where it reached 0.1186%. After period three the medium house price index started to decline gradually and passed through the steady-state level until it reached period six where it was -0.1541%. Beyond period six, the medium house price index increased until it reached the

positive region in period eight to period nine where it was 0.3052%. From period eight to period nine, the response of the medium house price index was not noticeable, however, it declined beyond period nine and remained in a positive region.

Initially, in regime 2, the medium house price index increased sharply from the first period to the second period due to a one standard deviation shock in the household debt-to-disposable income ratio. From the second period to the third period, the response of the medium house price index was not noticeable. However, the medium house price index started to increase from period three to period four where it reached 0.1025%. From period four to period five, the response was not noticeable. Beyond period five, the medium house price index declined until period eight where it reached 0.0511%, thereafter it increased until period nine where it was 0.0654%. This positive response sharply declined after period nine and stayed in the positive region.

In a bearish market regime, a one standard deviation shock to money supply growth rate decreased the medium house price index over time. This negative response sharply declined from period one until period two where it reached -0.0319%. After period two, the response of the medium house price index increased until the third period where it reached -0.0157%. It then declined until the fourth period where it was -0.0848%. From period four to period five, the response of the medium house price index increased to -0.0380%. Beyond the fifth period, there was a sharp decline in the medium house price index due to a one standard deviation shock to the money supply growth rate until period eight where it reached -0.1863%. After the eighth period, the medium house price index remained in the negative region.

Lastly, the response of the large house price index on a one standard deviation shock in the selected macroeconomic variables in Figure 4.12 was analysed. In a bullish market condition, a one standard deviation shock to employment increased the large house price index above its steady-state level from period one until period two where it reached 0.0323%. From the second period, the large house price index declined below its steady-state level until period six where it reached -0.0891%. Moreover, following period six, the large house price index increased below the steady-state level due to a one standard deviation shock in employment until period seven where it was -0.0117%. From period seven to period eight, the large house price index increased slightly then decreased until period nine where it reached -0.0309%. Beyond period nine, the large house price index increased above its steady-state level and remained in a positive region.

A one standard deviation shock to household debt-to-disposable income ratio in a bullish market initially increased the large house price index from period one to period two where it reached 0.0542%. Beyond the second period, the response of the large house price index decreased and passed through the steady-state level until period four where it reached -0.0348%. After period four, a one standard deviation shock to household debt-to-disposable income ratio resulted in an increase of the large house price index until period seven where it was 0.1998% above the steady-state level. Beyond the seventh period, the large house price index decreased gradually and passed through the steady-state level, and remained in a negative region.

Furthermore, in Figure 4.12, a one standard deviation shock to money supply growth rate in regime 1 decreased the large house price index below the steady-state level from the first period until the second period where it reached -0.1454%. From period two, the response of the large house price index due to a one standard deviation shock to money supply growth rate increased and reached the positive region until period five where it was 0.0632%. Beyond period seven, the large house price index decreased and was below its steady-state value where it remained in the negative regime.

In a bearish regime, in Figure 4.12, the response of the large house price index to a one standard deviation shock on employment was positive from period one to period two where it was 0.1903%. However, it gradually decreased from 0.1903% in period two to -0.3078% in period six. From period six, the response of the large house price index increased until period seven where it reached 0.0169%. Between period seven and period eight, there was no noticeable trend of the response of the large house price index as it stayed within the steady-state region. In addition, a one standard deviation shock to employment decreased the large house price index to -0.1146% in the ninth period. Beyond period nine, the response of the large house price index increased and remained in a positive region.

A one standard deviation shock to household debt-to-disposable income ratio increased the large house price index in a bearish market condition from period one to period two where it reached 0.0713%. However, the response of the large house price index began to decrease from the second period until it reached -0.1298% in the fourth period. Furthermore, a one standard deviation shock to household debt-to-disposable income ratio increased the large house price index to period five and then decreased slightly to the sixth period. After period six, the response of the large house price index started to rise above its steady-state level until period

seven where it reached 0.1707% after which it declined in period eight. From period eight to period nine, the response of the large house price index was not noticeable. However, beyond period nine, the large house price index declined below its steady-state level and remained in a negative region.

A one standard deviation shock to money supply growth rate decreased the large house price index in a bearish market condition from the first period to the second period where it reached -0.1162%. From period two, there was a sharp increase of the large house price index to period three. The response of the large house price index further increased above its steady-state level to period five where it reached 0.0506%. However, due to a one standard deviation shock to money supply growth rate, the large house price index started to decrease to -0.0338% in period six, and then it increased in period seven after which it declined in period eight to -0.0232%. Beyond period eight, the large house price index increased above its steady-state level and remained in the positive region as illustrated in Figure 4.12 below.

It was noted that the effects of shocks in the selected macroeconomic variables were different across different housing segments. It was also noted that in each housing segment, the impact of shocks of the macroeconomic variables was similar with regimes. Hence, the effects were seen asymmetric visually as illustrated in Figures 4.10, 4.11, and 4.12 above. Moreover, in both regimes 1 and 2, the effects also remained consistently significant across different segments. Furthermore, it was noted that the household debt-to-disposable income ratio had the most positive effects on the small and medium house price indexes in a bullish and bearish regime. Thus, a positive shock to the household debt-to-disposable income ratio led to an increase in both small and medium house price indexes.

This confirmed the findings by Lowe (2017) that an increase in household debt-to-disposable income ratio increases housing prices as borrowers/households take larger mortgages relative to their income. Furthermore, most lower and middle households have an investment property with a mortgage in small and medium segments (Lowe, 2017). Moreover, the money supply growth rate had the most negative influence on small and medium house price indexes. Hence, a positive shock to the money supply growth rate resulted in a decline in small and medium house price indexes. This could be a result of the monetary policy authority's reaction to a rise in money supply as they increase interest rates to curb inflation risk and prevent the house price bubbles from forming.

However, diverse patterns emerge for different MS-VAR models. The magnitude of the reaction of each housing segment to shocks in each macroeconomic variable differed across regimes with positive effects for the large segment lasting a way shorter period when compared to small and medium segments. The observed difference could be possibly attributed to the dual features of housing as being both consumption and investment good simultaneously. In effect, according to Inglesi-Lotz and Gupta (2013), the small and medium housing segments are believed to act as an investment good for relatively richer households who reside in mainly luxury segments of the market.

Bearish market conditions are more of a buyer's market, in light of this, richer homeowners might want to spend some of their wealth to acquire property in the small/medium segment as an investment (Simo-Kengne et al., 2012). The resulting increase in housing demand coupled with the typical optimism of the bearish regime might lead to increase inflation risks, causing the monetary policy authorities to respond more to increasing house prices in the bearish market of small and medium housing segments. At this stage, it is perhaps worth noting that the South African Reserve Bank is most likely to monitor house prices of all segments. Given this, the response of each house price segment following a shock to the selected macroeconomic variables could be depicting a typical response. However, having said this, in achieving the third research objective of investigating the impact of the selected macroeconomic variables on small, medium, and large house prices in a bullish and bearish market conditions was achieved. Therefore, the study's results do provide evidence that house prices of the small, medium, and large housing respond significantly to shocks/movements in macroeconomic variables.

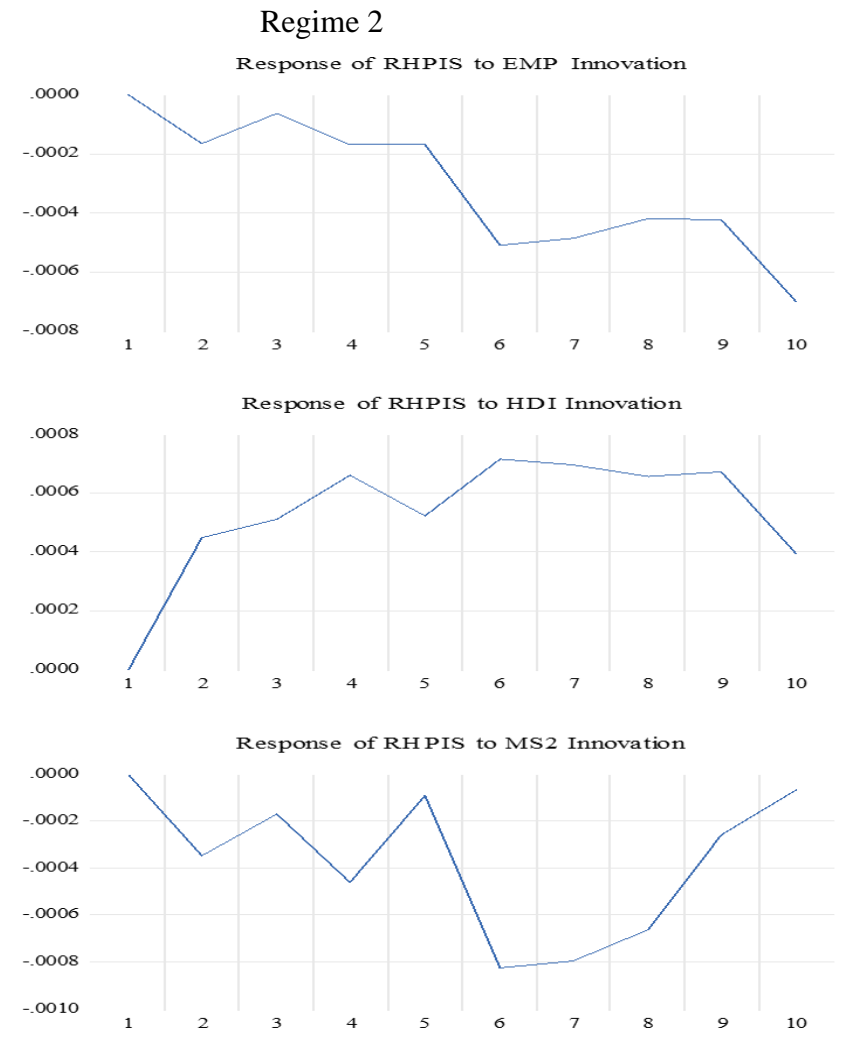
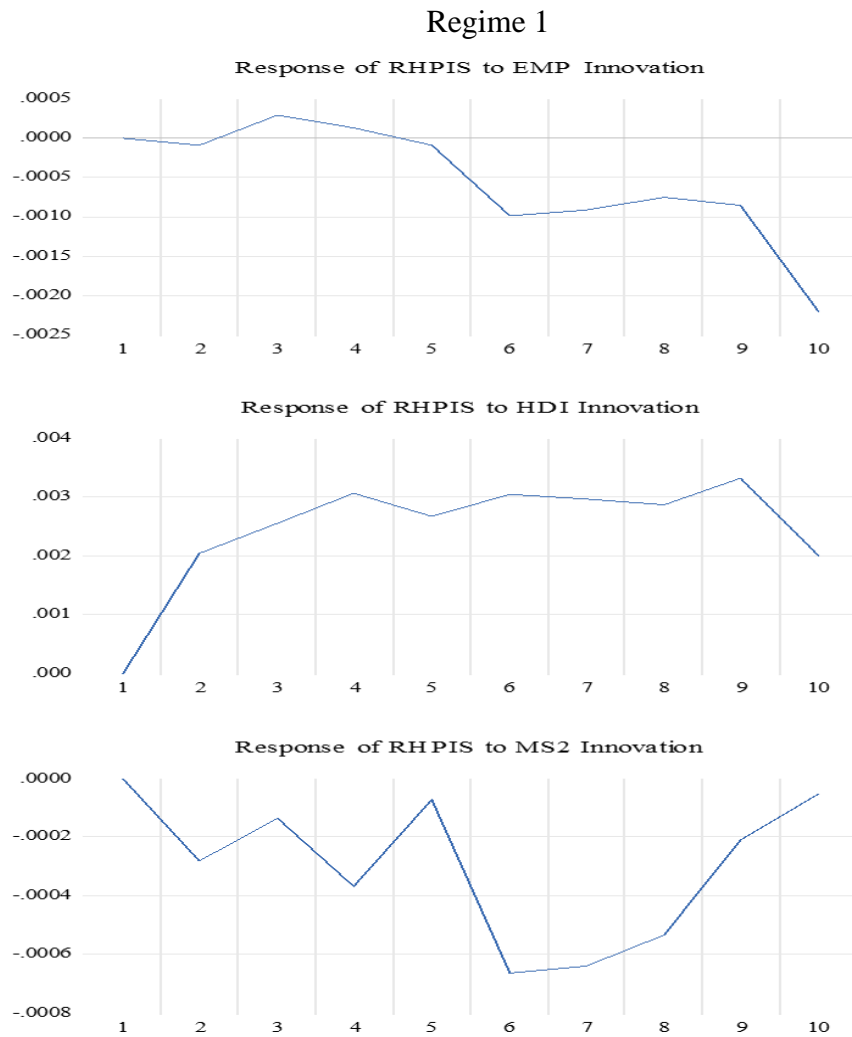


Figure 4.10: Response of RHPIS to macroeconomic shocks
 Source: Own compilation (2021)

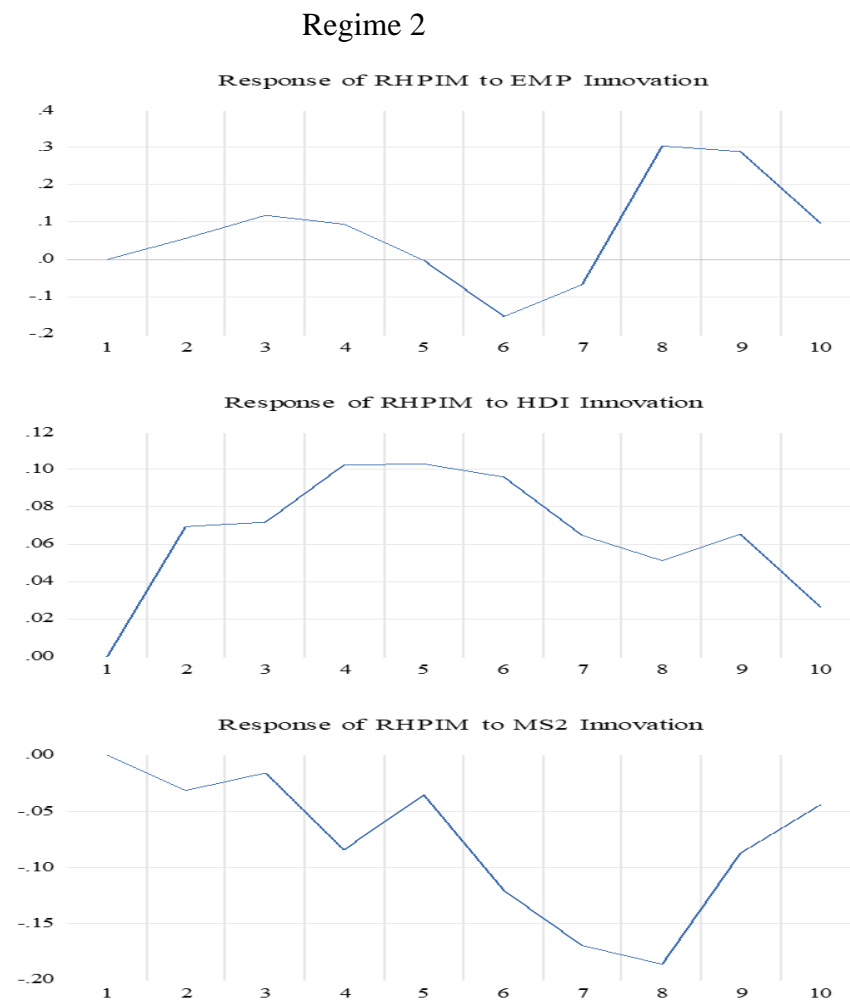
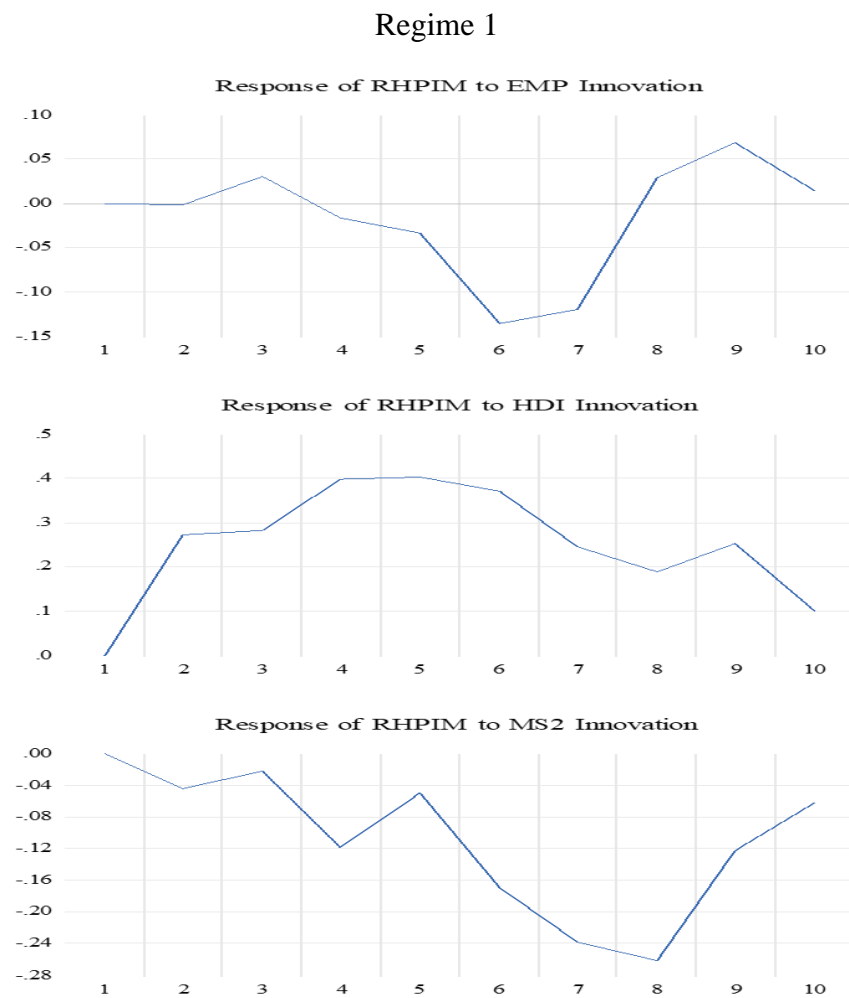


Figure 4.11: Response of RHPIM to macroeconomic shocks
 Source: Own compilation (2021)

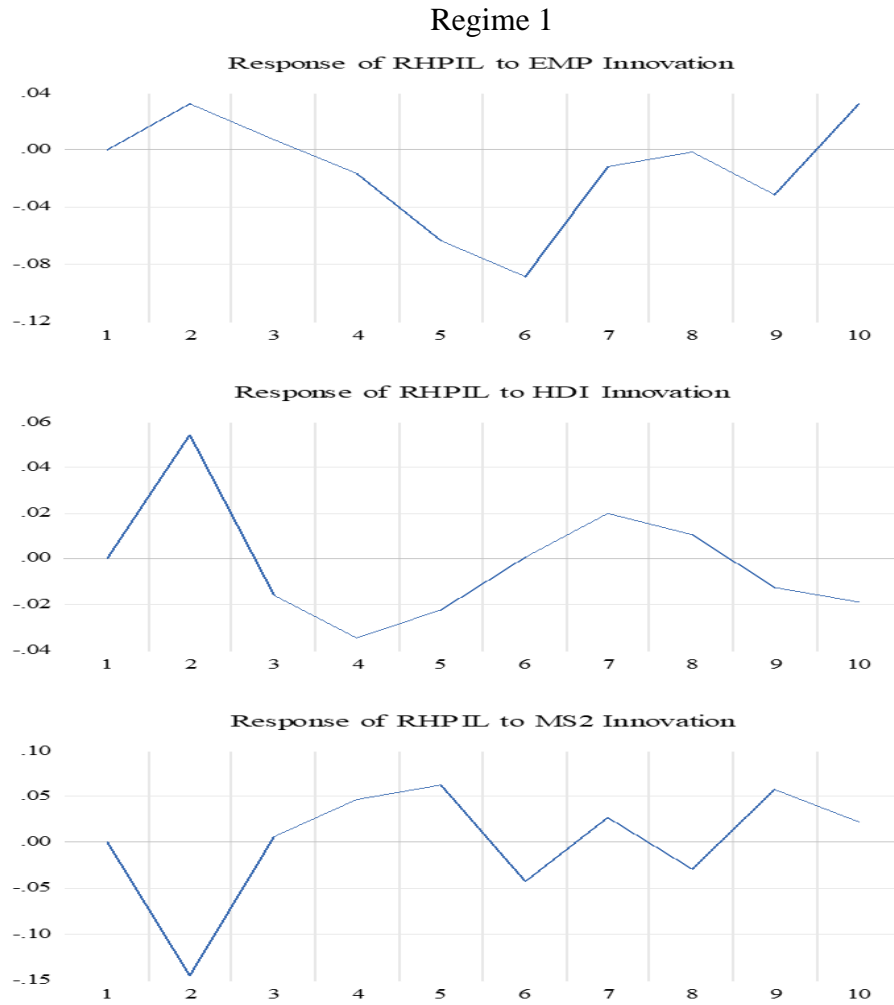


Figure 4.12: Response of RHPIL to macroeconomic shocks

Source: Own compilation (2021)

4.3.4. Discussion of the findings

The findings of the existence of two-house price bubbles in the housing segments were consistent with the study conducted by Patterson and Steenkamp (2017). The results of this study showed that there were five periods of explosivity in the small house price index, three periods of explosivity in the medium house price index, and four periods of explosivity in the large house price index. The housing bubble identified between 2003 and 2007, and 2009 coincided with the bubbles identified by Patterson and Steenkamp (2017), as well as the bubbles identified in Malaysia, New Zealand, Shanghai, and in the United State (Hui & Yue, 2006; Greenway-McGrevy & Phillips, 2015; Husain et al., 2011 & Shi, 2017). This was all due to factors such as a growing black lower/middle-income population, the South African economy becoming stable and investors gaining confidence in the market which increased the demand for mortgages due to low inflation levels and low-interest rates.

However, contrary to Patterson and Steenkamp's (2017) results that the South African house price bubbles ended in 2009, this study showed that the house price bubble existed beyond 2009 up until the end of the sample period. The overall findings of this study were in line with that of Patterson and Steenkamp (2017) that housing price bubbles existed in the South African small, medium, and large houses. Furthermore, the study investigated the effects of country risk components on the price of small, medium, and large houses in South African under a bull and bear market condition. In doing so, it was found that in a bullish market condition, economic risk had a significant influence on the small house price index, but the financial and political risk did not influence the small house price index in a bullish market. However, in a bearish market condition, it was found that all the country risk components do not influence the small house price index.

Further to this, in a bullish regime, all country risk components were found to have an insignificance influence on the medium house price index. In other words, economic, financial, and political risks were found to have no influence on the medium house price index in a bullish market condition. But, in a bearish market condition, financial risk and political risk were found to have a significant influence on the medium house price index. Economic risk did not have a significant influence on the medium house price index in a bearish regime. Lastly, in a bullish regime, financial risk and political risk were found to have a significant impact on the large house price index. However, the economic risk was found to have no influence on the large house price index in a bullish market condition. In a bearish market condition, all country risk components were found to have no significant influence on the large house price index.

The findings of this study correlate with the study conducted by Ong (2013) who examined the influence of economic risk on house prices in Malaysia and found that economic risk significantly influenced housing prices. Moreover, the finding that financial risk has a significant influence on the medium house price index was in line with Glindro et al., (2008) who found that financial risk has a significant influence on housing prices in nine Asian-Pacific economies. In addition to this, Muzindutsi et al., (2020) discovered that the three housing segments are most sensitive to political risk on a long-run basis in South Africa. This study's results confirmed the findings by Muzindutsi et al., (2020) that political risk has a significant impact on medium house price index and large house price index.

However, the political risk did not have a significant influence on the small house price index. This could be due to that the small housing segment is given less attention as compared to the medium house price index and large house price index (Islam & Asami, 2009). Thus, the overall effects of country risk component on house price of a small, medium, and large houses varied on the extent to which the market was in a bullish or bearish regime, hence, it could either be a significant or insignificance impact on the housing prices of each segment. Moreover, the results of the study suggest that country risk components differ in their influence across different housing segments.

This study also investigated the influence of macroeconomic variables on housing prices of small, medium, and large houses using regime-dependent impulse response functions. It was found that employment, household debt-to-disposable income ratio, and money supply growth rate do have a significant influence on the three housing segments. These findings were in line with the study by Agnew and Lyon (2018) who found employment to have a significant influence on housing prices. Moreover, this study's results were consistent with that of Sibanda and Mhlanga (2013) who found household debt-to-disposable income ratio to influence South African housing prices. The findings of this study that the money supply growth rate has a significant influence on housing prices of each segment were in line with the study by Fengyun (2013) who examined the impact of money supply on housing prices in Japan for pre-bubble and bubble periods. Fengyun (2013) found that money supply had a significant effect on house prices. It was noted that although the selected macroeconomic variable influenced each house price segment, the magnitude of the effect was different across the three segments and the two regimes.

It was seen that country risk components and macroeconomic variables had alternating effects on each house price index where country risk components had a significant effect on the three house price indexes in a bullish regime, and the effect was insignificant in a bearish regime and vice versa. Similarly, the magnitude of the effect of each macroeconomic factor was different according to the regimes. Thus, alternating efficiency and inefficiency were present amongst the three housing segments, The findings of the study were consistent with the AMH, as it suggested that the efficiency and inefficiency of asset markets were owing to changing market conditions (Lo, 2004). Thus, country risk components and macroeconomic factors affected housing prices differently under changing market conditions. In addition to this, the findings were seen to contradict the EMH, as the hypothesis suggested that asset markets future prices were not known by market agents, therefore, followed the random walk process, making the asset (housing) market efficient (Fama, 1965).

4.4. Summary of the chapter

Chapter 4 presents and discusses the results obtained from the estimations of the different methodologies. In summary, this study reports three empirical findings. Firstly, the results of the SADF and GSADF suggest that bubbles were present in the three South African housing segments over the sample period. Secondly, the results of the Markov regime-switching of conditional mean model indicate that country risk component influenced the prices of small, medium, and large houses in South Africa. Moreover, it was found that the influence of country risk components on each housing segment depended on whether the market was in a bullish or bearish regime. The third key empirical findings from the Markov switching vector autoregressive model suggests that all the selected macroeconomic variables influenced each house price index in bullish and bearish market conditions over the sample period. The next Chapter provides a conclusion with a discussion of the research findings. Moreover, the limitations of the study are revealed and recommendations for future empirical research are presented.

CHAPTER 5: CONCLUSION

5.1. Introduction

The occurrence of price bubbles in the housing market creates instability in the economy as this may lead to a financial crisis due to the bursting of the housing bubble (Das et al., 2011; Chang et al., 2016). The bursting of the housing bubble in the United States was followed by the global economic downturn which led to the 2008 global financial crisis (Zhu, 2014). In the South African housing market, housing booms and bubble formation periods are comparable from a historical perspective in terms of the new democratic era from 1994 as the government introduced new housing policies which allowed low-income households to access mortgage loans (Rust, 2006). According to Agnello and Schuknecht (2011), the occurrence of booms and bursts in the housing market is driven by economic factors.

Therefore, the booms and bursts in house prices are driven by a number of factors such as country risk components and macroeconomic factors (Du Toit, 2004b; Franken, 2007; Li & Ng, 2012; Simo-Kengne et al., 2014; Muzindutsi et al. 2020). In addition to this, more existing studies found that the market for different house sizes respond differently to changes in economic conditions (Burger & van Ransburg, 2008). However, earlier studies did not take into consideration that such influence may differ depending on whether the housing market is in a bullish or bearish regime. This could imply that the existence of bull and bear markets conditions are driven by fundamentals such as macroeconomic factors and country risk components. The response of small, medium and large house prices to changes in macroeconomic factors and country risk components in bull and bear market conditions have not been thoroughly examined in South Africa with a high level of macroeconomic and political uncertainty.

As a result, it was important to investigate the existence of price bubbles in the market of small, medium and large houses and examine how country risk components and macroeconomic factors influence the three housing segments in bullish and bearish regimes. The overall aim of the study was achieved through three specific research objectives. The first objective focused on identifying the levels of price bubbles in the prices of small, medium and large houses over the sample period. The second objective focused on examining the influence of country risk components on small, medium and large house prices in bullish and bearish market conditions. Lastly, the third objective focused on investigating the effect of macroeconomic factors on prices of small, medium and large houses in bullish and bearish market conditions.

The study utilised a time series analysis for a period starting from 01 January 1995 to 30 November 2016. The secondary monthly South African Absa house price index data of small, medium and large size were obtained from Bloomberg. Moreover, the obtained Absa house price index of each segment was adjusted into real terms using the South African Consumer Price Index obtained from STATSA. Furthermore, the South African monthly country risk components data developed by the International Country Risk Guide, was obtained in monthly form from The PSR Group (2020). Lastly, for macroeconomic variables included in the study was employment and household debt-to-disposable income data obtained from the South African Reserve Bank in quarterly figures and was converted in the EViews statistical software to obtain monthly observations. The money supply growth rate data was also included and was obtained in monthly form from the South African Reserve Bank.

Moreover, preliminary tests in the form of unit root and stationary tests with and without structural breaks, descriptive statistics, correlation analysis, normality tests, autocorrelation and heteroskedasticity tests were conducted. Following the relevant preliminary tests, the study employed the SADF and GSADF tests to achieve the first objective of testing for the existence of bubbles. In order to achieve the second objective of examining the influence of country risk components in bull and bear market condition, a Markov regime-switching of conditional mean model was employed. Lastly, the third objective of investigating the impact of the selected macroeconomic variables in a bullish and bearish market condition was achieved using the Markov switching vector autoregressive (MS-VAR) model.

5.2. Summary of the key findings

Pricing bubbles and the housing market

In order to achieve the first objective, the study had to answer the following question; what is the level of price bubbles in the prices of small, medium and large houses over the sample period? Therefore, the results from the estimated SADF and the GSADF tests revealed that bubbles were presence in the South African prices of small, medium and large houses. The results were focused from the one produced by the GSADF as it was considered as more superior than the SADF in Section 4.3. Hence, based on GSADF, it was found that there were five periods of explosive bubbles in the small house price index, three periods of explosivity in the medium house price index and four periods of explosivity in the large house price index. Based on the results of the study, the first objective was achieved. However, the formulated

hypothesis that there are more price bubbles in large house prices relative to small and medium house prices because of higher investor attention on the former was not achieved.

The estimated hypothesis was drawn from the fact that the large housing segment is dominated by the most affluent in the country and also foreigners, whose housing decisions are less likely to be influenced by pricing or other economic fundamentals whereas the small housing segment and the medium housing segment is mostly controlled by the government (Gupta, Jurgilas & Kabundi, 2010). However, in this study, the small housing segment had more periods of explosivity compared to the medium and large housing segment. The bubbles attributed to the small housing segment were due to the excess demand of small-sized houses which resulted to a boom in the small housing prices and thus, the formation of bubbles (Ahmed, Jawaid & Khalil, 2021).

5.2.2. Housing prices and country risk components

In order to achieve the second objective, the study had to answer the following question; What is the effect of country risk components on the prices of small, medium and large houses in bullish and bearish market conditions? Hence, the results from the estimated Markov regime-switching of conditional mean model revealed that the effects of country risk components on the South African prices of small, medium and large houses in bullish/bearish market conditions differed across the housing segments and across the two regimes. It was evident that in a bullish market condition, economic risk had a significant positive influence on the small house price index, However, financial and political risk did not influence small house price index in a bullish market condition. In a bearish market condition, all the country risk components did not influence small house price index.

Moreover, in a bullish regime, all country risk components were found to have an insignificance influence on medium house price index. In other words, economic, financial and political risk were found to have no influence on medium house price index in a bullish market condition. But, in a bearish market condition, financial risk and political risk were found to have a significance positive influence on medium house price index. Economic risk did not have a significance influence on medium house price index in a bearish regime. Lastly, in a bullish regime, financial risk and political risk were found to have a significance positive impact on the large house price index. However, economic risk was found to have no influence on the large house price index in a bullish regime. In a bearish market condition, all country risk components were found to have no significant influence on the large house price index.

Therefore, based on the results of the study, the formulated hypothesis attributed to the second research objective was achieved.

5.2.3. Housing prices and macroeconomic factors

The third objective was achieved by answering the following question; What is the impact of macroeconomic factors on prices of small, medium and large houses in bullish and bearish market regimes? On that note, the results of the estimated Markov switching vector autoregressive model indicated that the selected macroeconomic factors namely employment, household debt-to-disposable income ratio and money supply growth rate did have a significant influence on the three house price indexes. The regime-dependent impulse response functions were employed to examine such impact. The study noted that the magnitude of the significant influence of the macroeconomic variables varied across the three housing segments and across the market regimes. Hence, based on the results of the study, the formulated hypothesis attributed to the third research objective was achieved.

5.3. Conclusion

The primary objective of the study was to investigate the presence of bubbles in the small, medium, and large house prices and examine the influence of country risk components and macroeconomic factors on the three housing segments in bullish and bearish market conditions. Hence, the study set out to identify periods of the South African house price bubbles during the period from 1995 to 2016 using real house prices. By the use of the recursive GSADF test, the periods of house price bubbles were identified by plotting the BSADF values against the critical values. The results showed evidence of the existence of bubbles in the three South African housing segments. The periods of explosive bubbles in the housing market of each segment were due to factors such as the rising black middle-income population, the economy of South Africa becoming stable and investors gaining more confidence in the market and a rise in the demand for mortgage loans as a result of lower interest rates and inflation levels.

Furthermore, based on objective 2, the study concluded that the small housing segment was significantly affected by economic risk in a bullish market condition. On the other hand, the medium housing segment was significantly influenced by financial risk and political risk in a bearish market condition. The study also concluded that the large housing segment was significantly affected by financial risk and political risk in a bullish market condition. It was also noted that when country risk components had significant effects on each house price index, the effect was insignificant in a bullish regime and vice versa. Thus, country risk components

affected the housing market differently under changing market conditions. As a result, the alternating efficiency and inefficiency were present among the South African house price segments. This was consistent with AMH, as it suggested that the efficiency and inefficiency of asset markets are owing to changing market conditions.

The study also concluded that all macroeconomic variables had either positive, negative, or significant influence on each housing segment under changing market conditions. Through the use of regime-dependent impulse response functions, the results showed that employment, household debt-to-disposable income ratio, and money supply growth rate do have a significant influence on the prices of small, medium, and large houses. The effects of shocks in the selected macroeconomic variables were different across different housing segments. It was also noted that in each housing segment, the effects of shocks of the macroeconomic variables were similar with regimes. Hence, the effects were seen asymmetric visually. It was further concluded that the household debt-to-disposable income ratio had the most positive effects on the small and medium housing segments in a bullish and bearish regime.

On the other hand, the money supply growth rate had the most negative influence on the small and medium house price index. The magnitude of the reaction of each housing segment to changes in each macroeconomic variable differed across regimes with positive effects for the large segment lasting a way shorter period when compared to small and medium segments. Overall, the study concluded that, over the sample period, the South African housing market shows periods of explosivity and that economic fundamentals such as country risk components and macroeconomic factors had an effect on the South African housing segment and the influence depended on whether the market was in a bullish or bearish regime.

5.4. Implications of the study

5.4.1. Policymakers

It is essential for policymakers to control the formation and bursting of housing price bubbles in the market. Hence, a pick-up in the small housing segment may provide a stronger signal for normalising interest rates as more bubbles were present in the small housing segment. In addition to this, it is important for policymakers to control country risk components and macroeconomic variables efficiently, as these variables affect housing prices differently under changing market conditions. Based on the findings of the study, improved policy-making in financial, economic, political risk, and macroeconomic factors within the country can improve the growth of the housing market and thus investments in this market. According to Simo-

Kengne et al., (2012), this step is essential as the housing sector stimulates growth in the economy.

5.4.2. Market participants

The AMH asserts that investors are able to earn excess profits as markets are not always efficient because of the different behaviour of investors and changing market conditions. The findings of this study imply that the South African housing market is not efficient, and thus, changes in housing prices may be better understood by accounting for changing market conditions such as bullish and bearish regimes. In addition to this, the results of this study proved that market participant behaviour could fuel the formation of pricing bubbles in the housing market. Therefore, the results of this study have important implications for investors, specifically, financial market investors and property investors.

Hence, property investors in the small housing segment should monitor economic risk ratings of the country, so the rising house prices in the small segment are experienced by investors. Moreover, property investors in the medium housing segment should look closely at financial and political risk ratings during times of decreasing prices so that they are not negatively affected by changing market conditions due to a bearish regime. Investors considering to enter into property investments should monitor financial and political risk to make buy decisions in the medium housing sector during lower prices. Investors that own shares from large property companies investing in the large housing segment should monitor both financial and political risk ratings in a bullish market regime in order to assess whether a bubble is about to be formed during rising prices. Moreover, the appreciation of prices in the large housing segment should be experienced by financial market and property investors in the larger segment.

Investors should also monitor employment, household debt-to-disposable income ratio and the money supply growth rate closely, so that any changes in these macroeconomic variables are witnessed by both investors. This will enable investors to develop strategies on how to deal with changing effects of employment, household debt-to-disposable income ratio, and money supply growth rate on the three housing segments under bullish and bearish market conditions. Thus, it is important for both financial market and property investors to educate themselves on the housing market behaviour in bullish and bearish conditions based on effects from country risk components and macroeconomic factors. Given this, it is essential for both financial market investors and direct property investors in the South African housing market to seek the assistance of professional property advisors prior to making an investment decision. This will

reduce their risk of exposure to housing bubble bursts and increase their opportunities for making higher profits.

5.4.3. Other stakeholders

Professional property advisors, investment specialists, and property companies should consider developing strategies for minimizing the lasting effects of country risk components and the selected macroeconomic variables on the three housing segments under changing market conditions when advising their clients. However, in order to provide strategic advice to their clients, it is essential for these stakeholders to first understand what factors affect the housing market and how the market behaves in a bullish and bearish regime. Therefore, understanding what factors drive each housing segment under prevailing market conditions will benefit these stakeholders by reducing the risk of earning unfavourable returns in the housing market.

5.5. Study limitations and recommendations for future studies

This study had two limitations. Firstly, the study's time period was limited due to the availability of house price data from the Absa house price index. House price index data of each segment was only available up to 30 November 2016. The study would have been more recent and up to date if the sample period ended in 2020. Secondly, while there are several segmentations within the property market, this study only focused on small, medium, and large housing segments. Based on these limitations, this study has identified research opportunities to existing literature on housing market bubbles, country risk components, and macroeconomic factors in the South African context.

This study only examined the existence of bubbles in the housing market and the effects of country risk components and macroeconomic factors on three house price segments under changing market conditions for a limited time frame. Therefore, on the availability of data in the future, further studies could consider expanding the study time frame to achieve more recent findings. Several studies show that economic variables do influence house prices in different provinces. However, these studies did not explore such effects under changing market conditions. Given this, a recommendation for future research is to investigate the presence of bubbles in the prices of houses in different provinces and examine the effects of country risk components and macroeconomic factors on housing prices of the nine provinces in South Africa under bullish and bearish market conditions.

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APPENDIX

Appendix A: Markov switching Vector autoregressive model results

Table A1: RHPIS

Markov Switching Intercepts VAR Estimates (BFGS / Marquardt steps)				
Date: 10/14/21 Time: 15:10				
Sample (adjusted): 1996M02 2016M11				
Included observations: 250 after adjustments				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard deviation (rng=kn, seed=1544548577)				
Convergence achieved after 158 iterations				
Standard errors in () & z-statistics in []				
	RHPIS	EMP	HDI	MS2
Regime 1				
C	0.004051 (0.00105) [3.85840]	-0.028597 (0.03622) [-0.78952]	-0.060895 (0.06571) [-0.92674]	-0.585534 (0.24459) [-2.39390]
SIGMA-RHPIS	2.84E-05 (6.9E-06) [4.09424]	0.000113 (0.00022) [0.51970]	0.000976 (0.00046) [2.10259]	-0.001146 (0.00121) [-0.94657]
SIGMA-EMP	0.000113 (0.00022) [0.51970]	0.066063 (0.01385) [4.77064]	0.012805 (0.01729) [0.74070]	-0.025486 (0.05363) [-0.47521]
SIGMA-HDI	0.000976 (0.00046) [2.10259]	0.012805 (0.01729) [0.74070]	0.227607 (0.04778) [4.76393]	0.111716 (0.10436) [1.07050]
SIGMA-MS2	-0.001146 (0.00121) [-0.94657]	-0.025486 (0.05363) [-0.47521]	0.111716 (0.10436) [1.07050]	1.653657 (0.43148) [3.83251]
Regime 2				
C	0.002790 (0.00065) [4.29893]	0.013779 (0.00887) [1.55288]	-0.015469 (0.01079) [-1.43431]	0.065478 (0.16571) [0.39515]
SIGMA-RHPIS	3.66E-05 (4.0E-06) [9.11093]	3.44E-05 (3.3E-05) [1.04041]	-7.48E-05 (4.3E-05) [-1.75760]	0.001216 (0.00074) [1.65378]
SIGMA-EMP	3.44E-05 (3.3E-05) [1.04041]	0.004824 (0.00060) [8.09057]	-0.000905 (0.00052) [-1.73914]	0.010642 (0.00860) [1.23795]
SIGMA-HDI	-7.48E-05 (4.3E-05) [-1.75760]	-0.000905 (0.00052) [-1.73914]	0.007278 (0.00087) [8.36998]	-0.019664 (0.01058) [-1.85774]

SIGMA-MS2	0.001216 (0.00074) [1.65378]	0.010642 (0.00860) [1.23795]	-0.019664 (0.01058) [-1.85774]	2.371952 (0.27089) [8.75629]
Common				
RHPIS(-1)	0.912955 (0.06383) [14.3024]	0.667358 (0.91179) [0.73192]	1.189942 (1.16159) [1.02440]	0.805855 (15.6347) [0.05154]
RHPIS(-2)	-0.137758 (0.08426) [-1.63499]	-1.606414 (1.19969) [-1.33902]	-1.276520 (1.50942) [-0.84570]	5.982978 (21.4932) [0.27837]
RHPIS(-3)	0.057306 (0.08587) [0.66736]	1.487599 (1.21107) [1.22833]	-0.348210 (1.51487) [-0.22986]	-28.56255 (21.7776) [-1.31156]
RHPIS(-4)	-0.206759 (0.08617) [-2.39955]	-3.500524 (1.26785) [-2.76099]	2.426266 (1.66203) [1.45982]	10.03315 (21.9144) [0.45783]
RHPIS(-5)	0.168205 (0.08626) [1.94987]	3.565484 (1.29996) [2.74277]	1.760891 (1.63380) [1.07779]	33.68974 (21.9807) [1.53269]
RHPIS(-6)	-0.074225 (0.08537) [-0.86948]	-1.296444 (1.42374) [-0.91059]	-2.768621 (1.61384) [-1.71555]	-39.54043 (21.7509) [-1.81788]
RHPIS(-7)	-0.068762 (0.08516) [-0.80745]	0.763413 (1.31814) [0.57916]	-2.659032 (1.60009) [-1.66180]	26.94426 (21.8478) [1.23327]
RHPIS(-8)	0.055902 (0.08467) [0.66026]	-0.658257 (1.30337) [-0.50504]	4.523749 (1.54536) [2.92731]	2.272707 (21.5268) [0.10558]
RHPIS(-9)	0.046998 (0.08732) [0.53821]	1.709073 (1.24306) [1.37489]	0.089478 (1.48666) [0.06019]	-20.76927 (22.1851) [-0.93618]
RHPIS(-10)	0.084235 (0.08790) [0.95828]	-2.820905 (1.20469) [-2.34161]	-3.658087 (1.50045) [-2.43799]	7.210065 (22.4284) [0.32147]
RHPIS(-11)	-0.161491 (0.08708) [-1.85441]	3.221735 (1.17519) [2.74146]	2.418517 (1.52554) [1.58535]	-16.81777 (22.1115) [-0.76059]
RHPIS(-12)	-0.026941 (0.06451) [-0.41761]	-1.377874 (0.87446) [-1.57569]	-0.152541 (1.17216) [-0.13014]	8.442546 (16.1266) [0.52352]
EMPL(-1)	-0.001121 (0.00297) [-0.37723]	0.870314 (0.03973) [21.9060]	0.050202 (0.04778) [1.05070]	0.942425 (0.75471) [1.24873]
EMPL(-2)	0.002275 (0.00377)	-0.007601 (0.05475)	-0.066119 (0.06244)	-0.667898 (0.95562)

	[0.60401]	[-0.13882]	[-1.05897]	[-0.69891]
EMP(-3)	-0.002203 (0.00374) [-0.58904]	-0.353423 (0.05584) [-6.32957]	0.141905 (0.07113) [1.99506]	-0.239663 (0.94716) [-0.25303]
EMP(-4)	-0.000551 (0.00385) [-0.14298]	0.289851 (0.06090) [4.75915]	-0.114678 (0.07712) [-1.48701]	2.425302 (0.98057) [2.47335]
EMPL(-5)	-0.002182 (0.00407) [-0.53627]	0.103168 (0.05417) [1.90463]	-0.034322 (0.06665) [-0.51496]	-1.312036 (1.04263) [-1.25840]
EMP(-6)	0.002889 (0.00399) [0.72471]	-0.074245 (0.05729) [-1.29591]	0.091116 (0.07301) [1.24799]	0.627275 (1.01458) [0.61826]
EMP(-7)	-0.000127 (0.00388) [-0.03282]	-0.040206 (0.06275) [-0.64069]	-0.038575 (0.08120) [-0.47509]	0.362699 (0.98710) [0.36744]
EMP(-8)	-0.003201 (0.00396) [-0.80858]	0.176777 (0.05650) [3.12873]	-0.074826 (0.06777) [-1.10406]	-2.457777 (1.01020) [-2.43296]
EMPL(-9)	-0.002333 (0.00382) [-0.61142]	-0.131100 (0.05710) [-2.29603]	-0.018196 (0.07036) [-0.25860]	1.983257 (0.96797) [2.04888]
EMPL(-10)	0.003528 (0.00354) [0.99543]	-0.028494 (0.05451) [-0.52276]	0.157710 (0.06681) [2.36066]	0.283905 (0.90321) [0.31433]
EMPL(-11)	-0.007062 (0.00361) [-1.95478]	0.089287 (0.05234) [1.70585]	-0.075364 (0.06122) [-1.23106]	-0.334115 (0.92425) [-0.36150]
EMP(-12)	-0.000648 (0.00286) [-0.22692]	-0.109934 (0.04349) [-2.52793]	0.122016 (0.05030) [2.42563]	0.045874 (0.73239) [0.06264]
HDI(-1)	0.004821 (0.00178) [2.70985]	0.006803 (0.02341) [0.29065]	0.846627 (0.03064) [27.6294]	0.435110 (0.45524) [0.95578]
HDI(-2)	-0.002498 (0.00227) [-1.09922]	0.022401 (0.03113) [0.71959]	0.096290 (0.03954) [2.43553]	-0.484116 (0.57860) [-0.83670]
HDI(-3)	0.000632 (0.00226) [0.27959]	-0.118778 (0.03237) [-3.66897]	-0.819208 (0.04076) [-20.0997]	0.195637 (0.56815) [0.34434]
HDI(-4)	0.001797 (0.00255) [0.70524]	0.125110 (0.03797) [3.29470]	0.709131 (0.04860) [14.5915]	0.326831 (0.65769) [0.49694]
HDI(-5)	0.001088 (0.00268) [0.40567]	-0.002318 (0.03587) [-0.06461]	0.180274 (0.04784) [3.76859]	-0.656838 (0.68868) [-0.95377]

HDI(-6)	-0.001598 (0.00252) [-0.63361]	-0.111312 (0.04051) [-2.74790]	-0.425956 (0.05111) [-8.33412]	0.951888 (0.64341) [1.47944]
HDI(-7)	0.000539 (0.00252) [0.21377]	0.131213 (0.04295) [3.05531]	0.229656 (0.05408) [4.24687]	0.408198 (0.66171) [0.61688]
HDI(-8)	0.002680 (0.00261) [1.02648]	-0.038498 (0.03622) [-1.06299]	0.144460 (0.04671) [3.09263]	-0.828200 (0.67648) [-1.22427]
HDI(-9)	-0.004198 (0.00248) [-1.69242]	-0.059365 (0.04204) [-1.41216]	-0.223638 (0.05067) [-4.41400]	-0.102286 (0.63180) [-0.16190]
HDI(-10)	0.001613 (0.00222) [0.72647]	0.084829 (0.04032) [2.10414]	0.141727 (0.05039) [2.81254]	0.689925 (0.57361) [1.20278]
HDI(-11)	0.001926 (0.00223) [0.86342]	0.026686 (0.02910) [0.91699]	0.041123 (0.03703) [1.11055]	-1.017987 (0.56793) [-1.79245]
HDI(-12)	-0.001386 (0.00170) [-0.81338]	-0.014073 (0.02139) [-0.65805]	0.005040 (0.02623) [0.19217]	0.197582 (0.43212) [0.45724]
MS2(-1)	-0.000231 (0.00021) [-1.08051]	-0.004520 (0.00308) [-1.46518]	0.006188 (0.00375) [1.64952]	-0.016558 (0.05615) [-0.29491]
MS2(-2)	6.01E-05 (0.00020) [0.29343]	0.004968 (0.00305) [1.62754]	0.004111 (0.00379) [1.08539]	-0.009095 (0.05271) [-0.17255]
MS2(-3)	-0.000251 (0.00021) [-1.20967]	-0.001194 (0.00294) [-0.40578]	0.000525 (0.00374) [0.14034]	-0.046048 (0.05279) [-0.87229]
MS2(-4)	0.000164 (0.00021) [0.80022]	-0.003332 (0.00299) [-1.11356]	-0.011037 (0.00397) [-2.77878]	0.020301 (0.05237) [0.38762]
MS2(-5)	-0.000519 (0.00020) [-2.56104]	0.002402 (0.00309) [0.77829]	-0.006212 (0.00396) [-1.56754]	-0.008725 (0.05167) [-0.16885]
MS2(-6)	-1.20E-05 (0.00021) [-0.05711]	0.001436 (0.00295) [0.48643]	-0.005078 (0.00377) [-1.34552]	-0.063502 (0.05430) [-1.16943]
MS2(-7)	-3.42E-05 (0.00021) [-0.16061]	0.000991 (0.00298) [0.33301]	0.002785 (0.00377) [0.73850]	0.069050 (0.05355) [1.28937]
MS2(-8)	0.000180 (0.00021) [0.87291]	0.004304 (0.00303) [1.42216]	0.006619 (0.00388) [1.70433]	-0.012862 (0.05257) [-0.24468]

MS2(-9)	-6.81E-05 (0.00021) [-0.32577]	-0.002935 (0.00310) [-0.94552]	-0.005301 (0.00385) [-1.37712]	0.015972 (0.05237) [0.30497]
MS2(-10)	-0.000344 (0.00020) [-1.69134]	0.006217 (0.00291) [2.13420]	-0.000444 (0.00361) [-0.12286]	0.001448 (0.05221) [0.02773]
MS2(-11)	-7.31E-05 (0.00020) [-0.35943]	0.000395 (0.00303) [0.13065]	-0.005356 (0.00391) [-1.36965]	0.051144 (0.05121) [0.99876]
MS2(-12)	-0.000197 (0.00020) [-0.97883]	-0.003237 (0.00291) [-1.11208]	-0.003725 (0.00357) [-1.04199]	-0.522262 (0.05155) [-10.1317]
Transition Matrix Parameters				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
P11-C	-2.051620	0.592580	-3.462182	0.0005
P21-C	-1.093793	0.216799	-5.045181	0.0000
Determinant resid covariance		8.24E-08		
Log likelihood		802.3805		
Akaike info criterion		-4.643044		
Schwarz criterion		-1.515987		
Number of coefficients		222		

A2: RHPIM

Markov Switching Intercepts VAR Estimates (BFGS / Marquardt steps)				
Date: 10/14/21 Time: 16:55				
Sample (adjusted): 1996M02 2016M11				
Included observations: 250 after adjustments				
Number of states: 2				
Initial probabilities obtained from ergodic solution				
Standard errors & covariance computed using observed Hessian				
Random search: 25 starting values with 10 iterations using 1 standard deviation (rng=kn, seed=505240116)				
Convergence achieved after 200 iterations				
Standard errors in () & z-statistics in []				
	RHPIM	EMP	HDI	MS2
Regime 1				
C	0.428359 (0.09652) [4.43798]	-0.011119 (0.01037) [-1.07175]	-0.037683 (0.02619) [-1.43856]	-0.076246 (0.18153) [-0.42002]
SIGMA-RHPIM	0.509836 (0.06856) [7.43595]	0.007602 (0.00506) [1.50349]	0.081089 (0.02322) [3.49249]	0.279273 (0.11851) [2.35646]
SIGMA-EMP	0.007602 (0.00506) [1.50349]	0.005807 (0.00075) [7.74924]	0.000934 (0.00236) [0.39510]	0.040358 (0.01284) [3.14268]

SIGMA-HDI	0.081089 (0.02322) [3.49249]	0.000934 (0.00236) [0.39510]	0.086583 (0.01135) [7.62730]	-0.002795 (0.04914) [-0.05687]
SIGMA-MS2	0.279273 (0.11851) [2.35646]	0.040358 (0.01284) [3.14268]	-0.002795 (0.04914) [-0.05687]	2.947534 (0.39104) [7.53767]
Regime 2				
C	1.098145 (0.24985) [4.39529]	-0.020292 (0.02400) [-0.84563]	-0.105033 (0.02072) [-5.06888]	-0.415832 (0.25376) [-1.63866]
SIGMA-RHPIM	4.301116 (0.67476) [6.37429]	0.053528 (0.04190) [1.27743]	-0.029283 (0.02168) [-1.35046]	-0.498845 (0.31492) [-1.58403]
SIGMA-EMP	0.053528 (0.04190) [1.27743]	0.033994 (0.00532) [6.38804]	0.002499 (0.00170) [1.47021]	-0.040338 (0.02583) [-1.56146]
SIGMA-HDI	-0.029283 (0.02168) [-1.35046]	0.002499 (0.00170) [1.47021]	0.005184 (0.00097) [5.34307]	-0.003860 (0.01186) [-0.32534]
SIGMA-MS2	-0.498845 (0.31492) [-1.58403]	-0.040338 (0.02583) [-1.56146]	-0.003860 (0.01186) [-0.32534]	1.391390 (0.25946) [5.36265]
Common				
RHPIM(-1)	0.791491 (0.05505) [14.3789]	0.001284 (0.00563) [0.22814]	0.017005 (0.00560) [3.03659]	0.008638 (0.06521) [0.13247]
RHPIM(-2)	-0.186967 (0.06756) [-2.76749]	-0.000702 (0.00697) [-0.10079]	-0.017165 (0.00681) [-2.52127]	0.038608 (0.07903) [0.48850]
RHPIM(-3)	0.207908 (0.06319) [3.29025]	0.004503 (0.00654) [0.68811]	0.029380 (0.00661) [4.44419]	-0.019619 (0.07972) [-0.24610]
RHPIM(-4)	-0.136612 (0.06801) [-2.00884]	-0.013177 (0.00706) [-1.86508]	-0.006279 (0.00620) [-1.01196]	0.042553 (0.07890) [0.53936]
RHPIM(-5)	0.136572 (0.06681) [2.04429]	0.009804 (0.00701) [1.39856]	-0.013085 (0.00667) [-1.96038]	0.077445 (0.08147) [0.95065]
RHPIM(-6)	-0.154815 (0.06956) [-2.22566]	-0.001426 (0.00697) [-0.20448]	0.007585 (0.00699) [1.08466]	-0.226412 (0.08186) [-2.76581]
RHPIM(-7)	-0.167695 (0.06559) [-2.55691]	0.004048 (0.00687) [0.58913]	0.003233 (0.00684) [0.47260]	0.177451 (0.08487) [2.09083]
RHPIM(-8)	0.113337	0.005140	0.009416	-0.095014

	(0.06352) [1.78438]	(0.00656) [0.78347]	(0.00664) [1.41909]	(0.08508) [-1.11681]
RHPIM(-9)	-0.068033 (0.06151) [-1.10597]	0.006861 (0.00653) [1.05081]	-0.014960 (0.00761) [-1.96610]	-0.038079 (0.09110) [-0.41799]
RHPIM(-10)	0.261649 (0.06068) [4.31201]	0.004697 (0.00654) [0.71778]	0.009488 (0.00848) [1.11844]	0.108530 (0.09478) [1.14513]
RHPIM(-11)	-0.128714 (0.06315) [-2.03838]	0.010676 (0.00686) [1.55660]	0.004540 (0.00829) [0.54739]	-0.028680 (0.09202) [-0.31167]
RHPIM(-12)	-0.093435 (0.05246) [-1.78118]	-0.013131 (0.00560) [-2.34648]	-0.005076 (0.00627) [-0.80910]	-0.028693 (0.07321) [-0.39191]
EMP(-1)	0.198976 (0.60501) [0.32888]	0.763655 (0.06527) [11.6996]	-0.044993 (0.04989) [-0.90191]	1.317776 (0.66294) [1.98779]
EMP(-2)	0.318533 (0.69143) [0.46068]	-0.071151 (0.07381) [-0.96397]	0.088172 (0.06584) [1.33908]	-1.251420 (0.83257) [-1.50308]
EMP(-3)	-0.480833 (0.69176) [-0.69509]	-0.341809 (0.08119) [-4.21007]	-0.222851 (0.06672) [-3.34020]	0.036368 (0.83591) [0.04351]
EMP(-4)	0.115472 (0.68179) [0.16936]	0.314406 (0.07669) [4.09973]	0.373526 (0.07595) [4.91777]	2.056358 (0.93196) [2.20648]
EMP(-5)	-1.045038 (0.69639) [-1.50064]	-0.024803 (0.07528) [-0.32947]	-0.089823 (0.07865) [-1.14199]	-1.426920 (0.96172) [-1.48371]
EMP(-6)	1.009230 (0.66679) [1.51357]	-0.041406 (0.07369) [-0.56190]	-0.146808 (0.07470) [-1.96537]	0.977994 (0.92467) [1.05767]
EMP(-7)	1.516254 (0.69300) [2.18796]	0.078138 (0.07419) [1.05321]	0.299135 (0.08089) [3.69793]	-0.037672 (0.95902) [-0.03928]
EMP(-8)	-1.464118 (0.67931) [-2.15531]	0.088640 (0.07307) [1.21316]	-0.086843 (0.07866) [-1.10399]	-1.914746 (0.93311) [-2.05199]
EMP(-9)	-0.076359 (0.63844) [-0.11960]	-0.143816 (0.06930) [-2.07526]	0.084754 (0.09321) [0.90923]	2.220711 (0.95090) [2.33538]
EMP(-10)	0.585313 (0.53987) [1.08417]	-0.035356 (0.05765) [-0.61326]	0.056882 (0.09375) [0.60676]	0.008757 (0.96243) [0.00910]
EMP(-11)	0.003014 (0.56530)	0.189756 (0.06001)	0.046591 (0.08227)	-0.150564 (0.92092)

	[0.00533]	[3.16194]	[0.56629]	[-0.16349]
EMP(-12)	-0.581381 (0.45796) [-1.26949]	-0.172981 (0.04990) [-3.46670]	0.058720 (0.05619) [1.04511]	0.244625 (0.67810) [0.36075]
HDI(-1)	0.982457 (0.25369) [3.87267]	0.001597 (0.02764) [0.05777]	0.679004 (0.05647) [12.0234]	0.234478 (0.46979) [0.49911]
HDI(-2)	-0.405148 (0.33410) [-1.21265]	0.036195 (0.03578) [1.01171]	0.268807 (0.06401) [4.19965]	-0.261577 (0.58745) [-0.44527]
HDI(-3)	0.316335 (0.31735) [0.99681]	-0.071056 (0.03517) [-2.02034]	-0.554939 (0.05967) [-9.30086]	-0.042188 (0.58517) [-0.07209]
HDI(-4)	0.296734 (0.36278) [0.81795]	0.063630 (0.03956) [1.60830]	0.276935 (0.06790) [4.07858]	0.156093 (0.66263) [0.23557]
HDI(-5)	-0.283476 (0.38545) [-0.73543]	0.008768 (0.04163) [0.21062]	0.247555 (0.06434) [3.84759]	-0.060059 (0.67039) [-0.08959]
HDI(-6)	-0.426567 (0.37291) [-1.14388]	-0.023318 (0.04135) [-0.56385]	-0.426317 (0.05588) [-7.62919]	0.419823 (0.62557) [0.67111]
HDI(-7)	0.509044 (0.36538) [1.39318]	0.035630 (0.03960) [0.89981]	0.259854 (0.06989) [3.71826]	0.124367 (0.66892) [0.18592]
HDI(-8)	0.281754 (0.38361) [0.73449]	-0.031214 (0.04066) [-0.76760]	0.179323 (0.07276) [2.46453]	-0.344175 (0.69681) [-0.49393]
HDI(-9)	-0.808179 (0.34289) [-2.35694]	0.030207 (0.03817) [0.79132]	-0.475954 (0.06132) [-7.76159]	-0.313505 (0.62426) [-0.50221]
HDI(-10)	0.469578 (0.30348) [1.54729]	-0.012076 (0.03401) [-0.35506]	0.344457 (0.05882) [5.85620]	0.613639 (0.57734) [1.06287]
HDI(-11)	0.143155 (0.31101) [0.46030]	0.009843 (0.03408) [0.28884]	0.114526 (0.05551) [2.06326]	-0.796169 (0.55666) [-1.43027]
HDI(-12)	-0.064240 (0.24035) [-0.26728]	-0.000686 (0.02594) [-0.02643]	-0.099792 (0.03871) [-2.57777]	0.275672 (0.41243) [0.66840]
MS2(-1)	-0.028005 (0.02970) [-0.94296]	-0.002289 (0.00330) [-0.69310]	0.002589 (0.00543) [0.47669]	-0.009459 (0.05532) [-0.17099]
MS2(-2)	0.006018 (0.02981) [0.20189]	-0.001600 (0.00325) [-0.49249]	-0.014764 (0.00534) [-2.76335]	-0.036187 (0.05243) [-0.69025]

MS2(-3)	-0.054225 (0.02964) [-1.82965]	-0.005531 (0.00325) [-1.70174]	-0.009187 (0.00501) [-1.83412]	-0.051939 (0.05172) [-1.00424]
MS2(-4)	0.041008 (0.02919) [1.40468]	0.000825 (0.00317) [0.26055]	-0.008841 (0.00569) [-1.55445]	-0.007518 (0.05249) [-0.14323]
MS2(-5)	-0.073163 (0.03075) [-2.37946]	0.000738 (0.00331) [0.22309]	-0.011305 (0.00481) [-2.35221]	-0.020640 (0.05135) [-0.40197]
MS2(-6)	-0.037641 (0.02953) [-1.27470]	0.005398 (0.00319) [1.69151]	-0.005554 (0.00484) [-1.14680]	-0.077268 (0.05156) [-1.49859]
MS2(-7)	-0.053228 (0.03206) [-1.66008]	8.79E-05 (0.00334) [0.02634]	0.002375 (0.00568) [0.41820]	0.079483 (0.05245) [1.51531]
MS2(-8)	0.048118 (0.02902) [1.65797]	0.004420 (0.00317) [1.39616]	0.002228 (0.00547) [0.40766]	-0.004225 (0.05235) [-0.08070]
MS2(-9)	0.005108 (0.02963) [0.17237]	-0.000713 (0.00325) [-0.21925]	-0.009829 (0.00572) [-1.71939]	0.015912 (0.05263) [0.30231]
MS2(-10)	0.009270 (0.03013) [0.30765]	0.004996 (0.00328) [1.52456]	-0.013297 (0.00510) [-2.60693]	-0.021526 (0.05209) [-0.41323]
MS2(-11)	-0.005211 (0.02905) [-0.17937]	0.004004 (0.00322) [1.24432]	0.011083 (0.00478) [2.31969]	0.052889 (0.05106) [1.03590]
MS2(-12)	-0.034080 (0.02819) [-1.20900]	0.001012 (0.00313) [0.32344]	0.014814 (0.00506) [2.92838]	-0.466672 (0.05186) [-8.99835]
Transition Matrix Parameters				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
P11-C	1.964437	0.295690	6.643562	0.0000
P21-C	-1.454935	0.302780	-4.805246	0.0000
Determinant resid covariance		0.004432		
Log likelihood		-581.8547		
Akaike info criterion		6.430837		
Schwarz criterion		9.557895		
Number of coefficients		222		

A3: RHPIL

Markov Switching Intercepts VAR Estimates (BFGS / Marquardt steps)
Date: 10/14/21 Time: 17:13
Sample (adjusted): 1996M03 2016M11
Included observations: 249 after adjustments
Number of states: 2

Initial probabilities obtained from ergodic solution
Standard errors & covariance computed using observed Hessian
Random search: 25 starting values with 10 iterations using 1 standard deviation
(rng=kn, seed=186257258)
Convergence achieved after 205 iterations
Standard errors in () & z-statistics in []

	RHPIL	EMP	HDI	MS2
Regime 1				
C	0.021950 (0.12912) [0.17001]	0.019583 (0.00651) [3.00717]	-0.008569 (0.00664) [-1.28979]	-0.036552 (0.13412) [-0.27253]
SIGMA-RHPIL	2.400414 (0.32780) [7.32273]	-0.001665 (0.00993) [-0.16766]	-0.017689 (0.01022) [-1.73023]	-0.059313 (0.21882) [-0.27106]
SIGMA-EMP	-0.001665 (0.00993) [-0.16766]	0.004873 (0.00060) [8.06165]	-0.002051 (0.00045) [-4.51340]	0.008909 (0.00947) [0.94122]
SIGMA-HDI	-0.017689 (0.01022) [-1.73023]	-0.002051 (0.00045) [-4.51340]	0.005051 (0.00062) [8.10724]	-0.029093 (0.01007) [-2.89009]
SIGMA-MS2	-0.059313 (0.21882) [-0.27106]	0.008909 (0.00947) [0.94122]	-0.029093 (0.01007) [-2.89009]	2.528475 (0.30894) [8.18448]
Regime 2				
C	0.047036 (0.11911) [0.39489]	-0.017058 (0.02936) [-0.58097]	-0.013736 (0.04995) [-0.27500]	-0.503490 (0.19520) [-2.57934]
SIGMA-RHPIL	0.427460 (0.12860) [3.32384]	0.021861 (0.02594) [0.84260]	0.072361 (0.04896) [1.47803]	0.234724 (0.16598) [1.41418]
SIGMA-EMP	0.021861 (0.02594) [0.84260]	0.054805 (0.01030) [5.32337]	0.015918 (0.01223) [1.30195]	-0.001600 (0.04425) [-0.03615]
SIGMA-HDI	0.072361 (0.04896) [1.47803]	0.015918 (0.01223) [1.30195]	0.166158 (0.03101) [5.35776]	0.139425 (0.08223) [1.69564]
SIGMA-MS2	0.234724 (0.16598) [1.41418]	-0.001600 (0.04425) [-0.03615]	0.139425 (0.08223) [1.69564]	1.702221 (0.42358) [4.01866]
Common				
RHPIL(-1)	-0.171772 (0.05528) [-3.10709]	0.000758 (0.00444) [0.17059]	0.012491 (0.00436) [2.86427]	0.024739 (0.07155) [0.34577]
RHPIL(-2)	-0.183106 (0.05390)	-0.005690 (0.00442)	0.002409 (0.00509)	-0.014614 (0.07244)

		[-3.39745]	[-1.28872]	[0.47373]	[-0.20175]
RHPIL(-3)	-0.193276 (0.06343) [-3.04698]	-0.000234 (0.00415) [-0.05635]	0.001650 (0.00445) [0.37101]	-0.077698 (0.07648) [-1.01598]	
RHPIL(-4)	-0.251276 (0.05848) [-4.29699]	-0.010283 (0.00456) [-2.25436]	0.009862 (0.00481) [2.05067]	-0.014841 (0.07541) [-0.19681]	
RHPIL(-5)	-0.076693 (0.06472) [-1.18501]	0.003807 (0.00494) [0.77141]	0.014615 (0.00508) [2.87885]	0.105484 (0.08079) [1.30569]	
RHPIL(-6)	-0.151132 (0.07350) [-2.05628]	-0.005848 (0.00424) [-1.38072]	0.001520 (0.00429) [0.35433]	-0.027616 (0.08625) [-0.32019]	
RHPIL(-7)	-0.232783 (0.06789) [-3.42897]	-0.008158 (0.00463) [-1.76234]	-0.001882 (0.00458) [-0.41105]	0.047392 (0.08248) [0.57457]	
RHPIL(-8)	-0.008091 (0.07309) [-0.11070]	-0.003292 (0.00474) [-0.69446]	0.013886 (0.00460) [3.02140]	0.005681 (0.08236) [0.06898]	
RHPIL(-9)	-0.006158 (0.06899) [-0.08926]	-0.000573 (0.00437) [-0.13125]	0.006665 (0.00449) [1.48506]	0.008230 (0.08275) [0.09945]	
RHPIL(-10)	0.140628 (0.06432) [2.18646]	-0.011586 (0.00462) [-2.50831]	-0.005678 (0.00491) [-1.15690]	0.001447 (0.08188) [0.01767]	
RHPIL(-11)	-0.013621 (0.06382) [-0.21342]	0.008778 (0.00451) [1.94464]	0.006224 (0.00473) [1.31454]	-0.011115 (0.08061) [-0.13789]	
RHPIL(-12)	-0.281113 (0.06324) [-4.44507]	0.002359 (0.00484) [0.48694]	-0.009309 (0.00611) [-1.52240]	0.057895 (0.07843) [0.73821]	
EMP(-1)	0.740764 (0.84643) [0.87516]	0.836302 (0.04388) [19.0571]	0.067212 (0.03961) [1.69694]	0.903337 (0.79857) [1.13119]	
EMP(-2)	-0.418587 (0.88189) [-0.47465]	0.007269 (0.06150) [0.11819]	-0.079566 (0.05764) [-1.38046]	-0.874654 (1.00620) [-0.86926]	
EMP(-3)	-0.458030 (0.79856) [-0.57357]	-0.383968 (0.05703) [-6.73271]	0.123295 (0.05837) [2.11214]	0.436968 (0.98401) [0.44407]	
EMP(-4)	-0.418206 (0.93569) [-0.44695]	0.308417 (0.06180) [4.99025]	-0.079815 (0.06228) [-1.28162]	1.735282 (1.05018) [1.65237]	
EMP(-5)	-0.566679 (0.99737) [-0.56817]	0.111708 (0.05975) [1.86972]	0.042029 (0.05809) [0.72349]	-1.368960 (1.10789) [-1.23565]	

EMP(-6)	0.423510 (0.90815) [0.46634]	-0.112000 (0.06034) [-1.85627]	0.043110 (0.06365) [0.67733]	1.233096 (1.05711) [1.16648]
EMP(-7)	-0.256533 (0.80738) [-0.31774]	-0.040690 (0.06255) [-0.65049]	0.015605 (0.06368) [0.24504]	-0.086592 (1.01352) [-0.08544]
EMP(-8)	-0.594432 (0.87936) [-0.67598]	0.166172 (0.05606) [2.96394]	-0.071226 (0.05749) [-1.23892]	-2.455336 (1.05762) [-2.32157]
EMP(-9)	0.520757 (0.91502) [0.56912]	-0.117131 (0.05668) [-2.06666]	-0.088672 (0.05950) [-1.49026]	2.392060 (1.04779) [2.28296]
EMP(-10)	1.986374 (0.77184) [2.57354]	-0.038202 (0.05674) [-0.67326]	0.224176 (0.05786) [3.87422]	-0.211218 (0.97606) [-0.21640]
EMP(-11)	-1.265657 (0.77175) [-1.63999]	0.053990 (0.05323) [1.01418]	-0.125092 (0.05330) [-2.34676]	-0.278706 (0.96577) [-0.28858]
EMP(-12)	0.288374 (0.66528) [0.43346]	-0.081055 (0.03846) [-2.10747]	0.093903 (0.03873) [2.42436]	0.180230 (0.76047) [0.23700]
HDI(-1)	0.247944 (0.34819) [0.71209]	0.028494 (0.02673) [1.06620]	0.810953 (0.02733) [29.6752]	0.057668 (0.46704) [0.12347]
HDI(-2)	-0.400102 (0.46814) [-0.85466]	0.000517 (0.03258) [0.01588]	0.139743 (0.03354) [4.16683]	-0.138333 (0.59157) [-0.23384]
HDI(-3)	-0.250685 (0.52045) [-0.48167]	-0.114026 (0.03244) [-3.51522]	-0.806849 (0.03289) [-24.5340]	0.245314 (0.59568) [0.41182]
HDI(-4)	0.479463 (0.55118) [0.86989]	0.140250 (0.03764) [3.72616]	0.650137 (0.03862) [16.8358]	0.055514 (0.66074) [0.08402]
HDI(-5)	-0.428101 (0.56165) [-0.76222]	-0.011343 (0.03736) [-0.30363]	0.207114 (0.03789) [5.46626]	-0.144045 (0.68344) [-0.21076]
HDI(-6)	0.253564 (0.55894) [0.45365]	-0.077038 (0.03980) [-1.93567]	-0.332108 (0.04025) [-8.25072]	0.516695 (0.67265) [0.76815]
HDI(-7)	0.080190 (0.52148) [0.15377]	0.087686 (0.04157) [2.10919]	0.199177 (0.04572) [4.35687]	0.432195 (0.65479) [0.66005]
HDI(-8)	-0.113465 (0.59498) [-0.19070]	-0.024468 (0.03797) [-0.64445]	0.093631 (0.04232) [2.21225]	-0.443301 (0.69366) [-0.63908]

HDI(-9)	0.077083 (0.57920) [0.13309]	-0.060799 (0.03987) [-1.52502]	-0.240584 (0.04090) [-5.88242]	-0.583117 (0.64176) [-0.90862]
HDI(-10)	-0.515576 (0.44200) [-1.16646]	0.081604 (0.03961) [2.06018]	0.161277 (0.04143) [3.89302]	0.781985 (0.58252) [1.34241]
HDI(-11)	0.234360 (0.46659) [0.50228]	0.036030 (0.03149) [1.14426]	0.070586 (0.03387) [2.08411]	-0.674873 (0.58244) [-1.15869]
HDI(-12)	0.166065 (0.39226) [0.42336]	-0.019998 (0.02206) [-0.90671]	-0.022950 (0.02262) [-1.01464]	0.059648 (0.43811) [0.13615]
MS2(-1)	-0.094903 (0.04707) [-2.01631]	-0.002109 (0.00297) [-0.70891]	0.003593 (0.00305) [1.17839]	-0.011060 (0.05550) [-0.19928]
MS2(-2)	-0.012963 (0.04005) [-0.32370]	0.006260 (0.00315) [1.98655]	0.011612 (0.00329) [3.52664]	0.003951 (0.05355) [0.07378]
MS2(-3)	0.007320 (0.04084) [0.17921]	-0.000653 (0.00309) [-0.21121]	-0.001505 (0.00327) [-0.45974]	-0.052170 (0.05228) [-0.99786]
MS2(-4)	0.026387 (0.03929) [0.67154]	-0.002692 (0.00318) [-0.84700]	-0.012702 (0.00346) [-3.67448]	-0.018786 (0.05162) [-0.36390]
MS2(-5)	-0.030629 (0.03996) [-0.76658]	0.005486 (0.00311) [1.76450]	-0.009945 (0.00328) [-3.03586]	-0.046632 (0.05161) [-0.90358]
MS2(-6)	0.016494 (0.04529) [0.36419]	0.002374 (0.00294) [0.80835]	-0.005644 (0.00317) [-1.77984]	-0.081460 (0.05450) [-1.49477]
MS2(-7)	-0.025942 (0.04100) [-0.63266]	0.003165 (0.00303) [1.04448]	0.002980 (0.00324) [0.91863]	0.061709 (0.05271) [1.17061]
MS2(-8)	0.014813 (0.04246) [0.34885]	0.004588 (0.00317) [1.44663]	0.005546 (0.00325) [1.70823]	0.006116 (0.05247) [0.11656]
MS2(-9)	0.018475 (0.03802) [0.48597]	-0.003157 (0.00306) [-1.03047]	-0.003554 (0.00318) [-1.11645]	0.005177 (0.05194) [0.09968]
MS2(-10)	-0.046546 (0.04141) [-1.12391]	0.004397 (0.00297) [1.47851]	-6.58E-05 (0.00300) [-0.02195]	-0.038077 (0.05485) [-0.69424]
MS2(-11)	-0.038515 (0.03623) [-1.06307]	0.003700 (0.00319) [1.15883]	0.000224 (0.00323) [0.06925]	0.057347 (0.05061) [1.13316]
MS2(-12)	-0.058937	-0.007101	0.001319	-0.485805

	(0.04633) [-1.27223]	(0.00287) [-2.47040]	(0.00317) [0.41609]	(0.05394) [-9.00592]
Transition Matrix Parameters				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
P11-C	0.835025	0.194188	4.300096	0.0000
P21-C	1.446839	0.402046	3.598688	0.0003
Determinant resid covariance		0.003950		
Log likelihood		-522.3749		
Akaike info criterion		5.978915		
Schwarz criterion		9.114957		
Number of coefficients		222		

Appendix B: Regime dependent impulse response tables

B1: RHPIS

Regime 1

Period	EMP	HDI	MS2
1	0.000000	0.000000	0.000000
2	-0.000100	0.002036	-0.000281
3	0.000291	0.002542	-0.000136
4	0.000118	0.003059	-0.000370
5	-0.000102	0.002664	-7.44E-05
6	-0.000986	0.003043	-0.000664
7	-0.000924	0.002959	-0.000642
8	-0.000760	0.002858	-0.000533
9	-0.000860	0.003312	-0.000209
10	-0.002211	0.001999	-5.41E-05

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: RHPIS EMP HDI MS2

Regime 2

Period	EMP	HDI	MS2
1	0.000000	0.000000	0.000000
2	-0.000167	0.000446	-0.000348
3	-6.54E-05	0.000512	-0.000169
4	-0.000171	0.000659	-0.000460
5	-0.000169	0.000522	-9.24E-05
6	-0.000511	0.000717	-0.000825
7	-0.000487	0.000696	-0.000797
8	-0.000422	0.000654	-0.000662

9	-0.000425	0.000674	-0.000259
10	-0.000703	0.000392	-6.72E-05
Cholesky One S.D. (d.f. adjusted)			
Cholesky ordering: RHPSI EMP HDI MS2			

B2: RHPIM

Regime 1

Period	EMP	HDI	MS2
1	0.000000	0.000000	0.000000
2	-0.002000	0.271356	-0.044601
3	0.030881	0.282776	-0.021969
4	-0.016579	0.398378	-0.118640
5	-0.033368	0.403585	-0.050347
6	-0.135969	0.371127	-0.168927
7	-0.119393	0.244366	-0.238716
8	0.028904	0.188493	-0.260856
9	0.068306	0.251572	-0.122231
10	0.014925	0.099670	-0.061899
Cholesky One S.D. (d.f. adjusted)			
Cholesky ordering: RHPIM EMP HDI MS2			

Regime 2

Period	EMP	HDI	MS2
1	0.000000	0.000000	0.000000
2	0.056968	0.069388	-0.031865
3	0.118619	0.071996	-0.015695
4	0.095102	0.102548	-0.084761
5	-0.002177	0.102996	-0.035970
6	-0.154139	0.096279	-0.120687
7	-0.067096	0.065022	-0.170547
8	0.305165	0.051135	-0.186365
9	0.290221	0.065362	-0.087326
10	0.096890	0.026068	-0.044223
Cholesky One S.D. (d.f. adjusted)			
Cholesky ordering: RHPIM EMP HDI MS2			

B3: RHPIL

Regime 1

Period	EMP	HDI	MS2
1	0.000000	0.000000	0.000000
2	0.032312	0.054224	-0.145382
3	0.007476	-0.015881	0.005695
4	-0.016260	-0.034816	0.046382
5	-0.063544	-0.022418	0.063234
6	-0.089094	0.000527	-0.042212
7	-0.011744	0.019984	0.027121
8	-0.001765	0.010353	-0.029020
9	-0.030947	-0.012687	0.058283
10	0.032184	-0.018961	0.022162

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: RHPIL EMP HDI MS2

Regime 2

Period	EMP	HDI	MS2
1	0.000000	0.000000	0.000000
2	0.190283	0.071297	-0.116231
3	-0.011066	-0.086870	0.004553
4	-0.122013	-0.129799	0.037082
5	-0.244293	-0.023883	0.050555
6	-0.307763	-0.072296	-0.033748
7	0.016920	0.170648	0.021683
8	0.009596	0.011358	-0.023201
9	-0.114549	0.026730	0.046596
10	0.068820	-0.076232	0.017719

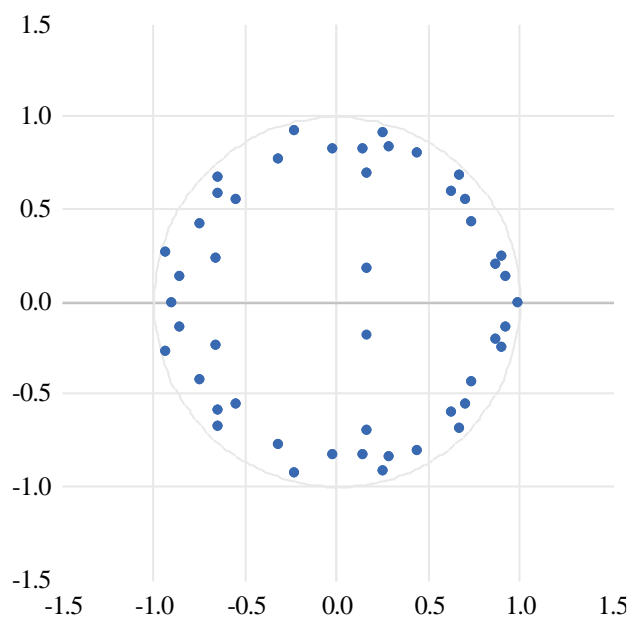
Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: RHPI HDI MS2

Appendix C: Regime specific AR roots

RHPIS

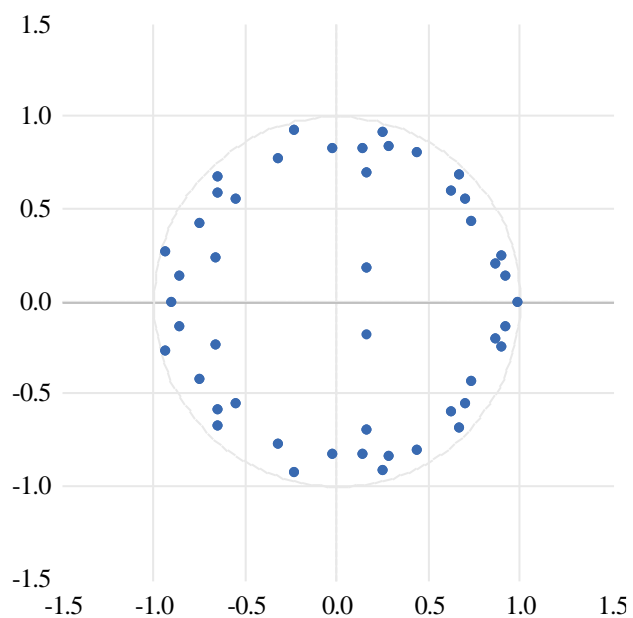
Regime 1

Inverse Roots of AR Characteristic Polynomial



Regime 2

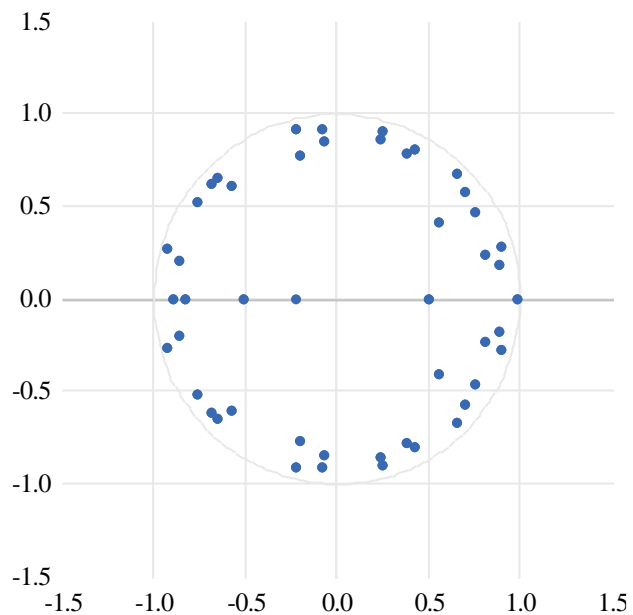
Inverse Roots of AR Characteristic Polynomial



RHPIM

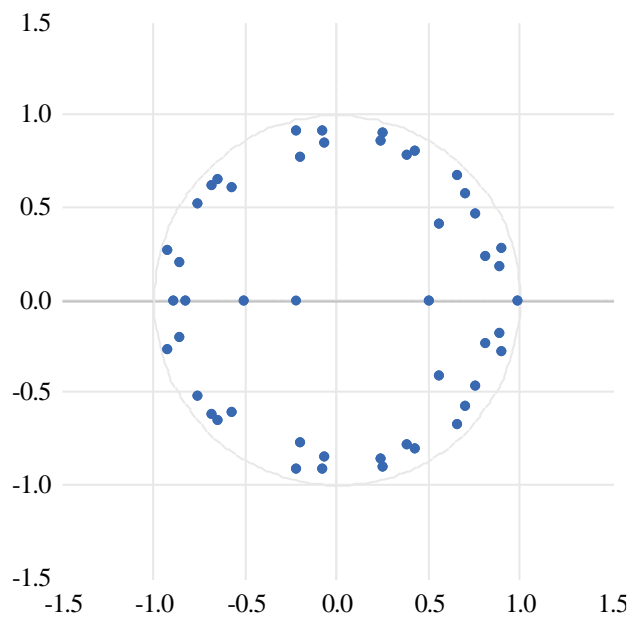
Regime 1

Inverse Roots of AR Characteristic Polynomial



Regime 2

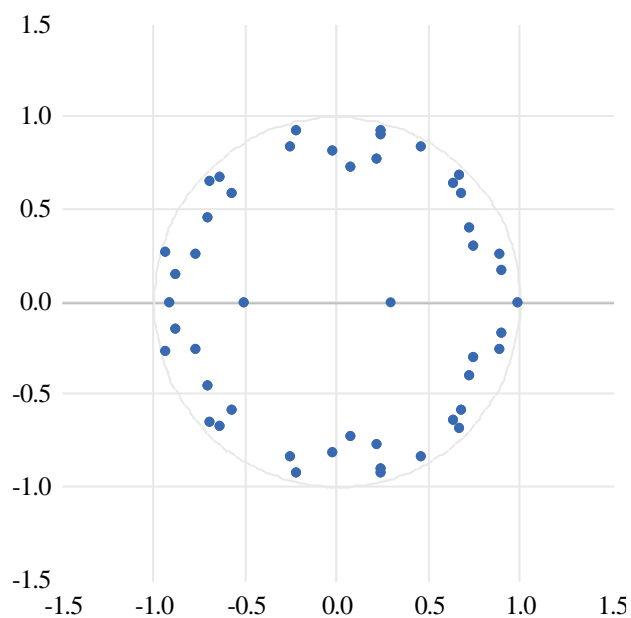
Inverse Roots of AR Characteristic Polynomial



RHPIL

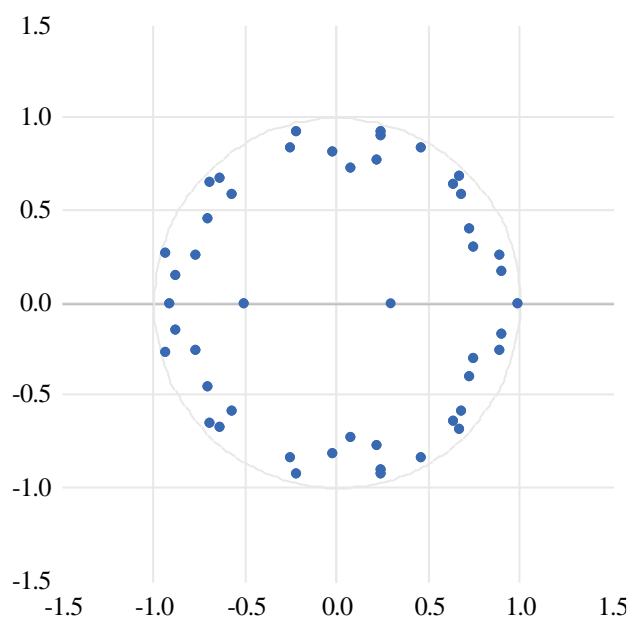
Regime 1

Inverse Roots of AR Characteristic Polynomial



Regime 2

Inverse Roots of AR Characteristic Polynomial





25 January 2021

Miss Mandy Zama Khumalo (214530021)
School Of Acc Economics&Fin
Westville

Dear Miss Mandy Zama Khumalo,

Protocol reference number: 00010636

Project title: Impact of country risk and macroeconomic factors on South African housing market segments under different regimes

Exemption from Ethics Review

In response to your application received on 20 Jan 2021, your school has indicated that the protocol has been granted **EXEMPTION FROM ETHICS REVIEW**.

Any alteration/s to the exempted research protocol, e.g., Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through an amendment/modification prior to its implementation. The original exemption number must be cited.

For any changes that could result in potential risk, an ethics application including the proposed amendments must be submitted to the relevant UKZN Research Ethics Committee. The original exemption number must be cited.

In case you have further queries, please quote the above reference number.

PLEASE NOTE:

Research data should be securely stored in the discipline/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours sincerely,



Prof Josue Mbonigaba
Academic Leader Research
School Of Acc Economics&Fin

UKZN Research Ethics Office
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Website: <http://research.ukzn.ac.za/Research-Ethics/>

Founding Campuses:  Edgewood  Howard College  Medical School  Pietermaritzburg  Westville

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Mandy_214530021_final_corrected_thesis_masters.pdf

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