Faculty of Economics and Business

CONSTRUCTION OF A PROPERTY CYCLE INDICATOR

FOR THE REPUBLIC OF SOUTH AFRICA

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Statement of Originality

The work described in this Final Year Project, entitled

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is to the best of the author's knowledge that of the author except

where due reference is made.

10TH JULY 2020   *Priscilla*

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ABSTRACT

Construction of a Property Cycle Indicator

for the Republic of South Africa

By

Priscilla Lai Wai Sum

The purpose of this paper is to study the fluctuations in the property market of South Africa and to forecast the shocks of its vulnerability in accordance with the economy of the country. This is done by constructing the property cycle indicator (PCI) which consists of six variables which make up the component series namely the London gold price, share price index, foreign direct investment, BRENT crude oil price, visitor arrivals and the industrial production index. The method employed in constructing the PCI is proposed by the National Bureau of Economic Research (NBER). This study displays the ability of the PCI to trail changes in the property cycle and offers an early detection of the turning points. Policymakers and investors will be able to utilise the PCI to forecast the trend of the property cycle and thus, make further concrete decisions.

ABSTRAK

Pembinaan Petunjuk Kitaran Hartanah

untuk Republik Afrika Selatan

Oleh

Priscilla Lai Wai Sum

Tujuan kajian ini dijalankan untuk mengkaji turun dan naik pasaran harta tanah di Afrika Selatan untuk meramalkan kejutan dan isyarat awal sesuai dengan ekonomi negara. Ini dilakukan dengan pembinaan petunjuk kitaran hartanah (PCI) yang terdiri daripada enam pemboleh ubah yang membetuk siri komponen iaitu harga emas London, indeks harga saham, pelaburan langsung asing, harga minyak mentah BRENT, kedatangan pelawat dan indeks pengeluaran industri. Petunjuk kitaran hartanah (PCI) dibina melalui kaedah yang diperkenalkan oleh *National Bureau of Economic Research (NBER)*. Kajian ini menunjukkan kemampuan PCI untuk mengesan perubahan dalam kitaran harta tanah dan menawarkan pengesanan awal dari segi titik perubahannya. Oleh itu, pihak kerajaan, penggubal dasar dan pelabur dapat menggunakan PCI untuk meramalkan trend kitaran harta tanah dan dengan itu, keputusan konkrit boleh diambil selanjutnya.

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My family, needless to say, is my pillar of strength in terms of motivation and support as I work tirelessly throughout my three years in university and giving those years a final spin with my Final Year Project. Without imposing further pressure on me, they have shown their support in various ways and have extended grace in times of need.

I would also like to extend my sincere gratitude to my friends who have not only witnessed my moments of stress but have gone through those moments with me, cheering me along the way. A huge thanks to Ann Ni, a postgraduate senior, who have guided me patiently as I ventured into this new indicator approach topic.

I am humbled throughout the process of writing this thesis, from beginning to the end, as I can only cling on to the strength I receive from God and the hope that He knows the path I am taking and that He has seen me through the entire journey.

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CHAPTER ONE
INTRODUCTION

1.1 Introduction

An economic cycle is described as the movements of asset prices around non-static equilibriums in the midst of economic activities which may be periodic but irregular, and can be measured by the fluctuations of macroeconomic variables of a nation (Hui & Wang, 2015). Past studies on cyclicality have always been on the issue of identification and the duration in which each phase might last. There have been no unanimous agreement where all researchers have come to agree upon a set classification of periods in a cycle. The term 'cycle' was usually associated with extremely consistent movements with accurately predictable period of which they might last. However, it has now become an arduous task to predict as it has been increasingly irregular, with major differences in lasting periods, magnitude and also how often it may occur.

The property cycle, similar to an economic cycle, is the sequence of recurring events with inconsistent fluctuations, particularly in the property market (Kuek, 2015). The pioneer of the study of property cycles was dated way back in the late 1800s to early 1900s by Homer Hoyt (1933) in the study "One Hundred Years of Land Values in Chicago". This study developed the characteristic of predictability of the property

cycle. The subject matter involves two processes, according to the study, which are the physical growth of the city which can be seen and is tangible and the second would be the growth of land values which cannot be seen or intangible. The former is measured by the number of new constructions, buildings, facilities, infrastructures and transportation lines whereas the latter is often motivated by the profit motive and is included in almost every building project. The theory behind the profit motive is that income can be generated just by having a building erected on an urban site. Hence, the two processes which contributes to the property cycle is very much interrelated.

In a model of natural-cycle developed by Ferlito (2018), two stages are identified which are the primary and secondary expansion. The primary expansion involves changes in the layout of time preferences and expectations where the system of property cycle becomes more forward-looking. On the other hand, the secondary expansion is a result of imitative investments or what is also known as the speculation fever. This phase involves profit expectations, especially involving speculations that the current reality or situation will not undergo changes. This process creates demand for loanable funds as an attempt to elongate the expansion process, which indirectly also increases the degree of risks. Barras (1994) in his study characterised the property cycle into three segments namely the real economy, property market and the money economy.

The property cycle is commonly characterised by four phases which are the boom phase, slump phase, stabilization phase and upturn phase. However, a recent article by The Malaysian Reserve elaborated on the four phases of the property cycle as the recovery phase, expansion phase, hypersupply phase and the recession phase (Aisyah, 2019). Firstly, the recovery phase usually occurs after a recession when the market is building up and when there is minimal activity in the property market. The property market interrelates a lot with the economy and the aspects that make up for it. In the recovery phase of the property market, the unemployment rate is high as there are few or neither ongoing nor upcoming constructions in the near future.

As the economy rebounds and stabilises, the property cycle goes through the second phase which is the expansion phase. This is when the rent rates start growing and where unemployment is low. At the peak of this phase, equilibrium in the market is reached and hence, development and construction begins again. When construction is on the rise, this is when the third phase happens and it is also known as the 'boom' in the property market. As supply has surpassed demand and equilibrium has been shifted, this results in a spillover effect which leads to the third phase which is the hypersupply phase. As a result of the oversupply in units, an overhang of property increases and hence, rental decreases as competition increases. The third phase will be superseded by the fourth and last phase of the cycle, which is the recession phase, if the decrease in demand for property is not recognised and action is not taken to deal with the vacancies and overhang issue.

1.2 History of South Africa

Officially known as the Republic of South Africa in 1961, the country with a population of 58,775,022, is located at the southernmost part of Africa. Taking its place as the largest country in Southern Africa, it is also the 24th largest nation in the world in terms of land and also in terms of most-populated nation. Its surface area is larger than that of Germany, France, Italy, Belgium and the Netherlands combined. The country is also known as the rainbow nation for its cultural, linguistic and religious diversity. Its constitution recognises 11 different languages. The people of South Africa comprises of the Bantu ancestry, which makes up the majority of the population and is further divided into several ethnic groups with a variety of African languages. The rest of the population is made up of Europeans, Asians and a multiracial ancestry.

South Africa's political status has evolved largely around the fact that it constitutes of a multicultural and multiracial nature. The country was declared to be a sovereign independent state in 1934 when the parliament of South Africa enacts the Status of the Union Act. In 1948, when the National Party (NP) was in power, the policy of apartheid was adopted. Apartheid, which literally means "apartness", was a legislative system in the country of South Africa which imposed policies that segregates against the black citizens of the country. When the National Party (NP) were in power with its all-white members, policies of racial segregation were enforced.

Nelson Mendela, also known as the father of South Africa, was elected as President of the country. He suffered 27 years in prison after being sentenced for life imprisonment for betrayal in 1961. However, two years after his release in 1992, he was elected as the first black President of the country. In 1994, history was made when the first free, universal and democratic elections were held. This marked the end of 300 years of colonialism and white supremacy. It marked the end of Apartheid. In the midst of political uproar, Mendela set a tone of reconciliation rather than revenge as he dreamt of a free, united and prosperous South Africa. The African National Congress (ANC), led by Nelson Mandela, was unbanned in 1990 and the party won its first non-racial elections in 1994. South Africa's status as a Commonwealth state was restored after being declared as a republic in 1961. Being a country true to its reference as a rainbow nation, South Africa was the first African country and also the fifth country in the world to pass the bill on same-sex unions.

The blacks have always been discriminated and have not had the right to vote in a political election until 1994. This issue has become a chapter in history where majority of the South Africans have been fighting to claim more rights from the reign of the dominant whites though they are the minority in the country. During the rule of Apartheid for instance, the black population do not have access to ambulances according to the law though they made up 80% of the population in South Africa. Up to today, the issue on apartheid and discrimination of the blacks have been a major

struggle for the victims worldwide and it has made a significant impact in world history and the politics of the country.

In present age, South Africa is the only country in the universe to hold three capital cities namely Cape Town, Pretoria and Bloemfontein. However, none of these capital cities are where businesses and economic activities concentrate as that would be in Johannesburg. The political situation in South Africa is a large factor of economic instability in the past decade due to corruption issues which affected every aspect of development of the country. It was uttered in the speech given by President Thabo in 2001, that there will be initiatives taken by the government to create a conducive environment for the economy to expand. Government expenditures were revised to include investment in infrastructure, in citizens suffering from human immunodeficiency virus (HIV) or acquired immune deficiency syndrome (AIDS), and to improve the efficiency of the criminal justice system.

1.3   The Economy of South Africa and its Property Market Background

South Africa is labelled as an upper-middle income country by the World Bank, and also a country that is newly industrialised. The economy of South Africa is the 33rd largest in the world and it is one of the top 10 country with highest per capita income

and highest human development index (HDI) in Africa. It is by far the most developed economy of all the countries situated at the south of the Sahara desert.

Since 1994 when the days of Apartheid has ended, the country experienced an economic boost, where its purchasing power has tripled to this day. During the reign of President Thabo Mbeki from 1999 to 2008, South Africa experienced 36 quarters of positive economic growth continuously with an average GDP growth rate of 3.25% and inflation of 5.6% (South African Market Insights, 2019). This success story was contributed by the teamwork between President Thabo and finance minister at that time, Trevor Manual.

South Africa's GDP growth slumped in 1998 when the country was affected by the Asian financial crisis which caught countries in East Asia and Southeast Asia off guard. The position of South Africa in the global realm has been largely influenced by its historical developments up till today. From mid to late 1990s, there was a need to produce trade surpluses, which equates to having more exports than imports, in order to generate foreign currency. However, when the Rand currency began to depreciate in 1999, its trade balance also started to improve as the country moves towards a new millennia.

In the mid-2000s, the gradual growth of its economy was driven by the services, retail and manufacturing sectors. The construction, transport and communications sector also contributed significantly to its growth. Though the mining and agriculture sector made little significance, the country's platinum exports were boosted by strong price increases which spurred the mining sector for a bit. South Africa's GDP growth was at its lowest point in the late 2000s during the subprime mortgage crisis which took place in the second half of year 2009. This was during the reign of President Kgalema Motlanthe, who unfortunately took over the presidential spot from Thabo in this untimely manner where not much could be done to prevent this unprecedented plunge in economic growth.

Under Jacob Zuma's tenure as President from mid-2009 to February 2018, South Africa experienced an average economic growth, though it could not reach the heights of economic growth as that under President Thabo. In the last decade, South Africa's commodity prices fluctuated drastically and this has impacted the country's economy as it is very much reliant on its resources and commodities. From the year 2007 to 2018, nominal house prices increased by approximately 57% but real prices showed a fall by 18% after adjusting for inflation (Delmendo, 2020).

Figure 2.1: Inflation-adjusted national poverty lines, 2010-2019
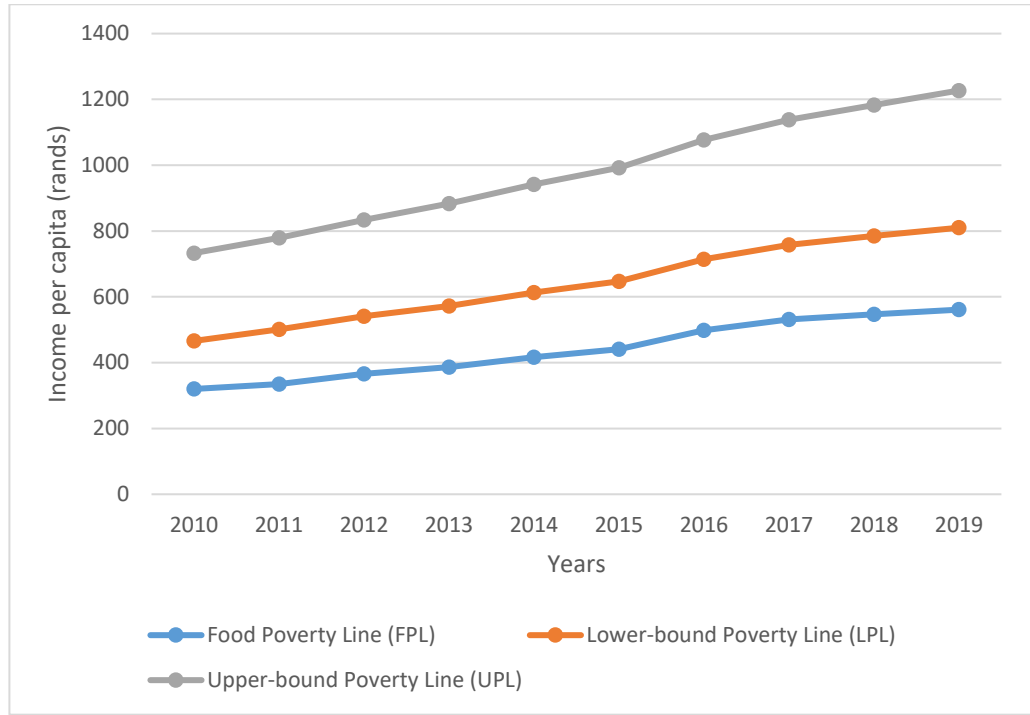
Source: Department of Statistics South Africa, national poverty lines

The land of South Africa has ample mineral resources, particularly golds and diamonds. The development of the country relies heavily on gold in the late 1800s and only began to develop its manufacturing and agriculture industry in mid 1900s. In the years of World War II, South Africa has already established a solid foundation on the manufacturing sector, with escalating growth rates including several years where its growth rate was among the highest in the world. However, in the late 1900s, due to the apartheid issues and policies created by the government, many investing countries withheld their foreign investments and imposed severe trade sanctions which resulted in an increase in trade barriers.

Figure 1.2: GDP Growth in South Africa, 1980-2018
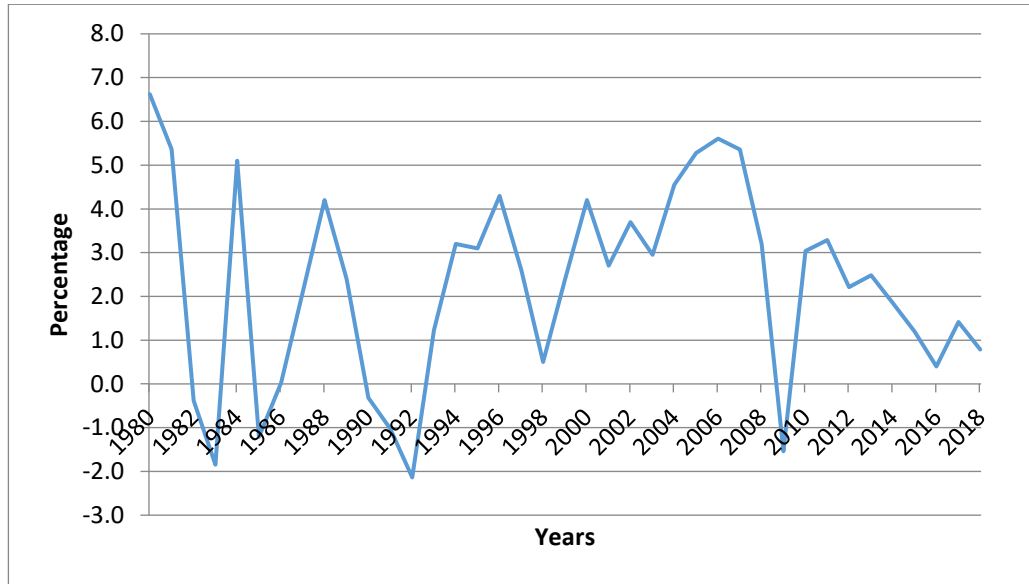
Source: CEIC Data, South Africa, GDP Growth

The GDP growth in South Africa over the period of sanction from 1986 to 1988 were 0.02 percent, 2.10 percent and 4.20 percent respectively, after having a triumphant GDP growth of 4.9 percent in 1974 before the sanction took place. The international oil price increased and due to its dependence on foreign trade, the economy of South Africa is sensitive to even the slightest changes in the global economy. This also implies that the country is not self-sustaining and the sanction that took place in the 1980s affected the economy of the nation vastly which ultimately resulted in a recession in late 1980s.

During the period of recovery from the recession, the country's economy stagnated for several years in the early 1990s. The end of the apartheid was the

beginning of a new era after the bilateral discussions between FW de Klerk and Nelson Mendela took place in 1993 for a change in policies and government. The country held its first universal elections the year after which resulted in the victory of the African National Congress (ANC). Government policies have since brought down inflation and stabilised the country's economy in terms of public finances and foreign investments. GDP growth still remained below average, up till 2004 onwards where it escalated significantly, bringing employment and capital formation up along with it.

The East Asian Financial Crisis that occurred in 1997 to 1998 was a disastrous nightmare worldwide. It has affected the global economy and livelihoods of people around the world including South Africa. The GDP growth in 1996 plunged drastically from 4.3 percent to 0.5 percent in 1998 which has led to the shutdown of many industries and a spike in unemployment. South Africa has the most persistent unemployment rates among the other countries in the world, stagnating at approximately 29 percent in the world today.

The mining, manufacturing and agriculture sectors in South Africa remains as their comparative advantage. However, the country has undergone a shift from primary to secondary economy in the mid-2000s and has now diversified to include other key economic sectors namely fisheries, vehicle manufacturing and assembly, food processing, textiles, telecommunication, energy, transportation industry and financial

and business services. From 1994 to 2004, the financial and business services sector experienced a drastic growth from 17 percent to 24 percent while the transportation and telecommunication sector grew significantly with mobile phones being one of its main contribution.

Figure 1.3: Unemployment rate in South Africa, 2008-2019
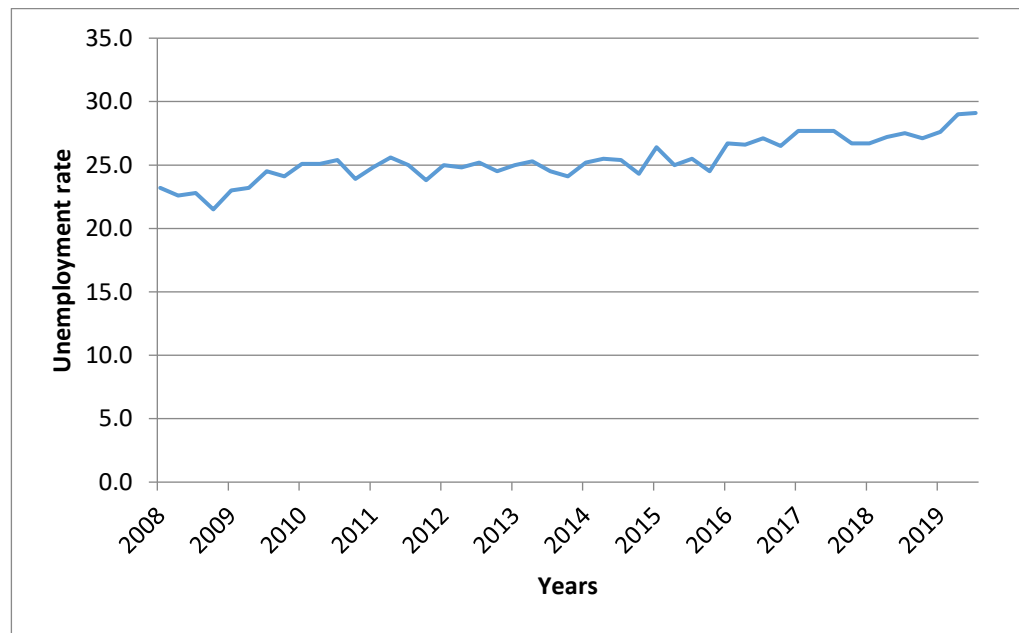
Source: CEIC Data, South Africa, unemployment rate

Poverty has been significantly reduced and over hundreds of thousands of black families are able to make it into the middle class every year. However, this does not exempt many citizens who are still living in poverty and are recipients of the result of inequality. South Africa was measured as the world's most unequal country when

apartheid was abolished after the first election in 1994 (Whiting, 2019). One fourth of the population in South Africa are unemployed and living on less than $1.25 a day.

The formation of BRICS was initially four countries with BRIC being the acronym of each country which comprises of Brazil, Russia, India and China. It was then reintroduced as BRICS with the induction of South Africa in 2010. The members of BRICS are recognized for their strong influence on regional affairs as the member economies are all G20 countries. As a result of its participation in BRICS, South Africa has attracted many investors from the member countries to contribute to their foreign direct investment. The tourist arrival in South Africa also spiked due to its involvement in BRICS. Tourism was one of the six core pillars of growth in the South Africa New Growth Plan 2010.

The positive growth in the tourism industry is a strong contributor to the economic growth of the country, as in the case of Turkey (Ivanov & Webster, 2007). There is a long-run relationship between the two variables and the existence of cointegration among the variables. The tourism industry in South Africa boasts in the wide variety of options available in the country, such as the natural landscape in the suburbs, diverse cultural heritage in both rural and urban areas and the highly attractive national parks. The Kruger National Park, coastline and beaches, and the cities like Cape Town and Johannesburg are all tourist attraction spots. The top five countries

with the highest number of tourists are from the US, UK, Germany, Netherlands and France. The diversity of the culture and the terrains in South Africa makes it all the more appealing to foreign tourists with different backgrounds or origin unlike South Africa.

Figure 1.4: Tourist arrival in South Africa, 2000-2017
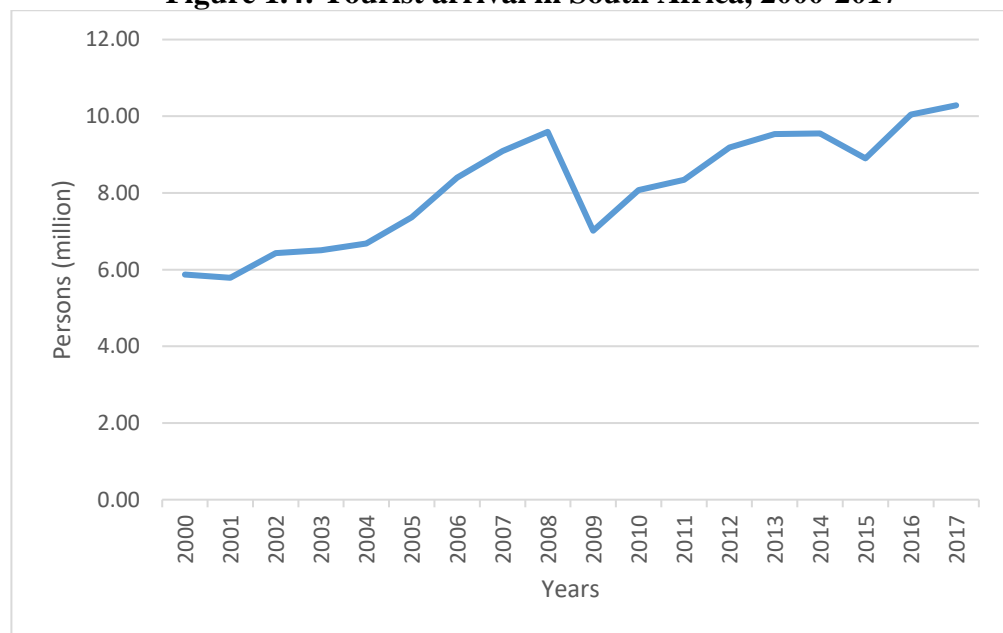
Source: CEIC Data, South Africa, tourist arrival

Tourist arrival slumped in between 2008 and 2009 due to the global financial crisis. However, the tourist arrival increased gradually since then until 2015 where it dropped again. The gradual escalation of tourist arrival in South Africa especially in 2010 is most likely associated with the FIFA World Cup hosted by the country in 2010. It was the first African country to hold a World Football Championship. The worldwide

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event helped to boost the country's image and to positively influence its national identity. Many would still have the stigma and negative image of South Africa due to the apartheid era which the country has been trying to erase.

1.4 Problem Statement

Similar to the property market across the globe, the property market in South Africa is drawn on the basis of demand and supply in the market. This market is highly interrelated with the financial market and the economy of the nation as a whole. Changes or events that take place in the economy of the particular country or a global-wide crisis can have a drastic impact on the property market of that country. In the case of South Africa, the issue of housing price has become an issue which led to the property market bubble scenario.

Inflow of investments have been directed particularly on the tourism sector and this has led to the increase in price of property around the coastal area. When the price of property around the coastal area has increased, the local citizens living in that area could not afford the price of houses without any schemes or financial aid from the government. Due to the increasing burden of cost of living for the citizens, the government came up with some policies to subsidize the housing cost for the citizens who are eligible, based on their financial status. The Finance Linked Individual Subsidy Program (FLISP) was founded by the National Housing Finance Corporation

and is among the initiatives taken by the government to give back to the citizens. This policy aims to provide loans to the beneficiaries of the program to have an opportunity in purchasing home settlements.

Another issue faced by South Africa up to today would be the rural-urban migration of the population following the apartheid whirlwind. Most of the blacks moved out from the rural areas to the cities which led to a congestion in the cities where the demand exceeds the supply of properties. Owners of properties in the city saw this as an opportunity to generate income by converting their property into office spaces or residential units. Prices will be hiked up due to the increasing demand of property units. Due to urbanization, foreign investment began to flood into the city as investors saw prospect of investment. This led to job creation as well through the development of the city and hence, the citizens are able to regain purchasing power of the properties.

Many factors have contributed to the property price bubble such as political stability which may increase the amount of foreign direct investment, leading to a rise in price of houses due to the rising demand. This implies that the construction of a property cycle indicator is crucial in determining the future trend of the property market. As much as the property cycle indicator can detect the booms of the cycle, it can also detect the bust in the cycle.

The study on property cycle is not foreign among researchers. Studies have been done on the forecasting of property cycle by using the property cycle indicator. This is mostly evident in developed countries such as in the UK, US and Australia. A study conducted by Newell and Macfarlane (2006) was done on applying the RICS Model, which is based on the office market cycles for the City of London, in the context of Australian property market. The RICS Model can only be fully utilised in developed countries such as in Australia due to the availability for high quality base data, which was collected by the Property Council of Australia (PCA).

Another study was done on developed countries namely Denmark, Finland, Norway and Sweden (Christoffersen, 2005). This study also utilises the Bry-Boschan (BB) methodology to capture the turning points of the Nordic business cycles, and the Hodrick-Prescott (HP) filter to detrend the data in the abovementioned developed countries. Though more research have been done in developed countries, there is an increasing number of property cycle forecasting studies that are being done in developing countries in the recent years.

Various methodologies have been utilised to study the property cycle of countries, however, not many studies have applied the concept of property cycle indicator. Some countries do have a specific indicator to measure their respective property cycle such as the Housing Price Index (HPI), as in the case of Shanghai (Chiang et a., 2012).

Figure 1.5: House Price Index (HPI) of South Africa, 2010Q1-2018Q4
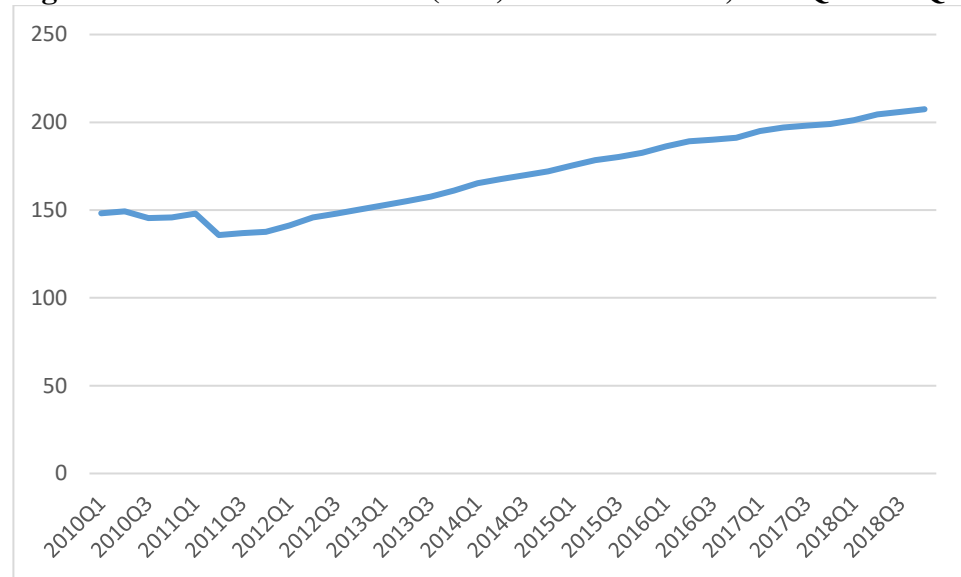
The government of South Africa does not possess a proper property cycle indicator, but the house price index is often used to measure the fluctuations of the property cycle (Luüs, 2003). Policymakers suggest policies based on the showings of the house price index which was constructed by the Amalgamated Banks of South Africa (ABSA) in 1966. In recent years, a private mortgage technology company called FNC, published a residential price index (RPI) which is used to measure the house price index in several countries.

By constructing a property cycle indicator for South Africa, the trend of the cycle can be easily seen which eases the process of decision making and future

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planning. This allows a forward-looking manner to anticipate the trend of the cyclical movement which is vital for policymakers and investors, which can result in the downturn or the upturn of the economy. The early signals given by the indicator can forewarn the government to take preventive measures to act as a cushion to reduce the impact of an anticipated crisis. The ability to predict the cyclical movement not only benefits the government in terms of fiscal policymaking, but it also aids in the monetary policymaking. Monetary policymaking then directs the financial institutions like commercial banks to come up with more relevant and appropriate mortgage loan schemes to enable potential house owners in purchasing a property.

1.5   Research Objective

1.5.1 General Objective

The purpose of this study is to construct a property cycle indicator for the Republic of South Africa.

1.5.2 Specific Objective

i.   To create a property cycle indicator that shows early signals of the property market vulnerability

ii.   To determine the turning points of the property cycle and identify the early signals from the constructed property cycle indicator

iii. To evaluate the capability of the constructed indicator compared to the property cycle indicator available in the Republic of South Africa

1.6   Significance of the Study

The aim of this study is to construct a property cycle indicator for the Republic of South Africa. The results of this study would benefit several parties namely, the government of South Africa, foreign and domestic investors, and also the major players in the construction industry in South Africa. The construction of this indicator allows the respective parties to foresee the trend of the property market, and take it into account for future decisions in relation to this.

The property industry covers a wide aspect in the economy of any country and is often very much interrelated with the economic condition of the country. Any slowdown in the economy or whenever a crisis occurs, the property industry would suffer the consequences and vice versa. When the property industry in a country faces a halt, most likely the development of the country will experience a slower progress.

The property bubble is a global phenomenon. Having a PCI in place, the government of South Africa would be able to prevent the property bubbles from taking place by introducing more effective policies prior to the downturn of the property industry. Investors' trust towards the system and the industry would then increase, inviting more foreign direct investment into the country.

1.7 Organisation of the Study

This research paper comprises of five chapters. Chapter One focuses on the background of the study, problem statement, general and specific objectives, and the significance of the study. This includes the history of South Africa and its property market background. Chapter Two discusses the literature reviews on past researches regarding property cycle in general, its indicators and also the construction methodology of these indicators. Chapter Three elaborates on the data and methodology used to construct the indicator. Chapter Four presents the empirical findings and the results of the indicator construction. The Fifth and final chapter of this thesis concludes with policy recommendations and applications based on the results in Chapter Four.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Property cycles have a distinct feature compared to other types of investment cycles and is considered one of the major contributors in terms of output in the business cycle. The property cycle covers a wide scope of buildings namely residential, industrial and commercial buildings. In 1930, Simon Kuznets first founded long building-cycles with a period of 20 years, compared to the common five years business cycle in the property industry (R. Barras, 1983). A property cycle consists of a peak and a trough, like booms and busts in a business cycle. When an economy experiences a boom, entrepreneurs see opportunities for profit-making, and hence, making the most of every opportunity to invest in long-term investment projects, which are capital goods like buildings and infrastructure.

There are six property cycles defined in various literature reviews which consists of the decline, initiation, expansion, peak, contraction and bottom. These definitions are often an improvement from the previous property cycle which may include market elements or disregard the equilibrium line. However, all phases can also be categorised into three different classifications which are the expansion, equilibrium and contraction (Majid, Said, & Chong, 2017).

2.2 Literature Review on Forecasting of Property Market

Researchers have conducted various studies on property market forecasting over the last decades, where it was seen to be a popularised concern across the globe. Housing prices have fluctuated, along with structural reforms and business cycles. The demand for knowledge on property prices have increased over the years as uncertainty glooms over governments, investors and parties affected by the happenings of the real estate market. Hence, studies have been done on property market forecasting for the benefit of several parties.

In 1997, a research on the property market in the UK was conducted as there was a significant increase in house prices in the early 1970s until late 1980s (Brown, Song, & McGillivray, 1997). This was a result of several structural reforms taken by the government, of which weak monetary policy was involved. The instability of house prices within the study period from 1968 to 1992 was due to the leniency in mortgage lending, causing the demand and supply of the property market to reach a disharmony. The Time Varying Coefficient (TVC) model is used to generate a forecast that outperforms the alternative constant parameter specifications of house prices.

A similar research was also done in Malaysia by Puah et al. (2016) on the Malaysian property market. The study involves the construction of a Property Cycle Indicator (PCI) which includes foreign direct investment (FDI), tourist arrivals, consumer sentiment index, gross domestic product (GDP), domestic and US share

price as the component series. The results of this research shows that the near-term forecasting of the property market in Malaysia has to encompass a wider perspective of the property market dynamics, and not just property prices per se. The disharmony of supply and demand in the property market is the cause of a spike in housing prices.

Hepşen and Vatansever (2011) did a study using the Dubai residential property price index (DRPPI) and found the importance of having an index to forecast the property market in the country. The peaks and troughs of property prices results in government policies created to cater to them. Knowing the magnitude and duration of the cycles allow for better preparation for all parties involved on what to expect. It is a win-win situation for all parties as the government will be able to monitor closely the behaviour of property prices while the investors may also earn profits by observing the trend of property prices.

The end goal of many researches on property market forecasting is to construct or improve an indicator so that it is reliable and accurate in predicting the cycles of the property market. However, the variables in constructing the indicator play an essential role in determining the consistency and reliability of the indicator. A study done by Zainun, Rahman, & Eftekhari (2010) uses the Principal Component Analysis (PCA) which includes nine indicators in determining the factors affecting low-cost housing demand in Johor Bahru, a state in Malaysia. It is found that out of the nine indicators, the PCA derived that income rate and population growth are significant compared to other variables.

Majid et al. (2017) conducted a study on the Malaysian housing market from 1990 to 2012 and found that throughout the period of study, the market experienced only certain phases which shows that the property cycle has not completed a full swing during the period of study. The forecasting of housing prices may show results slightly later or earlier, depending on the indicators whether they are leading, lagging or coinciding. GDP was found to be a leading and coinciding indicator, which shows a quick response to changes in the market. Most of the states in Malaysia have shown properties of a stable housing market in terms of occurrences of the housing bubble.

Another study was done in Singapore which involves GDP, unemployment rate and office employment as the variables of the study. The rent equation constructed by Ng and Higgins (2007) in this study accounted for 72% of variation in the gross rent in the study period. GDP was not statistically significant in explaining the variations in rent of the office property market. The forecasted values of the regression models were compared to the actual rent series and results showed that the office rent model could capture the changes in gross rent with substantial accuracy.

Ni, Huang, and Wen (2011) did a study on the housing market index in the US from January of 1994 to October of 2010. It was discovered in their results that majority of the change in the housing market index was caused by the unemployment rate, compared to the effects of other variables involved. A long-run relationship was also found to be present between the variables involved which

are the unemployment rate, consumer confidence index, Dow Jones industrial index and the FED interest rate.

A study was done by Lee, Liang and Chou (2013) in Taiwan using the composite leading index and reference cycle index to forecast the changes in the real estate market. This study uses the Markov-switching autoregressive model (MS-ARX) and Markov-switching auto-regression model (MSVAR). The MS models used in this study are able to capture the asymmetric characters emphasized by the business cycle theories. It is also reliable and suitable in identifying the turning points of the cycle. Hence, it can help to prevent pitfalls in the case where only business cycle trends are predicted and the changes in the real estate market are neglected.

Hadavandi et al. (2011) did a study on the forecasting of property indicator in Tehran, Iran over the period of 1996 to 2004. They used panel data analysis, comparing fixed effect model and random effect model and the results that the models show. The results show that the fixed effect approach provides more accurate findings compared to the random effect approach. Hence, it is chosen as a more suitable approach when dealing with housing market forecasting issues especially in a volatile economy. The housing prices in Tehran is very much affected by land prices and the government plays an important role in coming up with policies to control the fluctuations and the factors affecting the price of land.

2.3   Literature Review on Construction of Property Indicator

Several researches have been done on the forecasting of property indicator and the methods used to derive an indicator. The composite leading indicator (CLI) and the business cycle are in sync throughout the period of study done by Wong et al. (2012). The variables used in the construction of the CLI includes the Kuala Lumpur Stock Exchange (KLSE) share price index, the growth rate of consumer price index (CPI) for service sector, growth rate of industrial material price index, the ratio of price to unit labor cost for manufacturing sector, money supply (M1), housing permits approved, real total traded from eight major trading partners and new companies registered. This study uses the Bry-Boschan (BB) method and the Hodrick-Prescott (HP) filter. The forecasting performance of the CLI is proven based on its ability to provide signals to the real GDP under the growth cycle approach.

A study done on forecasting of oil price uses the methods by the Conference Board and Christiano-Fitzgerald (CF) filter is utilised in this study. Chong, Puah, and Mansor (2018) used the West Texas Intermediate (WTI) crude oil as the reference series in this study while the composite series comprises the OPEC and non-OPEC crude oil production change, world crude oil consumption change, world crude oil stock change, WTI futures contract price, open interest and the US business confidence index. The constructed oil price indicator (OPI) could predict the WTI at 75.2% accuracy whereas its competing model, The Chicago Board

Options Exchange crude oil volatility index (OVXCLS) can only predict up to 35.0% accuracy.

The Bry-Boschan (BB) dating algorithm is also used in a study on tourism in Maldives (Soh, Puah, & Arip, 2019). The component series consist of tourism cycle indicator (TCI) and the reference series used is the tourists' arrival. The Hodrick-Prescott (HP) filter is used in this study with the period of study ranging from 2000 to 2017. The findings show that by using TCI with leading characteristic, the dynamic tourism market in Maldives can prepare in order to reduce the burden of the incoming crisis and its disastrous impacts. Through the knowledge of future tourist activities, the government can come up with tourism-enhancing policies prior to the crisis to prove some aspect of good governance and avoid political instability.

A composite leading indicator (CLI) is constructed using the variables money supply (M1) and total exportation for a study done in Cambodia (Puah et al., 2016). The reference series used is real GDP and the data frequency for the study is dated monthly. The BB dating algorithm and HP filter are tools used to obtain the results of the study. Findings show that throughout the study period, five eventful events were successfully forecasted and the dated peaks and troughs corresponded accurately to the actual scenario. The leading characteristic of the CLI enables prediction of up to seven months on average and the CLI is also

capable of predicting imminent crisis if implemented with regular updates and enhancing.

Mansor et al. (2015) constructed an early warning indicator (EWI) to detect major turning points of the business cycle in Malaysia. The BB technique was used in this study, along with simple centred moving average and seasonal adjustments method. Findings show that the EWI is a robust forecasting tool, and has a moving average length of five months which is enough to smoothen out irregularities though the normal moving average length is seven months in other studies. The accuracy of the EWI is also tested to determine the direction of change in the business cycle. The constructed EWI can predict up to 94.6% accuracy on the turning points of the Malaysian business cycle.

Another study which involves the construction of a forecasting tool is one done on the Malaysian house price index (MHPI). The methodology applied in this study is the bivariate correlation analysis, SPSS and ratio analysis. Variables included in the study are GDP for all sectors, total housing loan approved, volume of housing transaction, base lending rate and the unemployment rate in Malaysia. Throughout the study period from 1990 to 2012, the housing market only experienced certain phases which shows that the property cycle have not completed a full cycle within the time period of study. Indicators generally have leading, lagging and coinciding properties. In this study, it was found that GDP was a leading and coinciding indicator, which reacts to sensitive changes in the market.

Most of the states in Malaysia are at a normal line in terms of occurrences of housing bubble.

Christoffersen (2005) had done a study on the cycle durations across G-7 countries using monthly data. The Bry-Boschan technique is used in this study and findings show that the cycle durations across countries vary but the expansions generally last longer than the contractions. Another study was done on the turning points of the real estate market in the UK and the US and monthly data were used in this study. The BB methodology is employed in this study too, and it detected the local maximum and minimum turning points. However, the Markov-switching model produces better results than the BB algorithm as the BB model may give inaccurate interpretations due to its minimum duration of expansions and contractions. The variable of Real Estate Investment Trust (REIT) can best detect the turning points of the real estate market, according to the study done by Bouchouicha (2010).

In 2008, Sam and Joo did a study on the business cycle in Korea on a monthly data basis. The Bry-Boschan algorithm methodology is employed in the construction of the indices. The composite index (CI) is used for measuring the duration and depth of the business cycle while the diffusion index (DI) needs to be compiled for the second concept of the business cycle. Hence, it is known as the diffusion, because the downside of the composite index is that it does not include a diffusion of economic activities. The DI is known as the proportion of components that contribute positively to the growth cycle. Business cycle in Korea is a growth

cycle, hence it experienced slumps in consumption and investment within the period where the two recessions occurred. In a growing economy, business cycle should not be classified as the classical cycle.

In the studies done by Chiu (2006), Edison, Luangaram, and Miller (2000), and Sebehela (2009), the impact of the Asian financial crisis and the subprime mortgage crisis on the housing market is analysed. FDI plays a major role in affecting the housing financial crisis as it acts as a precursor which moves in tandem with the economic growth of the country. FDI also reflects the openness of the economy and this openness could be the stepping stone to wider opportunities as well. Sebehela (2009) found that the financial institutions should regulate the lending given to the citizens as it may lead to inefficient and ineffectiveness of mortgage loans. The weak lending policies and interest rates may be a cause to the bust of the property cycle. The poor banking systems and lack of regulation gave way to failure in dampening the overheating pressures of the real estate sector.

2.4   Research Gap

In summary of all the literature reviews done in this chapter, it is found that the most common indices used in the forecasting of property market are the housing price index and the real estate price index. Some other indices namely Real Estate Investment Trusts (REIT), rent prices or housing loan approved are also used, though not as common as the abovementioned indices.

The studies done on the forecasting of the property industry has left a research gap in terms of the methodologies employed in the construction of property cycle indicator. Many researches have been done on the forecasting of property cycle using methods other than the Bry-Boschan (BB) model and that in The Conference Board (2001). The distinct methodologies employed may yield different results and the accuracy of the results may also be affected based on the various approaches.

Numerous variables have been experimented to test the impacts of those variables in predicting future property cycles. However, mixed results were obtained where the use and relevance of some variables in the component series are questioned. Loopholes were found and are inevitable in many studies done on the forecasting of property cycle. Hence, there are ample opportunities and reasons to conduct researches in an attempt to address the issues raised in previous studies regarding this matter.

Table 2.1: Summary of Literature Review on Forecasting of Property Cycle

Author (Year)	Variables	Sample	Methodology	Findings
Brown, Song and McGillivray (1997)	• House prices • Disposable incomes • Demographic variable • Nominal user cost of housing	• UK • Quarterly data from Q2 of 1968 to Q2 of 1992	• Time Varying Coefficient (TVC) modelling • Kalman filter	• UK property market suffered from several structural reforms of the system, with significant increases in house prices in early 1970s and 1980s, up till the late 1980s. Leniency in the mortgage lending market led to the structural instability of UK house prices. • TVC model is estimated using the Kalman filter. • The TVC model generates both static and dynamic forecasts and it shows that the model outperforms the alternative constant parameter specifications of house prices.
Puah, Kuek, Arip and Wong (2016)	• Reference series: Malaysian Housing Price Index (MHPI) • Property cycle indicator (PCI): - Foreign direct investment	• Malaysia • 1991 to 2013 • Monthly data	• Hodrick-Prescott (HP) filter	• The near-term forecasting in Malaysian property market needs to account for a wider perspective of property market dynamics than property prices alone.

	- Tourist arrival - Consumer sentiment index - Gross domestic product - Domestic share price - US share price			• The near-term forecasting in Malaysian property market needs to account for a wider perspective of property market dynamics than property prices alone.
Hepşen and Vatansever (2011)	• Dubai residential property price index (DRPPI)	• Dubai • Monthly data from January 2003 to March 2010	• ARIMA model • Box-Jenkins procedure	• Future peaks and troughs of property prices puts into perspective the impacts of government policy created to deal with them. Knowing the duration and magnitude of the cycles allow for better understanding and preparation for what is to come. • Government can monitor property price behaviour closely while investors may reap profits by using a trading rule which largely includes observing behaviour of property prices.
Zainun, Rahman and Eftekhari (2010)	• Dependent variable: Low-cost housing demand • Independent variable:	• Johor Bahru, Malaysia • Monthly data from January 2000 to	• Artificial Neural Networks approach • Principal Component	• Out of nine indicators, PCA derived two which are income rate and population

		December 2003.	Analysis (PCA) • Neural Network (NN) model	growth to be significant. • Comparison between actual and forecasted data shows that NN is capable to forecast low cost housing demand in Johor Bahru with the best value of Mean Absolute Percentage Error (MAPE) of 13.71%.
- Population growth - Birth rate - Mortality baby rate - Inflation rate - Income rate - Housing stock - GDP rate - Unemploymen t rate - Poverty rate				
Majid, Said and Chong (2017)	• Malaysian house price index (MHPI) • Gross domestic product (GDP) for all sectors • Total housing loan approved • Volume of housing transaction • Base lending rate • Unemploymen t rate	• Malaysia • Annual data from 1990 to 2012	• Bivariate Correlation analysis • SPSS • Ratio analysis	• Throughout the period of study, the housing market experienced only certain phases which shows that the property cycle have not completed a full swing within the time period of the study. • Some indicators may have leading, lagging or coinciding properties. Hence, it may drive the housing market slightly earlier or later. • GDP was a leading and coinciding indicator, which reacts to sensitive response to changes in the market. • Most states in Malaysia are at

			normal line in terms of occurrences of housing bubble.
Ng and Higgins (2007)	• GDP • Unemploymen t rate • Office employment	• Singapor e • Monthly data from June 1992 to Decembe r 2005	• Multiple regression analysis • Chow breakpoint test	• The constructed office rent equation accounted for 72% of variation in gross rent for the study period. Contemporaneou s office sector employment were founded to be the key determinants in explaining the variation in office rents in Central Region of Singapore. • GDP was not statistically significant in explaining the variations in rent of office property market. Unemployment rate and office supply was also not significant. • The forecasted values of the regression models were compared to actual rent series and it was found that the office rent model could capture the general changes in gross rent with significant accuracy.

Ni, Huang and Wen (2011)	• Housing market index • Unemploymen t rate • Consumer confidence index • Dow Jones industrial index • FED interest rate	• US • Monthly data from January 1994 to October 2010	• VAR model	• Majority of the change in house market index in the US is caused by the unemployment rate compared to the effects of other variables. • Long run relationship is present between the variables.
Lee, Liang and Chou (2013)	• Composite leading index • Reference cycle index	• Taiwan • Quarterly data from first quarter of 1971 to fourth quarter of 2006	• Markov-switching autoregressiv e model (MS-ARX) • Markov-switching auto-regression model (MSVAR)	• The MS model used in this study effectively captures asymmetric characters emphasized by business cycle theories. Hence, it is reliable and suitable in identifying the turning points in business cycles. This will prevent pitfalls of only predicting business cycle trends while failing to capture the changes in real estate market.
Hadavandi , Ghanbari, Mirjani et al. (2011)	• Price of one square meter housing unit substructure • Price of one square meter tore down house • Total substructure area of all properties	• Tehran, Iran • Panel data from 1996 to 2004 over 20 zones	• Panel data analysis: - Fixed effect model - Random effect model	• Fixed effect approach provides more accurate results and hence, it is more suitable than the random effect approach when dealing with housing market forecasting

• Price index of materials		problems especially in a volatile economy.
		• Most house prices in Tehran is affected by land prices. Hence, the government plays an important role in coming up with policies to control the fluctuations.

Table 2.2 Summary of Review on the Construction of Property Indicator

Author (Year)	Variables	Sample	Methodology	Findings
Wong, Mansor, Puah and Liew (2012)	• Real gross domestic product (GDP) • Consumer price index (CPI) • Composite leading indicator (CLI): - Kuala Lumpur Stock Exchange (KLSE) share price index - Growth rate of CPI for service sector - Growth rate of industrial material price index - Ratio of price to unit labor cost for manufacturing sector - Money supply (M1) - Housing permits approved - Real total traded from eight major trading partners - New companies registered	• Malaysia • Monthly series of CLI • Monthly series of CPI • Quarterly series of GDP	• Moore-Shiskin method • Augmented Dickey-Fuller (ADF) unit root test • Phillips-Perron (PP) unit root test • Johansen and Juselius cointegration test • Akaike Information Criterion as selection criterion • Hodrick-Prescott (HP) filter • Bry-Boschan procedure	• The CLI and business cycle are in sync throughout the period of study. • The forecasting performance and predictive capability of existing CLI is proven based on its ability to provide signals to the real GDP under the growth cycle approach. • The publicly available CLI is less reliable in terms of missing turning points and lead times being vastly erratic.

| Chong, Puah and Mansor (2018) | • Reference series: West Texas Intermediate (WTI) crude
• Component series:
- OPEC and non-OPEC crude oil production change
- World crude oil consumption change
- World crude oil stock change
- WTI futures contract price
- Open interest (number of contract)
- US business confidence index | • Monthly data from January 2001 to June 2016 | • Christiano-Fitzgerald (CF) filter technique
• Procedures from the Conference Board | • The oil price indicator (OPI) dated 10 turning points of WTI, where each turning point leads for varied months. The average lead time of 3.6 months shows that OPI is reliable in providing early signals to the WTI cycle.
• The constructed OPI can predict the WTI at 75.2% accuracy whereas its competing model, The Chicago Board Options Exchange crude oil volatility index (OVXCLS), can only predict up to 35.0% accuracy. |
| Soh, Puah & Arip (2019) | • Tourism cycle indicator (TCI)
• Tourists arrivals (TA) | • Data from 2000 to 2017 | • Hodrick-Prescott (HP) filter
• Bry-Boschan (BB) dating algorithm | • By using TCI with a leading characteristic, the dynamic tourism market in Maldives can be speculated to prepare in any way possible in order to reduce the burden of |

Author(s)	Variables	Data	Methodology	Findings
				the crisis and its disastrous impacts. • Political instability can also be curbed with tourism-enhancing policies prior to the crisis to prove some aspect of good governance.
Puah, Tan, Mansor and Wong (2016)	• Reference series: Real gross domestic product (GDP) • Composite leading indicator (CLI): - Money supply (M1) - Total exportation	• Cambodia • Monthly data	• Hodrick-Prescott (HP) filter • Bry-Boschan turning point dating algorithm	• Throughout the study period, five eventful intervals were predicted, and the dated peaks and troughs corresponded accurately to the actual scenario. • The leading predictive ability of the constructed CLI is up to seven months on average. • The CLI can predict imminent crisis if implemented with regular updates.
Mansor, Liew & Wong (2015)	• Real gross domestic product (GDP) • Consumer price index (CPI)	• Monthly data • Quarterly data	• Seasonal adjustment through Tramo/Seats method • Simple centered	• EWI is tested and proven to be a robust forecasting tool. • The EWI employs a moving

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				moving average • Bry-Boschan technique	average length of five months, as it is empirically sufficient to smooth out the irregularity, compared to the usual seven months in other studies. • The directional accuracy of EWI is also tested to investigate the accuracy of direction of change in the business cycle. • It is tested that the constructed EWI can predict up to 94.6% accuracy on Malaysia's major business cycle turning points.
Majid, Said and Chong (2017)	• Malaysian house price index (MHPI) • Gross domestic product (GDP) for all sectors • Total housing loan approved • Volume of housing transaction • Base lending rate • Unemployment rate	• Malaysia • Annual data from 1990 to 2012	• Bivariate Correlation analysis • SPSS • Ratio analysis	• Throughout the period of study, the housing market experienced only certain phases which shows that the property cycle have not completed a full swing within the time

				period of the study.
				• Some indicators may have leading, lagging or coinciding properties. Hence, it may drive the housing market slightly earlier or later.
				• GDP was a leading and coinciding indicator, which reacts to sensitive response to changes in the market.
				• Most states in Malaysia are at normal line in terms of occurrences of housing bubble.
Christofferse n (2005)	• Industrial production	• United States • G-7 countries • Monthly data	• Bry-Boschan model • Artis et al procedure	• Cycle durations vary across countries but expansions are generally longer and larger than contractions.
Bouchouicha (2010)	• UK - Halifax price index (residential) - Investment property databank (IPD) index (commercial)	• UK • USA • Monthly data from January 1987 to January 2010	• Non-parametric approach: Bry-Boschan algorithm • Parametric approach: Markov	• BB algorithm detects local maximum and minimum turning points. • Markov switching model produces better results

			Switching model	than BB algorithm as the BB model may give inaccurate interpretations due to its minimum duration of expansions and contractions.
	- Real estate investment trust (REIT) index - FTSE 500 (stock market) • USA - SP/ Case Shiller 10 composite index (commercial) - REIT index - S&P500 (stock market)			• REIT can best detect the turning points of the real estate market.
Sam and Joo (2008)	• Cyclical components of the coincident index • Coincident cumulated diffusion index • Historical diffusion index (HDI)	• Korea • Monthly data	• Non-parametric methodology • Bry-Boschan algorithm	• The usual classical cycle would suffer from two recessions, one in 1980 and one in 1998. However, business cycle in Korea is a growth cycle, hence it experiences slumps in consumption and investment between these two periods. Business cycle of a growing economy should not be defined in the classical cycle.
Chiu (2006)	• Gross domestic product (GDP) • Openness of economies	• Singapore • Hong Kong • Taiwan • South Korea	• Panel data analysis	• Movement of FDI into countries affects housing financial

	• Foreign direct investments (FDI)	• Annual data from 1997 to 2004		crisis. Property markets move on par with the economic growth of the country. General policy is to minimise government intervention.
Edison, Luangaram and Miller (2000)	• Foreign exchange currencies	• South Korea • Indonesia • Thailand • Annual data from 1991 to 1998	• Kiyotaki and Moore's model of credit cycles (KM model)	• Poor banking systems led to failure to dampen overheating pressures of real estate sector. Investors were also ignoring prices at their peak though the economic environment of these countries were at its peak.
Sebehela (2009)	• South African prime interest rate • Housing growth (%)	• Quarterly data from November 2001 to December 2007	• Correlation test • Causality test • Linear regression	• The financial institutions play an important role in their lending policies which might have led to the bust of property cycle.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

Constructing a property cycle indicator requires several methods that have been used by many researchers, whether from the aspect of property cycle or the business cycle. In this chapter, the methodologies used to construct this particular property cycle indicator for the Republic of South Africa is further elaborated. Section 3.1 expounds on the description of data used. In section 3.2, the general method of constructing the property indicator based on the Conference Board is discussed. Then, section 3.3 discusses the filter applied in the process of constructing the indicator followed by section 3.4 which elaborates on the Bry-Boschan dating algorithm. The final section of this chapter which is section 3.5 highlights the procedure of data analysis of the component series.

3.2 Data Description

The data series used in this study is from January 2001 to December 2018, equivalent to a span of 216 months. The reference series employed in this study is the Residential Property Price Index (RPPI) sourced from the Department of Statistics of South Africa. On the other hand, the component series comprises of six variables namely, London gold price (LGP), share price index (SPI), foreign direct investment (FDI), BRENT crude oil price (COP), visitor arrival (VA) and industrial production

index (IPI). The abovementioned variables for the component series are retrieved from the CEIC database.

3.3   Method for Constructing Property Indicator

The property cycle indicator (PCI) that would be constructed in this study uses the method revised by the National Bureau of Economic Research (NBER). The said method is commonly used in most of the indicator construction procedures. Some technical aspects of the index construction methodology such as standardization factors and components of the composite indexes will also be discussed.

The steps to construct the property cycle indicator listed below is in accordance with the Conference Board after taking over the Business Cycle Indicator (BCI) programme from the U.S. Department of Commerce's Bureau of Economic Analysis (The Conference Board, 2001). In overview, the steps involved in constructing the PCI includes selecting a set of variables for the component series and aggregating them to form a composite index, then choosing a base year for the composite index to be based upon. The steps of formulating the composite index are as follow:

i.   Calculate the month-to-month changes, $r_{i,t}$, for each variable, $X_{i,t}$, where i=1,…,n. For the variables in the form of percentage, basic arithmetic differences are calculated: $r_{i,t} = X_{i,t} - X_{i,t-1}$. Otherwise, a symmetric percentage change formula is used:

$$r_{i,t} = 200 * \frac{(X_{i,t} - X_{i,t-1})}{(X_{i,t} + X_{i,t-1})}$$

ii.   Adjust the month-to-month changes by multiplying them by the component's standardization factor, w_i. The results of this step are the monthly contributions of each component $c_{i,t} = w_i * r_{i,t}$.

iii.   Sum up the adjusted month-to-month changes across the variables for each month. This step would lead to the summation of the adjusted contributions:

$$S_t = \sum_{i=1}^{n} C_{i,t}$$

iv.   Compute the preliminary levels of the index using the symmetric percentage change formula. By setting the initial value of the index to 100, recursive derivation of the preliminary index of PCI is calculated based on the formula below:

$$I_2 = I_1 * \frac{(200 + S_2)}{(200 - S_2)} = 100 * \frac{(200 + S_2)}{(200 - S_2)}$$

Let $I_1 = 100$ denote the initial value of the index for the first month. S_2 represents the result from step (iii) in the second month. The following month's preliminary index value would be:

$$I_3 = I_2 * \frac{(200 + S_3)}{(200 - S_3)} = 100 * \frac{(200 + S_2)}{(200 - S_2)} * \frac{(200 + S_3)}{(200 - S_3)}$$

v.   Rebase the preliminary index of the PCI to the selected base year.

     The aggregation of component series will result in the formation of the raw composite index, which is the property cycle index in this study. The PCI data obtained

in this study is converted to the natural logarithmic form to ensure that the magnitude of coefficient is not too large (McDonald, 1980). Next, an extraction technique is used to extract the growth cycle of the PCI, with the aim of making sure the consistency of the PCI and the reference series in the analysis. The movement of both series will be presented in the form of a graphical analysis to allow an easier and smoother imitation of the actual property cycle in South Africa. This is also to ensure the leading attributes of the constructed indicator, that it is not lagging behind the reference series.

When the PCI is available and able to obtain satisfactory results, the Bry-Boschan (BB) algorithm will be used in dating the turning points and identifying the local minimum and maximum value of the indicator. Then, an analysis to compare between the PCI and the reference series is carried out to evaluate the accuracy and reliability of the indicator in signalling the movements of South Africa's property market.

The standardization factor is used to show how the monthly changes of each variable can affect the monthly changes in the constructed index. These factors are designed to give each variable an equal opportunity to contribute to the monthly changes of the constructed index in any given month. Adjustments are made to neutralize the volatility that each variable bring to the index. The standardization factors for each variable when added up will sum up to one. The standardization factor is calculated as:

$$Std\ factor = \frac{\frac{1}{stdev}}{\Sigma \frac{1}{stdev}}$$

Figure 3.1: Steps taken for Construction of Property Cycle Indicator

Constructing Indicator	• Finding variables from database, trial and error using variables to obtain component series
Extracting Cycle	• Processing PCI with Hodrick-Prescott (HP) filter and the standardisation procedure to obtain cycle
Dating of Turning Points	• Running data with Bry-Boschan dating algorithm to retrieve peak and trough of the cycle
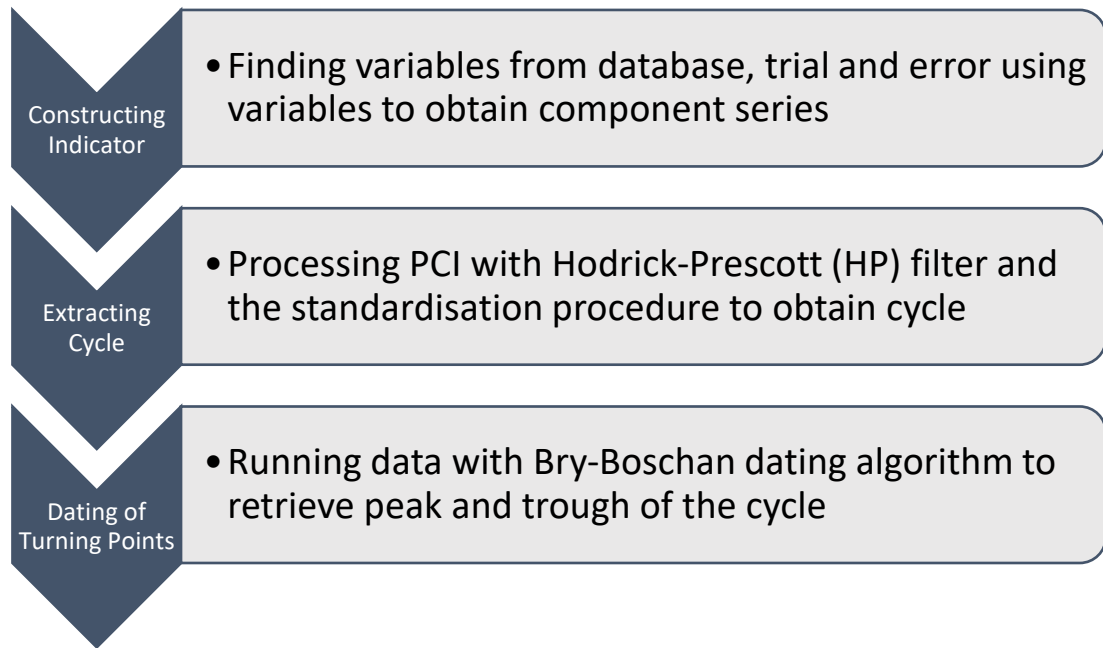
3.4   Filtering Technique for Trend Extraction

Filters are used to extract frequency or signals from a business cycle component in the variables of a time series. The business cycle contains noises or movements that may lead to inaccurate results if not filtered with the use of a right mechanism. Among the methods commonly used are the Baxter-King (BK) filter, the Christiano-Fitzgerald (CF) filter and the Hodrick-Prescott (HP) filter which are applied for different types of frequency extraction.

3.4.1   Hodrick-Prescott (HP) Filter

In this study, the HP filter is adopted. In 1980s, Hodrick and Prescott developed the HP filter and since then, it has been widely known method in the area of cycle extraction. The filtering process smoothens the estimates of the seasonally-adjusted time series which makes up the component series of the study. The estimates of the long-term trend of each element undergoes this process of filtering to obtain a smoothed cyclical component.

The basis of the HP filter is that it computes the smoothed series, s_t of y_t, and this is done by minimising the variance of y_t which surrounds s_t. This process performed by the two-sided linear filter is subjected to a trade-off which restricts the second difference of s_t. Therefore, the HP filter has resolved for s_t to minimise the following equation:

$$\sum_{t=1}^{T}(y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1}(s_{t+1} - 2s_t - s_{t-1})^2$$

where λ smoothens the series by correcting the component which focuses on growth.

Following the development of the HP filter, Hodrick and Prescott first applied their work in analysing the US business cycle in the early years of 1980s. The business cycle in the United States was in a bad shape particularly in the post-war era after the Vietnam War, the Cambodian Civil War, and repercussions of the Cold War, to name a few. In this study however, the HP filter is employed after the construction of PCI in order to obtain a filtered series showing a higher degree of volatility. This allows the movements of the series to progress in a relatively more volatile means.

3.5   Bry-Boschan (BB) Dating Algorithm

In the cyclical analysis of a time series, it is necessary to distinguish between different sections of the cyclical movements. The characteristics of the various segments can differ from each segment to another. However, it is preferred if the segments share similar characteristics or the behaviours are homogenous enough to ease generalised description and explanation. Hence, it is crucial to determine the turning points of any cyclical analysis to distinguish between the movements of the cycle.

Bry and Boschan developed a tool whereby they added the algorithm in a non-parametric approach to capture the maximum and minimum value in the economic cycle (Bry & Boschan, 1971). The National Bureau of Economic Research (NBER) decided on categorizing the phases to expansions and contractions, which are delineated by cyclical turning points, in order to reduce statistical problems. The method of NBER detects the booms and busts of a business cycle.

The BB dating algorithm follows a set of procedure for programmed determination of the turning points. The steps are listed below:

i. Determination of extremes and substitution of values.

ii. Determination of cycles in 12-month moving average (extremes replaced).

a. Identification of points higher or lower than three months on either side.

b. Enforcement of alternation of turns by selecting either the highest of multiple peaks or lower of multiple troughs.

iii. Determination of corresponding turns in Spencer curve (extremes replaced).

a. Identification of highest or lowest value within ± five months of selected turn in 12-month moving average.

b. Enforcement of minimum cycle duration of 15 months by eliminating either lower peaks or higher troughs of shorter cycles.

iv. Determination of corresponding turns in short-term moving average of three to six months, depending on the months of cyclical dominance (MCD).

    a. Identification of highest or lowest value within ± five months of selected turn in Spencer curve.

v. Determination of turning points in unsmoothed series.

    a. Identification of highest or lowest value within ± four months, or MCD term, whichever is larger, of selected turn in short-term moving average.

    b. Elimination of turns within six months of beginning and end of series.

    c. Elimination of peaks or troughs at both ends of series which are lower of higher than values closer to the end.

    d. Elimination of cycles whose duration is less than 15 months.

    e. Elimination of phases whose duration is less than five months.

vi. Statement of final turning points.

3.6 Interpolation Method

3.6.1 The Chow-Lin Method

The Chow-Lin method is used in this study to interpolate data that discloses the value of a series $\varkappa$ by using regression-based interpolation. This is done by relating one or more high-frequency indicator series Z to a lower-frequency benchmark series through the equation

$$\varkappa(t) = Z(t)\beta + \alpha(t)$$

where, β = vector of coefficients

$\alpha(t)$ = random variable with zero mean and covariance matrix V

The interpolated series is subject to the same restrictions as the equation

$$\sum_{t=b_k}^{e_k} \varkappa(t) = y_k$$

with the benchmark y in each period k, and b_k and e_k representing the beginning and end of each period. In the case of cubic variables such as stock, indices and flow variables, the same constraints are applied at specific points of time $(b_k = e_k)$ in which the interpolated series is equal to the benchmark y_k.

Holding on to the assumption that the errors follow an AR (1) process, the original solution by Chow and Lin (1971) uses generalised least squares to estimate the covariance matrix. However, the EViews software uses a state space model with the time series model for the states,

$$\alpha(t) = \rho\alpha(t-1) + \epsilon(t)$$

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where, $\epsilon(t) \sim N(0, \sigma^2)$ and $|\rho| < 1$. The parameters of ρ and β are estimated by maximum likelihood and the Kalman filter, and the interpolated series is then calculated with Kalman smoothing process.

The Chow-Lin interpolation is globally known as an interpolation method, and changing or adding any points to the indicator or benchmark series will for sure affect the points of the interpolated series with the basis of independent variables affecting dependent variables. This method of interpolation can also be done without using an indicator series. In the case where the period of the indicator series extends beyond the period covered by the endpoints of the benchmark series, $\varkappa$ will be extrapolated using the Kalman filter.

3.7 Selection of Component Series

The component series comprises of the potential variables that are chosen to be included in the series as the reference series throughout the analysis. These variables are namely London gold price (LGP), share price index (SPI), foreign direct investment (FDI), BRENT crude oil price (COP), visitor arrival (VA) and the industrial production index (IPI).

Mining in South Africa has been one of the main driving force in the country's economy. Though the contribution of this industry has declined over the years of development into a more advanced economy, mining still represents approximately 60% of South Africa's exports. The London gold price (LGP) acts as a signal in forecasting the global economy through the value of gold. The economy of South Africa is a major catalyst in the rise or drop in property market and this can be probed by the fluctuations in gold price.

Similar to the gold price index, there is the share price index (SPI). The SPI is calculated based on prices of common shares of public-listed companies across the globe. It measures the value of the shares bought by investors and thus, the value of the company's worth. This allows investors and parties affected by the market to provide a useful window into the company's or industry's performance at a glance.

Inflow of foreign direct investment (FDI) shows the value of a direct investment moving into the country which is made by foreign investors. The volume of FDI acts as a signal which portrays the health of the economy and merely a forecast for surrounding businesses as to what to expect. This can also be seen in the property market where the prices of property spikes when FDI inflows are high, depicting that the economy is booming. An increase of capital in the property market through investment indicates the attractiveness of the particular economy.

The use of crude oil is nearly inevitable in countries worldwide. It acts as a base for the creation of secondary products such as fuel for transportation and for the generation of electricity. The BRENT crude oil price (COP) influences the cost of these secondary products and the price of end products for consumers is largely affected by the cost of crude oil. Crude oil influences transportation fees and this affects the import and export of products across borders. Apart from production and transportation costs, the impact of crude oil price will assist in forecasting economic uncertainty (Becken, 2011). Hence, the BRENT crude oil price has been a proxy variable for international economic changes.

Visitor arrival (VA) is the number of international and domestic visitors arriving at the country in a given year. This is also used as a proxy or a measurement of tourism demand in that particular country. The tourism industry in South Africa has been growing over the years, especially after the apartheid era and the hosting of FIFA World Cup in 2010. This has opened up many opportunities for investments and hence, the increase in property price is contributed by the tourism sector as well. Foreigners

are allowed to own immovable property in South Africa without restriction as long as funds remitted to the country are declared legally and documented for official purposes. Hence, the variable of visitor arrival is useful in constructing the PCI.

Industrial production index (IPI) is an economic indicator measuring the real production output of industries namely manufacturing, mining and etc. IPI measures the physical unit of output which can also detect the data of inputs required to produce the output level required. The cost of living can be reflected in the index, other than common indices such as GDP per capita and consumer price index. Whilst the consumer price index (CPI) focuses on the demand side of trade, the IPI emphasises the supply side of trade. In the context of property market, the IPI can reflect the affordability of housing, particularly among residential properties.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

Chapter Four discusses the results obtained in this study, coupled with some detailed discussion on the matter. The whole of this chapter is further separated into two segments. The first includes the analysis of the construction of the Property Cycle Indicator (PCI) while the second elaborates on the Bry-Boschan test results and the amount of lead and lag obtained from the analysis.

4.2 Analysis of Indicator Construction of PCI and RPPI

The component series comprises of six variables. Following the method of The Conference Board by the National Bureau of Economic Research (NBER) in obtaining the PCI, the Hodrick-Prescott (HP) filter is adopted to establish its cyclical movement. The cyclical turning point of the PCI is then extracted through the process of standardisation. Figure 4.1 shows the movement of PCI in accordance with the reference series which is the RPPI of South Africa.

Figure 4.1: PCI versus RPPI, 2001M1-2018M1
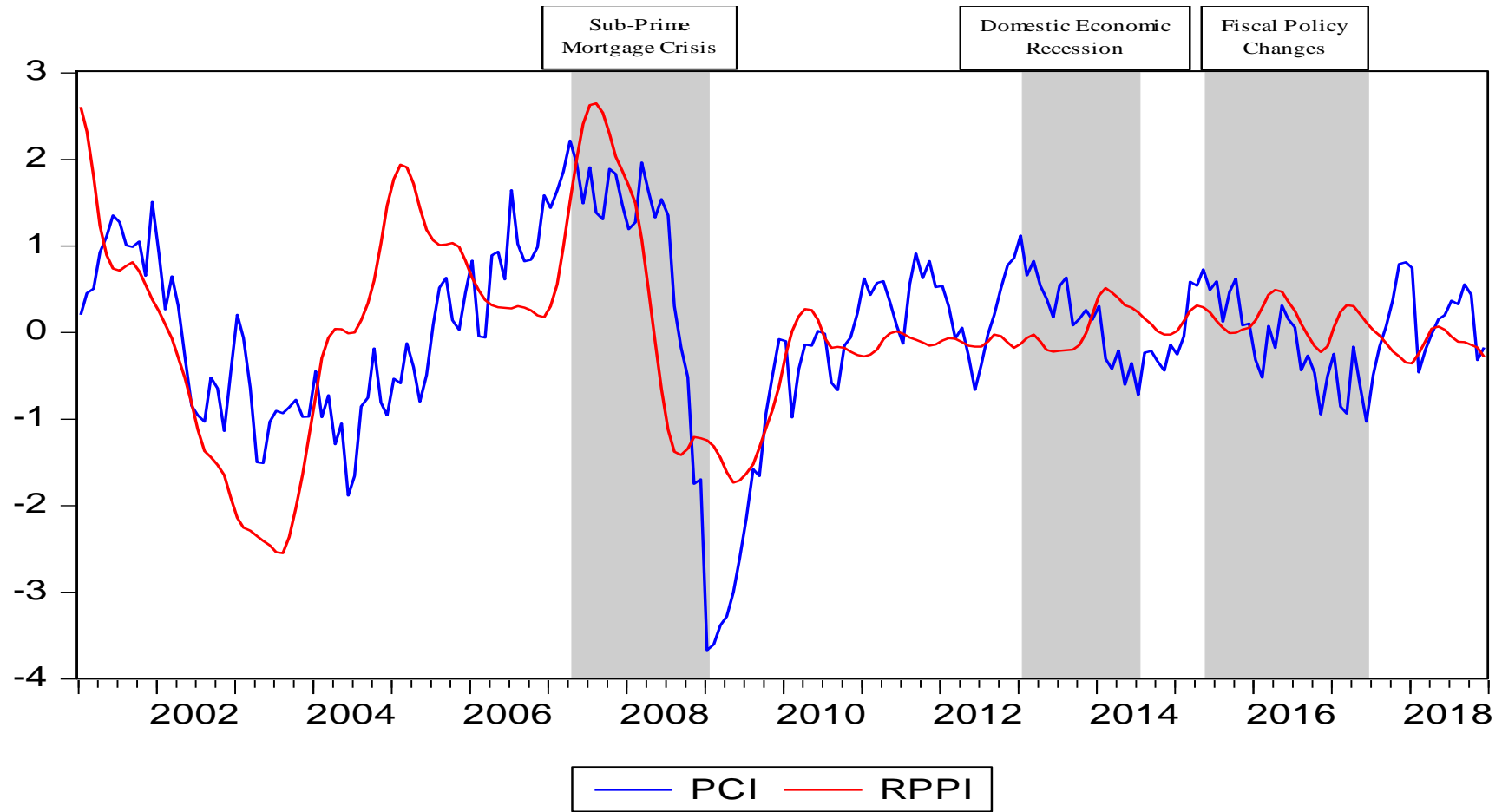
From the graph obtained, there is a consistent leading movement of the PCI as compared to the RPPI. This shows that the PCI has sufficient strength of signalling ahead of times against the RPPI. The turning point analysis done based on the Bry and Boschan (1971) approach shows the turning points which are appropriate in context of the historical events of South Africa's economy. The PCI detects the general movement of the property market and also shows its consistency in forecasting the directional change in the event of major economic incidents.

The PCI in this study successfully detects 6 important turning points which is further divided into 3 peaks and 3 troughs, between the time periods of 2001 to 2018. The predicted economic events that took place are approximately between 2007 to 2009, 2013 to 2014 and 2015 to 2017. Chronologically speaking, the downturn occurrences include the aftermaths of the 2008 sub-prime mortgage crisis, South Africa's domestic economic recession in 2013 and major fiscal policy changes in 2016.

4.3   Bry-Boschan Test Result Analysis

Table 4.1: Results of Turning Points Analysis of PCI and RPPI

Cycle Condition	PCI	RPPI	Period of Early Signals	Important Events
Peak	2007M4	2007M8	4 months	Sub-Prime Mortgage Crisis
Trough	2009M1	2009M5	4 months	
Peak	2013M1	2014M2	13 months	Domestic Economic Recession
Trough	2014M7	2014M12	5 months	
Peak	2015M5	2016M4	11 months	Changes in Fiscal Policy
Trough	2017M6	2018M1	7 months	
Average			**7.33 months**	

The average lead period of the PCI against the RPPI is 7.33 months. The first peak and trough have a lead period of 4 months before the RPPI could detect the repercussions of the sub-prime mortgage crisis. The domestic economic recession which resulted in the fall in commodity prices and gradual increase in unemployment rate was detected by the PCI 13 months earlier for the peak and the trough with a lead period of 5 months. The effect of changes in fiscal policy was forecasted 11 months earlier and its trough with a 7 months lead time.

The global financial crisis of 2008 has hit South Africa and its economy through plunging commodity prices and spiking prices of food and fuel which gave rise to inflation. The openness of the economy and financing activities of the affected countries play a crucial role in shaping the vulnerability of the housing market towards any changes in economic events. For instance, in the case of South Korea, Indonesia and Thailand, they were enjoying rapid economic growth while their currencies are

pegged to the US Dollar but few to no investors saw signs of the crisis happening though some prices peaked.

The growth rate of the South African economy in 2013 was at 1.9%, slower than other emerging economies. Though the global economic scene in 2013 looks promising, South Africa experienced a significant slowdown in growth. Disruptions on production due to work stoppages from the weak labour market has caused the decline in primary sectors. The plunge in tax revenue reflected the frailty of the domestic economic performance. Its weaker growth, higher current account deficits due to its underestimated budget, and soaring inflation has led to the depreciation of the Rand currency.

In February 2016, South Africa's finance minister then, Pravin Gordhan, stated in his Budget speech that the country was in an economic crisis. Coupled with contracting economic growth and a 25% unemployment rate, the country was severely plagued with poverty. The finance minister emphasised on having a budget-cut, instead of imposing austerity measures like increasing the income tax rate (BBC News, 2016). With a national budget cut, the property market is no-doubt affected by the changes in fiscal policy. The fiscal policy changes in South Africa was a result of more severe issues. The ruling government had an inefficient bureaucracy which goes hand-in-hand with political instability and the dwelling issue of corruption. Restrictive labour regulations were disabling the decrease in unemployment rate, as shortage of skilled workers already exist.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The results of this study can be used as a comparative measure when looking into purchasing or selling of a house, where the interest in house price data is of concern. The data used in this study spanned from 2001 to 2018. Monthly data were deployed in constructing the PCI to fully estimate the cause of fluctuation among variables to be able to obtain results that are more accurate and sensitive to the course of economic events.

Investors would most likely utilise this data to analyse investment potential of properties, examining and evaluating the possibility of property bubbles, or to predict the general economic activity of the country by looking at the happenings of the property market. Through the lens of making higher profits, higher risks are inevitable for investors, and hence, measuring the volatility of investments is among the many tools used to cushion the blow if things go south.

5.2 Policy Recommendations

It is difficult for South Africa to reach an unemployment rate that is on par with the rest of the world's developed countries or just to be anywhere close to the optimal unemployment rate. This is due to the stagnation of the economy where minimal to no growth can be seen since 2013. Developing countries should have

a higher growth rate as they harness more potential in replicating the methodologies and technologies of the countries who went before them. Developed countries have lower diminishing returns compared to developing countries and hence, growth is somehow doomed to stagnate or reach a sigmoid.

Based on the empirical results obtained from the analysis of the indicators, the PCI constructed yields an average lead period for the South African property market. The study has the potential in predicting the property market 7.33 months in advance by information absorbed by the PCI based on the variables studied. This lead time gathered by the PCI may be a signal to the policymakers to create new policies or to revise old ones to cushion the effect of economic changes. The use of the leading indicator to forecast the financial health of the economy using this non-parametric approach may also assist investors in property management to make necessary decisions in the particular sector based on insights obtained from the PCI.

Secondly, with a more secure control over the changes in property market, investors are more likely to invest and that a steady flow of domestic and foreign investment is ensured. The PCI encapsulates macroeconomic variables and hence, the property market does not only depend on the conventional demand and supply in determining its direction. It is no longer characterised by the local property-specific criteria and hence, having a more global outlook. The multiplier effect can be applied to the regular inflow of investment as it will eventually lead to

economic development and sustainability. Interest rates by the government such as the real property gains tax and the South African benchmark overnight rate (SABOR) should be lowered accordingly to increase the attractiveness of investment for both domestic and foreign investors.

In order to enhance policymaking to improve the property sector in South Africa, the government is encouraged to work on its completeness and collectiveness of the data available, particularly property-specific data. The transparency and openness in publishing data sources should be enhanced to allow more studies and researches to be done for the betterment of the country in general and also specifically, for the property market of South Africa. With more specific and complete data made available, the turning points and cycles will also be more accurate and sensitive so that policymakers may be able to utilise them to make policies that are effective and efficient.

Last but not least, the tourism sector has contributed indirectly to the property sector as tourism inflow increases the opportunity for investments. The knowledge of the local culture and economic health may attract tourists in investing into local projects which may boost FDI and the property sector. There was a significant boost in GDP growth from 2009 to 2010 and a fall in unemployment rate as a consequence of an increase in tourist arrival due to the FIFA World Cup which South Africa hosted in 2010. Policies to boost the tourism

sector should be further developed with more stable grounds to bring the South African economy to new heights.

5.3 Limitations of the Study

The study utilises six variables in constructing the PCI namely, LLGP, LSPI, LFDI, LCOP, LVA and LIPI. The data for these variables are monthly data spanning from 2001 through 2018. However, due to the insufficiency of monthly data, some of the data for these variables are quarterly data or annual data. Hence, the interpolation method was used to interpolate the quarterly and annual data as high-frequency data are not readily available. This affects the accuracy of the estimation as the sensitivity of the results is compromised.

Data in relation to the property market is also limited which restricts the construction of a more accurate indicator. As South Africa is a developing country which still has much potential to grow, the dataset of the property market in the country is not as complete as some developed countries. The means and methods used to record data may not be as advanced compared to more established property markets in other countries as well.

The financial institutions which are the main source of providing mortgage loans for housing investments play a vital role in preparing for

weakening economic conditions. In order to prevent a sudden bust in the property cycle, the government should monitor financial institutions in terms of having stricter measures based on the individual borrower's financial capabilities. As the economy of South Africa grows, fiscal and monetary policies are essential in encouraging consumers to limit their borrowings and to spend their own money wisely.

5.4   Direction for Further Study

The objectives listed earlier in the study was to construct a property cycle indicator for the Republic of South Africa which is able to show the early signals of the vulnerability of the property market. The PCI will also have the ability to date the turning points to detect early signals whenever there is a turn of events. Whilst these objectives may be achieved through the study, there still remain rooms for improvement of the study.

An area of the study which can be enhanced would be using a more dynamic approach of testing the variables and constructing the PCI. There are many methodologies in forecasting the property cycle especially when sufficient data is available in the future. These methods and approaches may enhance the sensitivity of the PCI and hence, providing more accurate turning points in relation to the information gathered on the property sector. By detecting the turning points better, more cycles can be obtained to ultimately create a more comprehensive indicator. When the PCI detects the

fluctuation on a more accurate scale, policymakers and investors may obtain detailed information on the market in making effective policies and decisions as well.

Another area of the study which can be further improved is the filtering process in which testing out other filtering techniques may be effective for other variables and different frequencies of data. In this study, the Hodrick-Prescott (HP) filter is employed and there are other methods like the Christiano-Fitzgerald (CF) filter, Baxter-King (BK) filter and Butterworth filter. Each filtering techniques produces varied results. However, with an improved dataset and frequency of data, other filtering techniques may be employed to be able to obtain the most accurate PCI.

The results of this study may be of great help to the policymakers of South Africa. However, there are policymakers and investors from other countries who may benefit from the study as well. This study can be adapted to other countries in constructing their own property indicators based on the economic events of respective countries. To aim more accurately, the study can be employed to other developing nations which have limited data resources and a similar economic health as South Africa. This will prove handy when the government decides to move forward and not be taken aback by sudden economic changes and hence, sudden crisis in the property sector.

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