Challenges and Opportunities Facing Emerging Real Estate Markets

An Empirical Examination of the Kuwait Residential Real Estate Market

A thesis submitted for the degree of

Doctor of Philosophy

The University of Reading

Henley Business School

By

Abdullah Adel Alfalah

July 2018

Acknowledgments

First, my greatest thanks to Allah for the countless things he has given me without my asking. I thank him for helping me on this thesis, which I achieved purely because of his willing it so. He made hard times easy, transformed troubles into solutions and made my limited capability unlimited. I pray to him to help me use what I have learned to benefit humankind.

Second, I owe my greatest debt to my wife, Kawthar Alsaqer, who supported me the most during the course of my study. I am extremely grateful to her for undertaking to look after our three children so that I could concentrate on my study. I dedicate this thesis to her and our family.

Third, it is a pleasure to express my appreciation to those who have helped me in this study. I would like to thank my big family at the University of Reading–Henley Business School, teachers, academics and staff. Specifically, my supervisors, Professor Simon Stevenson and Mr. Eamonn D'Arcy, both of whom worked with me as close friends and gave me the support and guidance I needed.

Last, but not least, I am extremely grateful to all of those people that I have never met who developed software programs such as Microsoft office, E-views, R-program, and thus made our work more accurate, faster and easier. To those who created online channels such as Google, YouTube, khanacademy.org and wikipedia.org, although not always considered to be a reliable reference source, we cannot deny that we learned from them and, therefore, deserve our thanks. And thank you to those who dedicated their time to record videos, audios and articles and used those channels to share their knowledge and experience, for a fee or for free. Looking back to what I have done over the last four years, I can imagine that if it had been ten years earlier, this experience would have been very different. So, a sincere *thank you* to all of you.

Declaration

I declare that this thesis has been composed by myself, that it has not been accepted in any previous application for a degree, that the work of which this is a record has been done by myself and that all quotations have been distinguished appropriately and the source of information specifically acknowledged.

Abdullah A. Alfalah

Thesis Abstract

This thesis examines emerging real estate markets using Kuwait as an example. It is structured as a combination of three self-contained papers that complement each other. The first paper overcomes data limitations by using the limited existing data and different methodologies to improve the constructed indices. Because of data limitations, parametric methods could not be used. Instead, the central tendency method, with improvements, was applied and produced satisfactory indices. Approaches to improve performance included using the mean and median as central tendency, the type of property, monthly and quarterly observations, different weighting techniques, subsamples versus full samples, and stratification based on cities versus stratification based on long-term mean prices. As a result, 74 indices were constructed and their performance compared using out-of-sample forecasting methods. This paper overcame data limitations and constructed the first housing indices for Kuwait. This paper constructed the first housing indices for Kuwait. The second paper uses the indices constructed in the first paper to evaluate and study influences on the dynamics of the Kuwaiti housing market using Error Correction Model. The housing market seems highly driven by the shortage of housing supply, strong housing demand, the price of oil, and signs from investors and speculators. Furthermore, the market seems to be sensitive to tax regulations and terrorist events, but less sensitive to local and regional political events. The third paper considers an alternative source of funding for real estate development, called sukuk. Using the Dynamic Conditional Correlation-Generalised Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model to test the correlation between sukuk and bonds, it has been found that sukuk are highly similar to bonds and are not expected to provide much of a diversification advantage if included in a portfolio with other assets. Furthermore, their relationship to bonds increases in volatile times. Also found that different types of sukuk perform similarly.

Table of contents (General)

Table of contents (First paper)

Table of contents (Second paper)

Table of contents (Third paper)

List of Abbreviation

ACF	*Autocorrelation Function*
ADF	*Augmented Dickey-Fuller*
ADIHAS	*Annual Demographia International Housing Affordability Survey*
AIC	*Akaike Information Criterion*
ARCH	*Autoregressive Conditional Heteroscedasticity*
ARIMA	*Autoregressive Integrated Moving Average*
CCC	*Constant Conditional Correlation*
CCQI	*The Census Constant Quality Index*
CGT	*Capital Gains Taxes*
CPF	*The Central Provident Fund*
CPI	*Consumer Price Index*
ECM	*Error Correction Model*
EY	*Earnest and Young*
FSI	*Financial Soundness Indicators*
GARCH-DCC	*Generalised Autoregressive Conditional Heteroscedasticity–Dynamic Conditional Correlation*
GCC	*Gulf Cooperation Council*
GDP	*Gross Domestic Product*
HAI	*Housing Affordability Index*
HDB	*Housing Development Beard of Singapore*
HPI	*House Price Index*
HQ	*Hannan-Quinn information criterion*
KCB	*Kuwait Credit Bank*
KPISS	*Kuwait Public Institution For Social Security*
LIBOR	*London Interbank Offered Rate*
MAE	*Mean Absolute Error*
MAM	*Mix Adjusted Measure*
MAPE	*Mean Absolute Prediction Error*
ME	*Mean Error*
MENA	*The Middle East and North Africa*
MIFC	*Malaysia's Islamic Finance Marketplace*
MPE	*Mean Percentage Error*
MSE	*Mean Squared Error*
MSPE	*Mean Squared Prediction Error*
NAR	*The National Association Of Realtors'*
NSA	*Mon-Seasonally Adjusted*
OECD	*The Organisation for Economic Co-operation and Development*
OFHEO	*The Office of Federal Housing Enterprise Oversight's*
OLS	*Ordinary Least Squares*
PACF	*Partial Autocorrelation Function*
PAWH	*The Public Authority of Housing Welfare*
PIR	*Price-to-Income Ratio*
PSM	*Per Square Meter*
REITs	*Real Estate Investment Trusts*
RMSE	*Root Mean Square Error*
SA	*Seasonally Adjusted*
SATORP	*Saudi Aramco Total Refining and Petrochemical Company*
SC	*Schwarz information criterion*
SCHAA	*The Select Committee on Housing Affordability in Australia*
SEC	*Saudi Electricity Company*
TPAFCI	*The Public Authority for Civil Information*
VAR	*Vector Autoregressive*
VAR	*Value at Risk*
YTM	*Yield to Maturity*

List of Charts and Graphs

List of Tables

List of Tables (continues)

Chapter One

General Introduction

1.0 General Introduction

The real estate sector is a cornerstone of a country's development, which relies heavily on housing and commercial property development. These activities in the real estate sector not only improve economic health and performance, but also improve the wealth and lifestyle of individuals by providing the most important asset in a family's life: home ownership. Many developed counties valuate the importance of the real estate sector and work on improving it to their maximum benefit. However, the question is why emerging counties in the Middle East and North Africa (MENA), Africa, Asia and South America, are behind in real estate development. Is it simply something out of their reach, or can it improve significantly if main real estate issues are taken into consideration?

To answer the question in the preceding paragraph, it is important to understand the main constraints on the development of the real estate market in any country. The presence of any of those constraints certainly has significant impacts on market performance. The following are the main six constraints causing the underperformance of real estate development, primarily in the housing sub-sector. (Note: this section extensively uses the World Bank reports by Hassler (2011), Ernst and Young (EY) (2013) and John Lang LaSalle (JLL) (2015), which cover most MENA countries).

1- Housing demand constraints
2- Housing supply constraints
3- Market regulation
4- Funding sources
5- Market stability
6- Market attractiveness

The first constraints are directly related to housing demand, such as family income and mortgages, which are critical to access the housing market. A market with low family income has difficulty stimulating housing demand, which is the case in some countries. To overcome this constraint, many markets have developed mortgage systems to help families access housing. For example, Saudi Arabia and Egypt require the construction of 150,000 and 280,000 affordable housing units for low-income families annually, respectively. Affordability differs among markets based on their individuals income, making it more crucial to understand the market studied. For example, the monthly income of a middle-class household is \$650–\$1,600 in Egypt, \$1,600–\$5,400 in Saudi Arabia and \$2,700–8,200 in the United Arab Emirates. This makes the price of affordable housing approximately \$37,200 in Egypt, \$120,000 in Saudi Arabia and \$215,000 in UAE (JLL, 2015). One way to secure housing access to low- and middle-income families is to develop mortgage systems, which do not exist or are not well developed in emerging markets. Algeria, Egypt, Saudi Arabia and the UAE are among the counties improving the mortgage systems in their markets to meet the financing needs of families in all income categories. However, they do not yet provide mortgage packages that meet all needs. Overcoming these constraints will not only create demand for owner-occupiers but also second-home buyers and investors, which will drive housing demand upward. For example, middle-income families account for about 40% of the population (820,000) in the UAE, 60% (3.3 million) in Saudi Arabia and 12 million in Egypt. Resolving housing demand constraints without unwanted consequences, therefore, requires careful understanding and consideration.

The second constraints are related to housing supply. To aid understanding, these are divided into two categories: constraints related to land availability and constraints related to development. Land availability for residential development might not be an issue in some countries but has been and still is in many countries, including developed nations. Coastal states in the US and Melbourne, Australia, face natural constraints on land availability. In the UK, the constraints are not related to natural issues but process complications that have reduced the land supply for housing in recent years. In addition to those constraints on land availability, most land in Dubai is under private ownership, reducing the government's ability to provide lands at low costs to be developed to meet housing demand from low- to middle-income families.

In the second category of supply constraints, development constraints consist of the significant impacts of issues related to real estate developers, such as funding, financing, regulation, costs and profitability. Even with available land, supply might not meet demand due to these issues among private real estate developers. The key point is that governments seek to provide housing to low- to middle-income citizens, while private real estate developers seeks profits, which might not be very attractive when developing housing for families at these income levels. Other issues arise in countries where real estate developers are either government subsidiaries or otherwise under the supervision of local government. In this scenario, developers' process and performance compare poorly to those of private real estate developers, as is the case in Kuwait. Another issue in this scenario is the need for funding and financing to develop infrastructure, in addition to housing, for low- to middle-income families. These challenges might arise not only in poorer countries but also wealthier countries, such as GCC nations heavily reliant on oil production, which has dropped significantly.

Third, constraints related to market regulations related to the real estate sector or other sectors can have indirect impacts on housing demand and supply. For instance, regulations related to foreign investors can affect housing demand. Some countries restrict foreigners' purchase of properties in their markets to reduce demand pressures, while other nations try to promote their markets and provide incentives to attract foreign investors, such as allowing them to take mortgages. Another way to reduce demand pressure is to enact restrictions that give control to the government. Oman, for instance, restricts GCC nationals from selling residential plots (empty lands) within four years of buying them unless they are developed. The intent is to reduce the impact of land trading, which has inflated market prices, mainly driven by GCC citizens. Taxation provides another way to affect housing demand and is mostly used to control housing demand. Malaysia, for instance, waives taxes on purchases of high-quality houses in the undeveloped state of Kelantan to improve the housing quality. This measure could also affect the supply side of housing by offering developers incentive to increase demand for high-quality houses. The housing supply can also be influenced by reducing or removing taxes on housing, such as VAT. The opposite approach is used in market with high housing demand; for instance, the UK has not only introduced a capital gains tax on foreign buyers but has also increased taxes on very expensive houses. These examples of how regulation can affect housing markets might not be applied effectively in other markets, particularly emerging markets. Understanding each market's unique characteristics is important to evaluate the impact of implementing and changing regulations.

The fourth constraint is related to funding on both sides, with end users representing housing demand and developers housing supply. Houses are considered to be the most expensive asset individuals buy, which in most cases requires external funding from lenders. Consequently, many countries have sought to develop their lending systems into mortgage systems for housing loans. However, funding sources, such as banks and financial institutions, might not be capable of providing such large loans or be unwilling to provide funding to high-risk families with low to middle incomes. In response, some governments directly and indirectly intervene in the lending market through vehicles to provide loans for underserved, low- to middle-income families. Some governments have been observed to be more active in less developed housing finance systems, as noted in the World Bank report on MENA region (Algeria, Egypt, Iran, Lebanon, Morocco, Syria and Tunisia), where the lending markets are heavily reliant on government participation. However, government intervention in lending markets is not favourable for two reasons: first, it exposes the government to lending risks, and second, it gives advantages to government lending vehicles, discouraging private lenders' participation in the lending market. Governments, therefore, must exercise caution regarding their roles in lending markets.

Moreover, funding for housing development is another main constraint. The MENA region, in particular, faces huge demand for housing due to the large populations of young people. For example, 72% of Kuwaitis are 35 years old or younger and will require double the number of current number of houses in Kuwait over the next 20 years. Funding for development is critical, therefore, and must come different sources. In emerging markets, including most GCC countries, governments have development arms that monitor and develop many aspects of cities, such as infrastructure, power stations and buildings, such as schools, hospitals and houses. At the same time, private developers are involved in the development process, both under government supervision and as independent developers. In all cases, government and private developers require additional funding to meet the needed scale of development. For instance, in Lebanon, Morocco and Tunisia, the governments invest in banks that provide funding to developers. This measure can encourage private lending without competing with government entities and take the advantage of expertise in private lenders, such as banks and financial institutions. However, governments, lending institutions and developers might not have sufficient capital to meet the required funding, particularly in emerging countries with limited funding capabilities and nations heavily reliant on oil production, such as GCC countries where oil prices recently crashed. Reliance on local capital might not meet provide the necessary funds for development in a country; therefore, international funding instruments might be needed. The fast-growing Islamic banking market and the high demand for Islamic finance products warrant consideration as sources of development funding in these markets.

Not all markets have those funding constraints, but at least one exists in most emerging markets. Understanding the nature of each market will provide a clearer understanding of the market needs, which might be met by improving the current mortgage system or offering government support and guarantee to borrowers. However, these actions are highly related to markets with decent housing supply but limited demand due to the ratio of income and housing prices. Markets with the opposite situation—high demand and short supply—need to be treated differently. Although the World Bank recommended that all MENA countries develop mortgage systems to improve their housing markets, doing so could have negative impacts on market with high demand pressure and housing shortages. These markets need to focus on developing the housing supply and needed funding while controlling housing demand. Further study of each housing market, therefore, is needed to evaluate its situation and determine the best practices to improve its performance.

The fifth constraint is markets' economic and political performance and stability. These are crucial not only to foreign investors but also to local investors. Capital investments have no boundaries and follow the markets most likely to be stable over the investment period. Many studies have tested the impact of national economic performance on housing market performance. For instance, Adam and Fuss (2010), Kasparova and White (2001), Iacovello and Minetti (2003) and Bełej and Cellmer (2014) studied the impact of economic factors on housing performance. GDP, the unemployment rate and income usually are the main drivers of housing performance and the real estate sector. However, the World Bank noted signs of economic instability in the MENA region not limited to historical fluctuations in performance but also future expectations (Hassler, 2011). Countries reliant on limited income sources, such as GCC nations dependent on oil production, are considered to be instable as they are vulnerable to crisis caused by dropping oil prices and, therefore, need to diversify their income sources.

Political instability can similar impacts on capital flow to markets. The possibility of changes in the government or the political system might severely affect investors. Chan and Wei (1996) tested the impact of political news about the conflict between China and Hong Kong on the Hong Kong stock market and found that the stocks of companies controlled by non-Chinese holders exhibited significant volatility, reflecting concerns about political issues and the uncertain future of this market. The MENA region provides a good example of instable political systems that recently caused the wave of revolutionary events called the Arab Spring in many Arabic countries. It, however, is important to note that the political systems of MENA countries differ; some are highly democratic, whereas others more resemble dictatorships. Also, it should be kept in mind that a high degree of democracy does not guarantee stability as some dictatorships might provide more protection to investors, especially foreign investors.

Economic and political instability can significantly affect housing demand and supply in emerging market. This can occur directly through buying and selling of housing units and indirectly though the funding of development and financial institutions that provide mortgage to home buyers.

The sixth constraint to consider is market attractiveness. Indeed, market attractiveness is highly important to attract investors to any business activity in local and international markets. Many researchers have found a positive relationship between market openness and investment flow. Anyanwu (2012) confirmed this relationship when studying 53 countries. However, it is important to highlight the main factors affecting market attractiveness. First, market transparency is among the most important factors that affect investors' interest in a market. In any market, international and local investors require clear information about market performance and future expectations to make investment decisions. This information includes studies and data on countries' macroeconomics, political system and the targeted investment market (real estate development). Equally important is a country's future plans and specifically targeted markets for investment, which help investors have a clear understanding of market performance and expectations to make well-informed investment decisions. The second factor is the market system, such as its process and procedures. Bureaucratic, restricted, complicated and slow systems negatively affect the flow of investment to markets. Many countries, therefore, use the Economic Freedom Index to measure their performance and try to improve their markets based on these criteria (Heritage Foundation, 2016). The third factor is unethical market activities, such as corruption. This factor is very critical to foreign and small investors as they risk becoming victims. Wei (2000), Habib and Zurawicki (2001), Voyer and Beamish (2004) and Grosse and Trevino (2005) concluded that corruption significantly affects foreign investment, and high levels of corruption in markets decrease investment certainty and might cause complications and conflicts of interest in business. Many investors, therefore, prefer to avoid corrupt markets, even when they are profitable. The impact of market attractiveness on investment flow should not be underestimated and should be studied carefully to ensure an environment attractive to both local and foreign investors.

Those six constraints can be considered to be the most important factors affecting the growth of development in real estate markets, primarily emerging markets. A clear understanding of a market helps to evaluate the market situation and understand what factors most influence this specific market. It also helps to determine solutions and future plans to overcome those constraints, which will improve market performance.

1.2 Housing cases from emerging markets

Most emerging markets are considered youthful, with the majority of their populations made up of young people. This drives growth in housing demand and requires supply to respond at a similar pace, although this is not necessarily the case in markets where supply is not as active as it should be in meeting demand. There are also constraints, such as individual incomes and mortgage availability, that weaken demand for home purchases. Because of such considerations, housing markets in emerging countries are imbalanced. For example, the estimated number of affordable homes needed in the MENA region was 3.5 million units as of 2011, with the majority required in Egypt, Iraq, Morocco, and Saudi Arabia (JLL, 2011). JLL (2011) explained this shortfall as follows:

- High land values reducing access to affordable plots
- The cost of infrastructure in new cities
- Not A lack of prefabricated construction techniques causing costs to increase'
- Low returns in comparison to other sectors making markets less attractive to investors
- Low-income families having limited access to suitable finance in immature mortgage markets

These factors can be considered general, as each market has its differences in terms of the importance of these considerations or the impact such factors might have. For example, in a market with a shortfall in supply and high-income individuals, improving the mortgage market might worsen the situation and drive house prices higher. The following case studies examine emerging markets in order to understand the constraints facing different economies.

1.1.1The Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia (KSA) is an interesting emerging market that has recently announced a major development plan, called ‘Vision 2030’. It targets concerns including housing issues, the diversification of income, and the development of major projects—refineries, power stations, hospitals. KSA is one of the largest countries in the Middle East, with a land mass of 2,150,000 square kilometres. It is not only important in terms of size but is also the second largest oil producer in the world, which contributes 13% of global production. KSA relies heavily on oil production, which accounts for 87% of its budget revenues. Its population is about 32 million people and is expanding at 1.5% per year. Around 20 million are Saudis, with 51% younger than 25 years old. Saudi families number about 3.42 million, of which 63% are owner-occupiers. ‘Vision 2030’ sets out a short-term plan to provide 195,000 units of housing and 85,000 new housing loans to Saudis, which is to be achieved within three years (Eskan, 2017). KSA, like other GCC countries, is challenged by the fall in the price of oil, which it heavily relies on. Drops in oil price have caused KSA to record budget deficits from 2014 to 2017. In addition, huge housing demand—driven by the country’s demographics—is another factor that requires further consideration from a supply perspective. To achieve the targets of the major development plan, there is a need to understand and solve market challenges. It is worth noting that KSA has introduced a new tax on empty land, with around 2.5% of its value paid every year until the land is developed. The total undeveloped land mass (owned by non-government parties) in three major cities was recorded at about 365 million square metres, which is significant. Experts in the market noted a fall in land price of about 15% a year after introducing the tax. So, KSA is clearly challenged by a housing supply shortfall and the funding required for development. However, the ownership of residential land by non-government entities remains very high, therefore the new tax might quickly affect supply flow to the market. This requires further study in order to understand market dynamics and to evaluate its performance and draw up solutions. KSA is also challenged by limited data, for instance housing indices were only created in 2014. Solving this issue will help to build a better understanding of the market and how it can overcome its challenges.

1.1.2 Egypt

Egypt is another example of an emerging market that is struggling with housing challenges. Egypt is the most populated country in the Middle East and the third most populous in Africa. It sees annual population growth of 2.45% and has around 97 million citizens. On average, 1 million marriages take place every year, and about 2.5 million people enter formal employment annually. This huge population and associated growth rate could be the main drivers behind housing demand, which is expected to reach about 500,000 units yearly, in addition to the current accumulated deficit of around 3 million units (Oxford Business Group, 2018). On top of this, about 3.2% of domestic inhabitants live in non-durable housing, which is prone to collapse and failure. So, from a demand perspective, it is clear that Egypt is under high pressure, mostly driven by low-income individuals. Unlike other countries in MENA, the GDP per capita in Egypt is around $2,700. In contrast, it is $22,000 in KSA and $32,000 in Kuwait (Trading Economics, 2018). The very low income level of most Egyptians challenges their ability to buy homes, which drives the government to promote and support a number of plans to improve the mortgage system in Egypt. Although mortgages, as well as affordable housing, are considered a priority by the Egyptian government, it is important to also consider its financial strength in meeting such priorities. For example, the Egyptian government has recorded continuous deficits for the last 10 years, yet its debt-to-GDP ratio has been increasing over the last 10 years to a record of 101% in 2017 (Trading Economics, 2018). Therefore, solving the affordable housing shortage may require foreign investment, in addition to local investment from the private sector. The advantages of the Egyptian market are the low costs of land, labour, and construction materials. Solutions to housing problems in Egypt may not take a similar approach to those of other markets, such as KSA, but Egypt as well as KSA require to have adequate data in order to construct indices so that they can conduct reliable studies to find solutions for market challenges.

1.1.3 Ghana

Ghana is an example of a fast-growing economy that is also dealing with a challenging housing market. Ghana's land mass is 238,535 square kilometres, which is about a tenth of the size of KSA. However, they have a similar population size. Ghana has a population of around 29 million, whereas KSA's is around 32 million. This indicates the high population density of Ghana. Interestingly, Ghana suffers from a high rate of poverty and experienced a series of military coups prior to the peaceful election of 1992. Since then, Ghana's economy has grown and the poverty rate has dropped, from 52% in 1991 to about 21% in 2012 (World Bank, 2015). This was driven by political stability and the growth of exports (Anaman, 2006). Ghana's main exports are gold, oil, and cocoa. Although Ghana is not solely dependent on oil production like GCC countries, the discovery of major offshore oil deposits has boosted its economy (McDonnell, 2018). But Ghana still has a low GDP per capita of about $1,800 (Trading Economics, 2018). However, this has been continuously improving over the last three decades and is naturally low due to the country's large population. Debt-to-GDP ratio is relatively high, measured at around 70% in 2017. Inflation is very high at 10%, with interest rates at 17% as of May 2018. Unemployment was at 2.4% in 2017 (Trading Economics, 2018).

The performance of the real estate market in Ghana is challenged by a number of issues. Boamah (2010) examined two of the main cities in Ghana—Kumasi and Tamale—and found that government intervention in the housing market had been unsuccessful over the years. Although different approaches were used in the cities, the survey results indicated an overall failure in government intervention. For example, it provided concessionary housing loans to citizens, established bank-to-finance construction, and provided mortgages. However, such approaches where not as active as they were intended to be. In 2001, Home Finance Company Limited (HFC), a government bank, provided mortgages to citizens totalling $4.9 million, which accounted for 95% of mortgages issued that year. This indicates that commercial banks were not providing mortgages to home buyers. Boamah (2010) referred to the tiny amount of mortgages being provided as being the result of high inflation, which causes high interest rates. This drives commercial banks to focus on buying treasury bills and bonds, which provide higher rates of return and less risk. Mortgages are dictated by three factors: house price, income level, and the mortgage products available. Looking at the Ghana market, it is clear that those factors did not support mortgage providers. Individual incomes were very low, houses prices were very high in comparison, and mortgage products were very limited and served individuals with strong financial positions.

Financial limitations not only affect the demand for the housing in Ghana but also the supply, as financing for development is not very active. As explained earlier, commercial banks in Ghana are not attracted to housing development because of alternative opportunities in buying treasury bills and bonds, which provide double-digit returns. They can provide higher returns with less risk for commercial banks. As a result, there is an estimated unsatisfied housing need of around 1.5 million units (Mahama and Antwi, 2006) with an annual increase of around 133,000, while the number of houses constructed averages only 25,000 annually (Boamah, 2010). Interestingly, these houses are often constructed independently by households, with real estate developers only building 8% of all homes. Ghana's market has potential for development but requires further understanding of its funding limitations and potential improvements to supply and regulation. Like other markets, data is limited and unorganised, which means studying the market and finding solutions should become a priority.

1.1.4 India

India—the sixth largest economy in the world and second largest in terms of population—is also challenged by housing issues but on larger scale than other countries. India has showed continued economic progress over the years. Whereas its GDP was $500 billion in the early 2000s, it reached $2,500 billion in 2017. India's GDP per capita increased from $750 in 2000 to reach $2,000 in 2017; its debt-to-GDP ratio has stabilised over the last few years to around 70% (Trading Economic, 2018). The Indian economy is considered well diversified between its agricultural, industrial, and service sectors. It has also maintained an unemployment rate of around 4% despite rapid population growth. Although India's land mass is 3,287,263 square kilometres—50% larger than KSA— it has 40 times the population of KSA. India's population has grown very quickly, from 360 million in 1950 to 1,300 million in 2017. This increase has significantly affected housing demand across India, which now requires a huge supply of homes. The shortage of houses in urban areas was about 18 million as of 2010. Urban areas are occupied by only 30% of the population (about 379 million people) with the remainder residing in rural areas (Nandi and Gamkhar, 2013). Interestingly, the expected movement of people from rural to urban areas is set to increase to 50% of Indians, which is equivalent to 875 million people, by 2050 (Nandi and Gamkhar, 2013). In addition, about 30% of urban populations live in slums. This causes more pressure for housing demand in urban areas. However, both still need a huge supply of houses, mainly affordable homes. Based on India Vision 2022, the expected need for new houses in urban areas is between 26 million to 29 million units, in addition to a current shortfall of 19 million units. For rural areas, the expected need is between 23 million and 25 million units, in addition to the current shortage of 40 million units. This totals 107 million to 113 million new housing units (KPMG, 2014)

The Indian housing market faces huge development plans and needs to solve its current issues. First, the financial system is under-developed, both in terms of housing demand and supply. This includes the mortgage system, which lacks options for low-income individuals or those who work in informal jobs. A total of 35% of employees in Delhi work in informal sectors, therefore are not eligible for mortgages (Sivam, 2002). The financial system also requires further improvement to attract liquidity from local and international investors. Based on the previously described expectations of the required housing units for India until 2022, funding of around $2 trillion is needed (KPMG, 2014). This requirement doubles current investment in housing, from $120 billion to $250 billion annually (KPMG, 2014). To achieve this, KPMG (2014) has highlighted important factors such as improvement of currently under-developed equity and debt markets, incentives for foreign funding, and the improvement of the low-income sector's access to credit.

The second important factor is private sector involvement, which is essential to meet the housing plan targets in terms of funding requirements and development quantity. The Indian government acknowledges the need for the private sector in achieving its plan, and has considered ways to incentivise local and foreign investors to participate in the housing market, either through development or investment funding. Sivam (2002), KPMG (2014), and Gopalan and Venkataraman (2015) believe improvement in private sector participation is heavily influenced by solving the next three issues.

The third consideration is land title complications due to a lack of proper records on land ownership, from both individual to government level (Gopalan and Venkataraman, 2015). In India, not all land transactions need to be registered. Land acquisitions, court decrees, and mortgages do not require registration in the state system. This limits access to a large amount of land in urban areas, forcing development to expand outside such zones and causing additional work to be done to construct infrastructure and transportation, leading to the next issue.

The fourth factor is an increase in land and construction costs. This is caused by the limitation of land available for development within urban areas and because of the additional cost accrued due to infrastructure costs in newly developed areas. Such cost increases not only challenge low-income individuals wishing to buy but also reduce private sector attractiveness because of low expected returns.

Last, complicated processes and corruption challenge the development of the housing sector in India (Sivam, 2002). Processes—conducted through central and several state governments—require further improvement to speed up procedures and reduce corruption channels. Unless this is solved, it will be hard to meet scheduled housing targets and the market will find it harder to attract investors.

India’s large and fast-growing economy has the potential to create huge improvements in housing conditions. Given the country’s plan to develop more than 100 million housing units over the next few years, it is in our interest to further understand market dynamics, ways to solve challenges (complicated processes, development funding, mortgage availability, and land title complications), and so release land supply. Such studies will improve development performance and may reduce some of the costs associated with this plan.

1.1.5 Other emerging countries

Although not all emerging countries produce adequate data or studies about their housing markets, some show signs that can be used as indicators of their housing challenges. Beidas-Strom et al. (2009) address housing issues by considering ownership ratios—45% in Algeria, 68% in Bahrain, 38% in Egypt, 65% in Morocco, and 56% in Saudi Arabia. They also note that, in these markets, house prices are very high compared to average incomes. The price-to-income multiplier was recorded at 12 for Algeria and Bahrain, 7 for Egypt, and 9 for Morocco. Data for the rest was not available.

A similar study by the World Bank (2014), focusing on East Asia and the Pacific region (EAP), shows the following. Ownership ratios were at 52% in Bangkok, 57% in Jakarta, and 54% in Kuala Lumpur. Another important factor taken into consideration is the percentage of the population living in slums. In 2005, the level in China was 33%, Indonesia was 26%, Mongolia was 58%, Myanmar was 46%, the Philippines was 43%, Thailand was 26%, and Vietnam was 41%. These figures are strong indicators of the inefficiencies of housing markets and the need for improvement and further study.

Baharoglu et. al. (2005) raised the same concerns about the increase of populations living in informal settlements in Algeria, Morocco, Iran, and Yemen, and assumed this was driven by the high cost of houses and limitations on low-income individuals buying homes. They also noted that undeveloped mortgage systems and land supply were among the reasons for high housing prices. Hassles (2011) ran a comparison between the ratio of housing loans to GDP in OECD (The Organisation for Economic Co-operation and Development) and groups of developing countries in worldwide regions. In OECD, the level was above 50%. In South Asia it was 4%, Sub-Saharan Africa saw 5%, the Middle East and North Africa saw 6%, Central Asia saw 7%, Latin America and the Caribbean saw 8%, and East Asia and the Pacific saw 13%. This clarifies the level of mortgage system development in those regions.

Literature and professional reports covering such markets also note a lack of historical data, especially housing traction information. Also, such markets have underdeveloped financial systems, both in terms of development and interaction with end-users. Also, land supply and infrastructure are among factors affecting the housing sectors of those markets.

1.2 Thesis rationale

This thesis tries to setup an example of real estate development in an emerging market and the possibility of overcoming its constrains. Although this thesis will be using one country as an example, Kuwait, it will cover many of the common constrains expected to face other countries in emerging markets. Based on the main constrains mentioned above, this thesis will try to address the most possible factors influence the development of real estate market under study. To achieve this, the thesis we have the following goals:

1.2.1 Overcoming Data limitations

Most of the emerging markets have insufficient information. They do not have adequate historical data which can be used to understand the market. For example, Hassler (2011) found only two countries in MENA that have housing price indices, Morocco and Lebanon, while other countries such as Bahrain, Kuwait, UAE and Jordan provide limited raw data on sales transactions. Interestingly, these markets might have decent data, but it has not been gathered and prepared to be useful. Such information is not only limited to housing, but also to the economy overall, population, market competitiveness, financials. In addition, in cases of not having the required data, it is sometimes possible to use proxies that can provide the required data. Having decent data is critical from two perspectives: one, a transparent market full of needed information helps to evaluate and solve problems, and two, it attracts investors, either local or foreign, for investment or lending purposes.

The possibility to overcome data limitations is a corner stone to study, evaluate and provide solution to any of the constrains real estate market faces. Without overcoming data limitation researchers and decision maker cannot draw guidelines and plans to solve real estate market imbalance as they cannot differentiate whether what drives the marker is supply constrains or demand, or both. Market regulation adequacy, required funding to development and end users, market economical and political stability, as well as market attractiveness, all those keys constrains cannot be evaluated and solved without overcoming data limitation in targeted markets. Therefore, overcoming data limitation will be the main focus of the first paper of this theses, however, the second paper will also provide further solutions to overcome data limitations.

1.2.2 Studying market dynamic

Many of the emerging markets have insufficient commercial and academic research studies. If data were not available, then it would be impossible to produce such studies and research. Therefore, the existence of these studies and research would provide a greater understanding of market dynamics, including what drives these markets in the short and long terms. In addition, up-to-date, in-depth studies of those markets would have a significant impact on their attractiveness and in helping policymakers in their decisions. Examples of useful studies, which are found in most developed counties, are those that address housing supply and demand and what fuels this dynamic; studies on legislation and taxation systems for locals and foreigners; and studies on financing systems for individuals and developers. Such studies will help to identify the market main strength and weaknesses and what should to take the priority for policymakers and market participants. Also, this will reduce the uncertainty of the market so investors will have decent information about the market to take the investment decisions.

1.2.3 Providing solution

After overcoming the main constrain of data limitations then studying the dynamic of the market and have clear understanding of the market situation, it is necessary to provide solution the real estate market under study. Based on World Bank reports by Hassler (2011), Earnest and Young (EY) (2013) and John Lang LaSalle (JLL) (2015), development funding is a critical constrain face most of the real estate emerging markets. Not only countries with limited sources of funding but also countries that relies on limited sources on income such as GCC countries which relies on oil production which dropped significantly in 2014. Interestingly, unlike developed countries, most of the population in emerging markets is very young with a high growth rate. This requires huge funding for development which is not available in most of the emerging countries. The World Bank report highlighted the need for development funding for housing as well as other real estate sub-sectors. those countries have not yet developed well-established, fixed-income markets that can attract liquidity to be used for development purposes. Also, the uses of Share'ah complain financing products such as Sukuk are still at an early stage, and although there is clearly a market appetite for these products, they are not yet well-established and optimized.

Countries relying on development funding from their government and local investors might not be able to meet the funding require to such a huge funding for housing supply. Therefore, the third goal of this thesis to provide a solution to development required funding and evaluate this option.

The purpose of this thesis is to address these three main issues affecting the development of the real estate sector in emerging markets and to find solutions to overcome those difficulties. Worth mentioning, the three issues under study in this thesis are highly interlinked. Without solving the first issue of insufficient information, it is impossible to study the real estate market and reach an understanding of the market, including what problems exist and how they can be solved. In addition, having sufficient information without using it to understand market dynamics is useless and cannot help to draw solutions. Last, solving the first issue of insufficient information and the second issue of insufficient studies will only help to identify the problem; however, having a solution to the third issue, which is development funding, is the solution for the problem that exists in real estate markets in emerging countries.

The achievement of this thesis will provide a model for other emerging countries to follow to develop their real estate markets, improve economic performance and achieve overall goals for those countries in general and their citizens. To provide the best example from the emerging markets, Kuwait has been selected as the target market to be studied. Further details about the reason for selecting Kuwait are below.

1.3 Kuwait Overview

In this thesis, Kuwait has been selected as an example representing the housing in emerging markets. This raises the questions of what is considered an emerging market and why Kuwait? The term emerging market was first used in 1981 by an economist at the International Financial Corporation (IFC) of the World Bank, Antoine Van Agtmael (Ochieng et al., 2017). He referred to countries that progress towards becoming more advanced with rapid growth and industrialization and that experience some expanding roles in economic and politics worldwide. This definition offers an indication of the potential countries; however, nowadays, rating and mentoring agencies have their own standards for categorising countries, whether developed, emerging, frontier. Kuwait has been categorised as an emerging market by the International Monetary Fund (IMF), and it will be promoted to the position of secondary emerging market in 2018 by the Financial Times Stock Exchange (FTSE) and a frontier market based on the Standard & Poor (S&P) categorisation. Therefore, it is a vague definition, but tens of other agencies have different categorisations of Kuwait and all other countries. What really matters for this thesis are the countries with potential for development and that showed improvement in their economy, a high-medium income per capita, a growing population and work toward attracting investment from locals and foreigners. Examples of these countries include China, India, Indonesia, Malaysia, Pakistan, Russia, Brazil, Kuwait, Saudi Arabia, Qatar, Oman and the United Arab Emirates, as they are in a transitional phase to become developed markets in the future; however, as of this thesis, they are mostly categorised as emerging markets.

Why choose Kuwait? This is a key question to consider when looking for a representative example of most emerging countries, or at least one that represent most of the issues in other emerging countries. Many factors make Kuwait the perfect representative for issues in emerging markets. Regardless of the country's location, whether in MENA or anywhere else, in the following page are the reasons for selecting Kuwait to be an example of emerging markets.

1.3.1 Highlight on Kuwait

Kuwait, as shown on a map, is located between Saudi Arabia and Iraq; it shares land borders with Iraq and Saudi Arabia and maritime borders with Iraq, Saudi Arabia and Iran. Kuwait is considered a relatively small country in terms of size at 17,820 km^2; however, it has the fifth largest reserve of oil in the world and has a high GDP per capita of around $35,500 as of 2015 (Trading Economic, 2017). Oil production accounts for approximately 95% of the country's income and half of its GDP (World

Bank, 2014). Although Kuwait benefited from the high price of oil before 2014, the economy was hurt afterward when prices dropped by 50%. The total population of Kuwait is 4.2 million, with Kuwaitis accounting for about 1.3 million (The Public Authority for Civil Information, 2015). The population aged 35 years or younger in Kuwait accounts for 72%. Housing in Kuwait is currently short by 100,000 homes, which is equivalent to two-thirds the current existing housing in Kuwait. Yet, the expectation is that Kuwait needs double the existing number of houses to be developed over the next two decades to meet the need for accumulated demand. Further details about Kuwait will be in the related sections.

1.3.2 Kuwait Economy

Kuwait is one of the healthiest economies in the world's emerging markets. It has been awarded an AA ranking by Standard and Poors, an Aa2 rating by Moodys and an AA rating by Fitch (Trading Economics, 2013). Its strong ranking is due largely to the country's huge oil reserves, which represent 9% of total global reserve oil and which sell for a high price (Coleman, 2013). Because of these reserves, when oil prices are high, Kuwait's Gross Domestic Product (GDP) grows rapidly, the unemployment rate stabilizes at around 3% (Trading economics, 2016) and inflation remains stable at around 3.5%. Details on these variables are provided in the data section. In Kuwait, these economic health indicators depend on oil production and prices; therefore, they represent both a strength and an area of concern, since oil production accounts for approximately 95% of the country's income and half of its GDP (The World Bank, 2014). Thus, changes in oil prices have a significant impact on Kuwait's economy. For example, the sharp drop in oil prices from around $100 in 2013 to below $50 in 2014 caused Kuwait to record a real deficit. This significantly impacted all other sectors, including Kuwait's real estate market, which is a key focus of Kuwait Vision 2035.

Kuwait Vision 2035 is Kuwait's biggest development plan since the 1980s. This 25-year plan seeks to make Kuwait a regional financial hub, to diversify income sources and to meet local demand requirements, such as requirements related to infrastructure, education, hospitals, housing (Kuwait Yearly Plan, 2010). Such development (totalling more than 1,000 projects) requires significant investments. For example, the 2010 to 2014 phase of the Kuwait Vision has been allocated a budget of around 30 billion Kuwaiti Dinar ($107 billion USD), which is large compared to Kuwait's annual budget of 27 billion Kuwaiti Dinar in 2014 or its annual income from oil. The plan is currently facing several challenges, such as a decline in oil prices and challenges in the business environment. However, since the housing part of the plan has attracted serious interest from the government, it may be less likely to be affected by the factors hampering other areas of Kuwait Vision 2035.

It is also important to consider the attractiveness of Kuwait's economy. Economic attractiveness is essential for meeting development plan objectives and improving the economy. Currently, although Kuwait's economy is healthy and stable, Kuwait is not an attractive business environment for either foreign investors or locals. According to a World Bank report, Kuwait ranks 74th of 183 countries with respect to market openness and 149th with respect to starting a business (The world Bank, 2016). Alnasser (2007) found that US investment in 19 countries was highly influenced by their market openness. Similarly, using a sample of 53 countries, Anyanwu (2012) found that market openness attracts more foreign investment. The Heritage Foundation's 2016 Index of Economic Freedom ranked Kuwait 61st out of 180 countries (The Heritage Foundation, 2016). The report noted several barriers to foreign investors that slowed down investment, such as complicated government procedures, bureaucratic delays and competitiveness from local businesses that take advantage of family or clan relationships. Furthermore, Kuwait has several restrictions on foreign investors seeking to invest in oil sectors or real estate, which are the most attractive sectors in Kuwait.

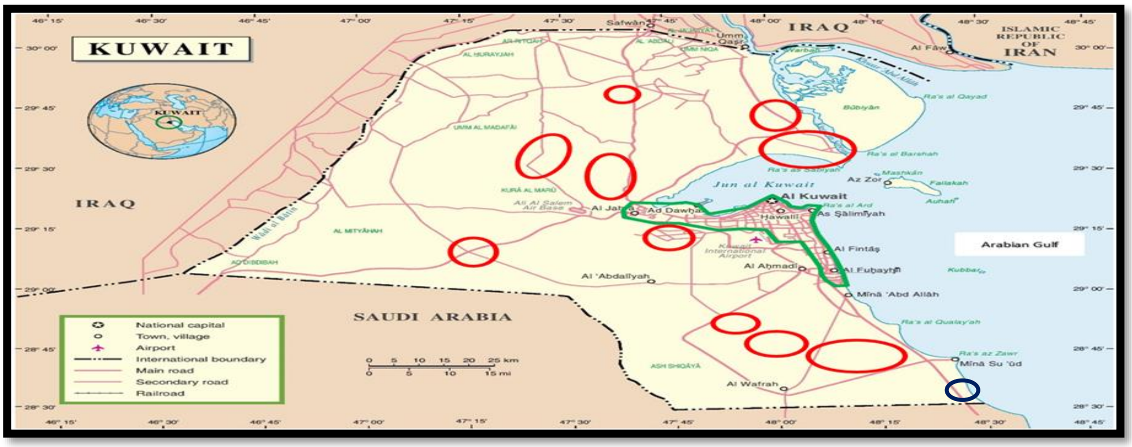
Finally, it is critical to consider the issue of corruption, which has become a growing challenge in Kuwait. On the Corruption Perceptions Index, Kuwait ranked 67th out of 175 countries in 2014 and 35th in 2003 (Trading Economics, 2015). These issues affect not only foreign investment, but also local investment. Across several different markets, Wei (2000), Habib and Zurawicki (2001), Voyer and Beamish (2004) and Grosse and Trevino (2005) concluded that corruption significantly affects foreign investments. A country's political situation is always important for investment, particularly foreign investment. İkizlerli and Ülkü (2012) studied the Turkish market and found that foreign investments in the Istanbul Stock Exchange have immediate and strong reactions to negative political news, but only slow and small reactions to positive political news. Similar findings have been reported in numerous other studies, including those by Khan and Akbar (2013), who studied 94 countries; Hayakawa et al. (2013), who studied 89 countries; and Busse and Hefeker (2007), who studied 83 counties. All of these authors found that political risk—including, particularly, government stability—has a huge impact on foreign investment. In Kuwait, this represents a significant concern, since, in the last nine years, Kuwait has had eight different governments resign and five elected parliaments dissolved/abolished (Council of Ministers General Secretariat, 2013), and still shows no signs of stability. All of these issues are important when considering a major plan like Kuwait Vision 2035, which require large amounts of funding and involves several real estate projects.

1.3.3 Kuwait Demographic

Kuwait is a small country with a total population of 4.2 million, of which Kuwaitis accounted for only 1.3 million in 2015 (The Public Authority for Civil Information, 2015). The country's demographic structure and growth level will influence the housing supply, the government's plans and expected prices. According to a Real Estate Association (2015) report, the average growth rate for the last 15 years has been 4.4%. The number of Kuwaiti families has increased from 153,587 (comprising 840,000 Kuwaitis) in 2000 to 266,353 in 2015 (Real Estate Association, 2015; TPAFCI, 2015). Family size has not changed significantly; in 2000, the average Kuwaiti family was 5.48 members, while in 2015, it was 7.08 , including maids, cooks and drivers (where applicable). Another critical demographic consideration in Kuwait is the population pyramid. Unlike European countries, Middle Eastern countries are much younger, and the majority of their residents are youths. In Kuwait, according to the Real Estate Association, (2015) report, 72% of Kuwaitis are younger than 35 years old, and 48% are younger than 19 years old. This distribution has serious consequences for the housing market.

1.3.4 Kuwait Housing

Kuwait's housing market is a unique market with numerous issues that need to be considered when comparing it to other housing markets anywhere else in the world. First, it is important to understand the typical occupants of Kuwait housing. On one hand, Kuwaitis have not yet accepted the concept of living in multi-family buildings or "apartments"; instead, they prefer to live in single-family houses (Real Estate Association, 2015). They prefer single family housing for two main reasons: the feeling of property and land ownership and the desire for privacy. The many Kuwaitis who do not own houses prefer to live in apartments rented as part of a house (typically a two-floor houses) than in an apartment in a multi-family building. On the other hand, non-Kuwaitis, with the exception of GCC people, cannot buy properties in Kuwait. Furthermore, non-Kuwaitis prefer to stay in areas populated by people from the same nationality. Since cost is essential for workers with low incomes, these individuals also seek cheap housing. Therefore, non-Kuwaitis prefer to live in multi-family buildings. As a result, these two segments—Kuwaitis and non-Kuwaitis—are clearly separated in Kuwait, and nearly all areas of Kuwait have either single-family houses or multi-family buildings, but not both. The term 'housing' in Kuwait typically refers exclusively to single-family properties, while multi-family buildings are called investment buildings or "zoned investments". Since this paper examines the housing market in Kuwait, it will focus exclusively on single-family homes, and the term "housing" in this paper will always refer to single-family houses.



Second, Real Estate Association (2015) reports that Kuwait is home to approximately 76 residential areas (small cities), each ranging from 400 to 4,000 house units. The map above illustrates how these areas are closely linked (surrounded by green line) and how all are geographically close to major destinations, such as Kuwait City, hospitals, airports, shopping destinations (note: red circles are potential new cities while the black one is Sabah Alahmad Sea City). This trend might reduce the impact of proximity to major destinations on prices. Interestingly, these residential areas represent only 11% of Kuwait's land and comprise a total approximately 170,000 houses (Real Estate Association, 2015). Although this number may appear small, it is a big number from the perspective of Kuwait, especially when compared to current accumulated housing demand, which was 118,000 in 2015 (Real Estate Association, 2015). This indicates the need for an additional supply of houses almost equal to the total number of existing houses, even without considering future demand, which will be discussed later.

Third, when examining the housing situation in Kuwait, it is important to consider the typical specification of houses. The standard house size in Kuwait ranges from 250 m^2 to 1,000 m^2, and less than 5% of total houses are larger than this range. The zoning code for the housing sector in Kuwait specifies that the maximum built-up area above ground is 210% of the land size, and that there is an option to build a one-floor basement of 100% of the land size (Real Estate Association, 2013). Obviously, nearly all houses are built to the maximum size possible, since it is cheaper to build all at once than to expand after a few years. Interestingly, there is a new trend in which the ground floor and basement, including kitchens, bathrooms, are occupied by landlords and their young children, while the first and second floor, if any, are divided into independent apartments with back-door entrances. This structure allows landlords' mature sons to occupy separate but connected apartments when they get married and also allows landowners to rent out space to earn additional income.

Finally, it is important to consider the expenses related to occupying or owning a property. In Kuwait, the government provides support for households by reducing the costs of electricity and water. According to a Real Estate Association (2013) report, electricity costs the Kuwaiti government 41 fils per kilo watt, and water costs 11.626 Kuwaiti dinars per gallon; however, the government charges households only 2 fils for electricity and 0.800 Kuwaiti dinar for water. In addition, households do not pay any taxes, such as council, income or capital gain taxes. Although such government support initiatives may waste resources, they also provide attractive investment opportunities for locals in the housing sector. These opportunities will be discussed later.

1.3.5 Housing supply in Kuwait

1.3.5.1 Supply of lands

Housing supply, mostly residential lands, used to be driven by both the government, which owned the vast majority of the land, and individuals and companies, which owned large plots of lands (5,000–1,000,000m^2). However, over the years, the role of individuals and companies as sources of land supply has shrunk. As they have sold their stock in the market, the government has become the major land supplier. The Real Estate Association (2015) reported that the total number of residential plots (400–1,000 m^2) in all Kuwaiti cities is less than 14,000. Whatever land supply comes to the market, therefore, is supplied by the government.

1.3.5.2 Supply of Houses

The housing supply in Kuwait is not like most countries that have a large share of second homes and investment homes. Although there is not precise statistics on the owner-occupier ratio in Kuwait, two factors can help estimate this ratio. First, the number of families in Kuwait is about 300,000, while the total number of houses is half this number. Second, the number of housing transactions in one year is around 2,000 transactions, while the total stock is about 170,000 houses, which means that the owner-occupier ratio in Kuwait is very high, and the housing supply in the secondary market is very weak. The main housing supply source, therefore, is the new supply of houses and lands provided by the government.

1.3.5.3 Current situation

The housing supply is considered one of the primary issues—if not the most critical issue—in Kuwait's housing sector. As mentioned earlier, Kuwait's population is rapidly growing and composed primarily of young people. These trends should give the government an indication of future demand; however, current numbers show a weak supply-side response to the expected demand. Over the last 15 years, Kuwait has supplied an average of 3,000 housing units on an annual basis, a number that is very low compared to annual demand, which is more than 8,000 units each year (Real Estate Association, 2013). This discrepancy stems from several issues. First, Kuwait's housing supply is highly controlled by the government, and all new cities, areas and plots must be approved by the Ministry of Housing. Furthermore, to construct a new area or city, the Ministry of Housing must seek permission from other ministries, such as the Ministry of Planning, the Ministry of Oil, the Ministry of Defence. Then, it must coordinate with the Ministry of Public Works to develop the infrastructure through tendering to private contractors. Finally, when the infrastructure is completed and the land plots are clearly divided, the plots are delivered to end users, who develop their houses themselves using contractors in the public market. Most of the plots delivered to end users are land plots; however, some are completed houses. The lands and houses given to families are gifted, they can sell them subject to PAHW terms and conditions

Second, not only does the approval process take a long time, but proposals are most often rejected by one or more of the involved ministries. Since Kuwait relies on oil production, the Ministry of Oil controls large plots of land throughout the country, and it tends to reject land development proposals due to the existence of an oil well or refinery. The same issue occurs with the Ministry of Defence, which rejects the conversion of certain locations to cities due to safety concerns.

Third, the Ministry of Housing lacks the capability to efficiently manage all of the tasks mentioned above for large numbers of units, especially given the discrepancy between what the Ministry has delivered in the past and what it is expected to deliver in the future. For example, Real Estate Association (2015) predicts that the average number of house units needed to meet demand is about 17,000 per year, while the current average delivery rate is less than 3,000 units per year. Such issues raise the possibility and the potential benefits of involving the private sector in early stages of the proposal and development process, such as the infrastructure stage. This possibility is currently under investigation, and no result has yet been announced (Real Estate Association, 2015)

A final issue related to the housing supply in Kuwait involves the country's many vacant lands. Numerous individuals and companies own lands in Kuwait with no intention to develop or resell them in the short term, either because they hope to use eventually use them for personal use or resell them for higher prices in the future. However, even if all of these vacant lands were converted into residential housing units, they still would not solve the housing shortage, since the total number of vacant plots is approximately 14,000 and the accumulated demand for housing, according to the Ministry of Housing (2015) report, is about 118,000 (PAWH, 2015).

1.3.5.4 Future plan

As housing became a serious issue in Kuwait, it caused clashes between the parliament and the government. Therefore, the government decided to take serious action. Specifically, it decided to release a large portion of previously undeveloped lands to become a major cities in different locations in Kuwait. These cities are expected to not only cover current accumulated demand, but also meet additional demand for the next 20 years (Real Estate Association, 2015). According to the Real Estate Association report (2015), over the next 20 years, Kuwait will need an additional 340,000 housing units, including 118,000 units of current accumulated demand. This demand is equivalent to two times the current total number of houses in Kuwait, meaning that meeting the demand will require a major shift with serious consequences on the market. However, the government's plan seeks to ensure that welfare applicants wait no longer than one year to get a house. By contrast, current applicants to the Public Authority of Housing Welfare (PAHW) wait 18 years to get a house, and if Kuwait does not change its current housing supply rate, this waiting time may grow to more than 40 years (Real Estate Association, 2015). More details about welfare are provided below.

1.3.6 Housing Demand in Kuwait

Although demand for housing in Kuwait comes from different sources, one of the primary ones is Kuwaitis applying for PAHW welfare. In Kuwait, by law, Kuwaitis who do not own their own house and gets married can apply for PAHW and choose one of three options, assuming that they have been married for at least five years or have a child. The first option is to apply for a mortgage from Kuwait Credit Bank (KCB), a government bank established to provide mortgages for Kuwaitis. Mortgages offered by KCB are interest-free up to a maximum of K.D.70,000, but have to be repaid with a minimum monthly payment of K.D.100 or 10% of the borrower's salary, whichever is higher (KCB, 2015). This option is considered the fastest option for getting a home, since it allows the family to buy a house from the market; however, they must pay the loan using their own resources. The second option is to apply for both land and a K.D.70,000 loan from KCB. Families who pursue this option have to wait for the PAHW to give them land to develop themselves. They can still take K.D.70,000 from KCB; however, if the construction costs more than K.D.70,000, the family must pay the additional costs themselves. The third option is to apply for a house. Families who apply for houses wait their turn and then receive a built house, which is considered a combination of a land gift from the PAHW and a K.D.70,000 mortgage from KCB; therefore, the land is free, but the families must repay the K.D.70,000 (PAHW, 2015). Although the second and third options seem attractive, as previously noted, the waiting times are extremely long, with current waiting times exceeding 18 years (Real Estate Association, 2013). Together, according to the PAHW (2015), welfare applicants pursuing one of these three options had an accumulated demand for housing of 118,000 units at the end of 2015.

The other demand for housing in Kuwait comes from Gulf Cooperation Council (GCC) citizens and from investors and speculative Kuwaiti traders. When considering the demand from GCC citizens, it is important to consider the prices for houses in Kuwait, since Kuwaiti houses are more expensive than those in other GCC countries. Furthermore, although GCC citizens are the only non-Kuwaiti individuals allowed to own property in Kuwait, each GCC citizen can only own one Kuwaiti property. Therefore, their demand is not expected to have a major influence on Kuwait’s housing market. However, demand from investors and speculators could have a huge impact on housing in Kuwait and could represent one of the main factors impacting housing prices. Unfortunately, there is no data on investment and speculation in Kuwaiti housing, though there are several factors that may make Kuwait an attractive environment for this kind of demand. First, as of the end of 2015, there were 118,000 families waiting for their turn for PAHW house (PAHW, 2015), and all of these individuals are either participating in the rental market or staying in their parents’ houses. Therefore, the rental market has been strong and has continued to grow over the last 15 years. In addition, the shortage in housing supply has increased housing prices and created good opportunities for short-term property traders, especially given Kuwait’s lack of taxes or restrictions on the purchase and sell of houses by Kuwaiti individuals.

1.3.7 Mortgage system in Kuwait

Mortgages in Kuwait differ somehow from those in other countries in that the total allowed loan is capped for everyone, even people with high incomes. Currently, the maximum loan is K.D. 70,000, and total monthly instalments cannot exceed 40% of total monthly income. For example, if individuals A and B have monthly incomes of K.D. 2,000 and K.D. 10,000, respectively, and both can meet the 40% of total income condition, then both will have the maximum allowed mortgage of K.D. 70,000. Therefore, a family with two working parents with high incomes can take a maximum mortgage of K.D. 70,000 each from commercial banks plus K.D. 70,000 from KCB, making the maximum loan for any family in Kuwait K.D. 210,000 (KFH, 2015). However, individuals often have other loans, such as consumption loans, which reduce their maximum housing mortgage. This loan issue are important to consider in the context of housing because it means that any houses priced above K.D. 210,000 must be paid from personal or family equity. The only cases of higher mortgage allowances occur when individuals other non-salary income (due to owning multi-family buildings or personal companies that generate stable income). Loans to such individuals are categorised differently and do not consider income from salary, meaning that these loans are unavailable to the majority of Kuwaitis (Kuwait Finance House, 2015).

1.3.8 Housing transaction process

The process of selling houses and lands in Kuwait is similar to that in most countries. First, the seller meets with the estate agent to discuss the market and expected prices, and then they sign an agreement for the agent to market the house or land on the owner's behalf. Second, the estate agent and the agent's team advertise the house or land verbally, in newspapers and on websites and social media channels. Third, the real estate agent manages and arrange visits by prospective buyers to explore their interest and prices. Competition can happen in a process similar to an auction but conducted by telephone. Fourth, the seller selects an offer from the bidders, considering the price, cash offers and buyer reputation. Last, the parties sign a buy-and-sell agreement setting the payment schedule (10% now and 90% after the process is completed) and start the transfer of ownership from the seller to the buyer. This requires a visit by a municipal representative to assess whether the house is suitable for use and to ensure that the houses matches the plan filed.

1.3.9 Houses and lands valuation

The most common way to evaluate a house or land is to use comparable examples from the same city. This might seem obvious, but it is not always conducted in a professional way as might be expected. Developed countries use a hedonic approach to break down the values of house characteristics and use the findings to build a rough value for the house under evaluation based on its characteristics. This is not the case in Kuwait, where a very general comparison method is used, considering the time of the transaction, age of the house and size of the plot and comparison these to the house or land to be sold. Although transaction prices are supplied online, they lack much information about homes, such as renovations, the number of bedrooms and bathrooms and total built-up area. The location of houses and lands sold recently is available to active estate agents, but the measurements of differences in locations are very subjective. Another issue to be considered is the limited examples to be used as comparables. As a result, buyers and appraisers might refer to recent transactions within the same city but with major differences characteristics from the house evaluated.

Real estate agents' credibility is critical when evaluating houses and land. Some real estate agents make evaluations of houses and land based on either their appraisal certification or their experience. Less honest agents, who are unfortunately common, might mislead sellers and buyers about the estimated price of the house or land. Consequently, sellers and buyers tend to meet a number of estate agents and to ask friends and experts for their opinion on the house or land price and its expected market performance.

1.4 Reasons for selecting Kuwait

Data Availability

Although most of the data needed in emerging countries should exist somewhere in related ministry archives, they are either not prepared or not allowed to be shared with the public. One reason for selecting Kuwait is the availability of raw data, either online or collected from a related party. Raw data include sales transactions of properties, demographics, number of houses, individual income and other required information. Worth mentioning is that some of the data in Kuwait that are not available, do not exist or are not of high frequency, were replaced with proxies, which replace well those not available data.

Market size

To have decent data, especially data related to highly heterogenic real estate, it would require a large amount of data if we were to consider other large markets such as Saudi Arabia or Egypt. While if considering smaller markets such as Bahrain or Qatar, we would face the risk of bias because of limited data. So, Kuwait, with 76 cities and 60,000 sales transactions, is well-suited in terms of size and is manageable, especially when those transactions are collected manually.

Richness of events

Kuwait provides interesting findings to the general literature on real estate because of the events accrued over the period studied. A few examples to consider include: Kuwait's accumulated housing demand, which is close to the size of the total existing houses in Kuwait; Kuwait relies solely on oil production, which dropped significantly over the last few years; and Kuwait witnessed a large wave of demonstrations in surrounding countries during the "Arab Spring", and wars followed. These issues had an interesting impact on the real estate and housing markets.

Major development plan

Kuwait has a major development plan called the "Kuwaiti Vision 2035", which targets the development of double the existing number of houses in Kuwait over the next 20 years. Having such a plan would make the existing housing and real estate indices very important, as would decent studies evaluating and monitoring the performance of the market and its reaction to surrounding factors. Also, having such a plan from a country with a limited source of income from oil would challenge Kuwait's ability to meet this major development plan after the oil price crisis unless alternative sources of funding are introduced.

Supply constraints

Kuwait is a good example of the consequences of relying on the government to provide housing. As noted by the World Bank report and further detailed in the second paper, the housing supply does not meet the demand, and that capability has not improved over the years. Such an issue is not limited to Kuwait, and many of the other emerging countries have experienced similar negative consequences of poor housing market performance.

Closed market

The Kuwait housing market has a unique feature that limits the purchase of housing to locals. This will control for the foreign impact on housing and give a much more reliable reading of the interactions between housing and other factors such as economic, political, legislative.

Tightened mortgage system

Another interesting point to consider in the Kuwait housing market is its tightened mortgage system, where individuals are limited in their borrowing to a maximum of K.D. 70,000 with total monthly installments not to exceed 40% of their monthly income. These limitations would reduce market sensitivity to interest rates and might give greater weight to other factors.

So, taking these points into consideration, we believe the Kuwait housing market is a good example as a representative of emerging countries. We have noted the differences among emerging countries in terms of size, stability, wealth, development; however, the issues to be studied in this thesis are expected to yield useful information to most of the emerging countries, regardless of their status.

1.5 Thesis structure

This thesis is presented in three self-contained, independent papers related to the real estate markets in emerging countries. The structure is simple and divided into five chapters, as below:

Chapter 1

This chapter gives a general introduction to the thesis and explains its purpose, aims and objectives as well as the structure used.

Chapter 2

This chapter contains the first independent paper. It contains an abstract, introduction, literature reviews, research questions, data, methodologies, findings, conclusion and limitations. However, references and appendices will be combined with the other papers at the end of the thesis.

Chapter 3

This chapter contains the second independent paper. It contains an abstract, introduction, literature reviews, research questions, data, methodologies, findings, conclusion and limitations. However, references and appendices will be combined with the other papers at the end of the thesis.

Chapter 4

This chapter contains the third independent paper. It contains an abstract, introduction, literature reviews, research questions, data, methodologies, findings, conclusion and limitations. However, references and appendices will be combined with the other papers at the end of the thesis.

Chapter 5

This chapter presents the overall thesis contribution to general literature and recommendations.

References

This chapter contains all references used in the three papers.

Appendices

This chapter contains all appendices used in the three papers, organized separately for each paper.

1.6 Purpose of thesis

The purpose of this thesis is to select one county from the emerging markets and to investigate the main challenges facing this market, including how to overcome them to improve the real estate market's performance, the country's economy and the lives of its citizens. Kuwait, as noted above, has three main challenges facing the real estate market: the availability of useful data, the availability of decent studies on the real estate market and the difficulties in providing funding to Kuwait's major development plan. These can be considered the main challenges facing most emerging real estate markets; therefore, using Kuwait to solve those challenges will offer a good example to be followed by other markets. Because each of the three papers of this thesis is designed to stand alone, each will not contain and cover all three key issues. However, they are interlinked to cover related issues. The aim of each paper will be explained below in brief, while further details will be discussed in the respective sections.

1.6.1 First paper

Title: Constructing Housing Price Index in an Emerging Real Estate Market

The first paper challenges the limitation of data and constructs useful and accurate housing indices based on available information. This paper has been selected to be the first in this thesis, as it provides the foundation for the other two papers. The objective is to provide a solid foundation for the literature on housing in Kuwait. With a limited number of sales transactions of around 60,000 over 13 years and limited information about those transactions, this paper is challenged in using non-parametric central tendency (mean/median) methods to construct indices for housing. However, this paper attempts to make the best of such limited information with no choice but to use the central tendency methods by applying different adjustment techniques, including stratification, weighting and observation frequency in order to develop useful indices. Another reason for using these techniques is to show how each factor influences performance and the indices under construction and to provide other emerging countries with a clearer idea of what to expect. The complexity of constructing such indices, including difficulties in gathering the required data, has hampered everyone from constructing housing indices for Kuwait, making the indices in this paper the first to be constructed for Kuwait. The existing of housing indices will positivity influence all parties involved in the real estate sector, particularly policymakers, local and foreign investors, households and lenders. Overcoming the challenge of limited information and making use of a non-parametric methodology means that many of the other emerging countries can produce similar, useful indices that can be used to meet the variety of needs mentioned in the literature section of this paper.

1.6.2 Second paper

Title: Modelling Housing Market Fundamentals and the Response to Major Events

The second paper seeks to build a foundation of research for the real estate sector in Kuwait, focusing on the housing sub-sector. First, this paper will construct housing affordability indices for Kuwait using different methodologies. Second, this paper will use the indices constructed in the first paper to understand the dynamic between housing sector and influencing factors which will provide a solid grasp of the nature of a targeted market, what might influence it, what historical data is available and how the data can be used. Third, this paper will test the housing market sensitivity on local and regional levels to surrounding events such as political issues, legislation changes and terrorist attacks. These tests will use the indices constructed in the first paper but will use further adjustments to reduce noises in these indices so that they will provide decent readings when tested. It will also challenge the limitations of data by creating proxies, replacing any factor not available or not available at the required frequency. Achieving these aims will provide a deep understanding of the market under study and what challenges are the main and how to overcome them. In this way, not only to the use of this thesis, but future researchers can point to the key challenges in the market, the solutions they need and set goals to solve them. In addition, this paper discusses issues related to methodologies and modeling the housing market and proposes different approaches to overcome them. These strategies should provide decision-makers with a solid ground from which to take action toward solving real estate issues in Kuwait or in any other emerging countries.

1.6.3 Third paper

Title: The Portfolio Advantages of Sukuk:
Dynamic Correlations between Bonds and Sukuk

The third paper discusses the third main challenges facing real estate development in emerging countries: funding sources. Lately, many countries in the MENA region use Sukuk to fund their developments. Sukuk are instruments like bonds but in compliance with Islamic law and have been growing dramatically. This paper will offer a clear understanding of these relatively new financing products, how they are different from bonds, their complicated structure, examples of uses, market size and future potential (details in the third paper). In a market like Kuwait, which depended on one source of income, oil production, that dropped in value dramatically and caused a budget deficit, or in other markets that do not have reliable funding for their development projects, the use of outsourced funding is the ultimate solution. The main question here and the focus of this paper is determining how Sukuk differ from bonds and whether they provide further diversification for investors. Answering this question is critical in understanding the reason for the dramatic growth of this product and, most important, to determine if Sukuk should be used as a source of funding for a major development plan such as Kuwait has, which includes doubling the existing number of houses. Covering these issues will provide an adequate understanding of the usefulness of Sukuk for such purposes, not only for Kuwait, but for any other emerging country in need of additional funding to meet development plan goals to solve housing issues.

Thesis Three Papers

Chapter two-First Paper

Constructing Housing Price Index in an Emerging Real Estate Market

Abstract:

Housing indices are important tools to measure and evaluate market performance in decision making by policy makers, developers, investors and households. The methodologies of most indices require much information about houses sold and transaction details; however, many countries, primarily emerging markets, do not have housing indices because of data insufficient. Kuwait, the target market of this paper, has data on housing but not a housing index. From 60,000 transactions gathered from February 2004 through March 2017, 53,000 transactions are retained after eliminating faulty transactions and major outliers. Of the transactions retained, 31,000 transactions involve empty residential land, and 22,000 existing houses. The data collected are not sufficient for advanced parametrical indices, such as the hedonic and repeat sales methods; therefore, central tendency methods has been used to construct the first Kuwait housing index. First indices were stratify by city then apply a number of different methodologies to improve the readings from the constructed indices. Seventy-four indices were constructed, all based on the same dataset but with different characteristics. The main findings are that, first, the indices based only on land transactions have less heterogeneity but also significantly higher volatility than the indices based on only housing transactions. Second, even when cutting data by up to 40% to avoid noise and outliers, the result still produced highly competitive indices with higher accuracy than the indices with the full sample of data used. Third, and finally, an alternative stratification method has been developed based on long-term mean prices that has similar performance as the indices based on the original stratification by city. Using central tendency methods that are easily modified can produce stable, highly accurate indices that might provide performance competitive with advanced indices.

1.0 Introduction

The existing indices to measure price movements in the property sector are highly important from the perspective of individuals, organisations and governments. Among the most significant reasons, housing indices help understand the dynamics of housing price and how they influence or are influenced by national and international factors, such as the economy, politics and policies. Haan and Diewert (2011) explain most of the other uses of housing indices, as presented in the following:

1. Macro-economic indicator of economic growth.
2. Monitory policy and inflation target.
3. Input for estimating the value of housing as a component of wealth.
4. Financial stability or soundness as an indicator of risk exposure.
5. Input into individual citizen's buy or sell decision making.
6. Input into construction of a consumer price index.
7. Making international and inter-area comparisons.

First, economic performance has always influenced the property sector. Housing prices increase during economic expansion but fall during economic slowdowns. Goodhart and Hofmann (2007) find that 16 industrial countries show a high correlation between economic performance and housing prices. As well, Reinhart and Rogoff (2009) find that all six banking crises since the mid-1970s were associated with bursting of housing bubbles. The link between the economy and the housing market can be viewed as following three channels. First, higher housing prices drive the construction of new houses, which requires hiring more employees and provides higher income for those working in related industries, such as brokers, construction companies, lenders and legal professionals. Higher housing prices also drive the demand side for both owner occupiers and investors. Second, higher housing prices lead to more transactions, resulting in increased tax revenues followed by increased government spending. Third, higher housing prices creates higher household wealth, leading to greater spending and investments. Household spending in the United States, however, increased faster than household income during the 1990 and 2000s (US Congressional Budget Office, 2007), and these effects run in both directions: when prices fall, they lead to the opposite consequences.

Second, central banks typically set inflation targets and use indices to monitor inflation. For example, some counties use the monetary conditions index, and others the consumer price index (CPI) to measure inflation level when setting interest rates. Both indices include housing price movement due to its importance role in the inflationary process and economic performance.

Third, housing prices are included in the measurement of aggregate wealth in the economy and balance sheet accounts in the Systems of National Accounts. It, therefore, is necessary to know housing prices to estimate real household wealth.

Fourth, financial soundness indicators (FSI) measure the current health and soundness of a country's financial system on a corporate and household level. FSIs include aggregated individual institution data and indicators representative of the markets in which those institutions operate, including data on real estate prices. The purpose of these indicators is to monitor and strengthen the global financial system and to increase its stability, especially after financial crises. The real estate cycle and price movements are well recognised as important factors in debt crises and the stability of the financial system, especially in countries where real estate accounts for a significant proportion of the national and individual wealth. Therefore, information about residential and other kinds of properties is important for FSI, particularly prices and loan-to-value and earnings-to-loan ratios.

Fifth, buying a house is often the largest financial transaction individuals make, so it is very important for them to have expectations about future prices and rent. These influence their decision to buy a house, in addition to other factors, such as the interest rate and loan-to-value ratio. Negative expectations of housing prices may influence household decisions to sell and buy another house or rent until they expect positive change in housing prices. Sixth, many countries include housing prices when measuring CPI. They can be measured directly when including owner-occupier housing costs or indirectly when measuring the influence of housing prices or the rent tenants will pay or landlord investors will collect. Last, housing prices also can be used for national and international comparison, including differences in the cost of living between different areas of countries.

Emerging countries, most of which do not have housing indices, require these indices for all the uses mentioned previously. Kuwait, the target market of this paper, is among those markets that need housing indices to evaluate market performance, its main challenges and to determine how to overcome them. As each housing market is unique, countries require reliable housing indices to draw conclusions about them. With this in mind, this paper attempts to use exiting data for Kuwait and to employ different methodologies to construct a useful index for studying its market. This is critical for Kuwait and other emerging markets that have data limitations and no previously exiting housing indices. Overcoming this will allow researchers to draw a greater understanding of market performance, the main challenges in the market and possible solutions for them. These will be addressed in the next pages of this thesis.

2.0 Literature review

With all the uses of indices mentioned in the first section, it is critical to create indices that can best describe the property market under study. Recent literature addresses ways to construct the most useful indices using different methodologies. Due to the focus of this paper on housing indices and the data limitation restricting to the use of the central tendency methods, it will focus on main three methods for constructing housing indices. We discuss their underlying theory, advantages and disadvantages and finally compare them.

2.1 Housing indices

Constructing a housing price index is challenging and not as simple as indices for other goods, such as those included in the CPI. Wood (2005) attributes this difficulty to three key characteristics. First, and most importantly, houses are heterogeneous, and no two are the same. A sample of houses sold, therefore, might not be a good indicator for all houses. Second, houses usually are sold infrequently. In the 1990s, for example, only 7% of houses in the United Kingdom were sold, meaning that on average, it took 14 years for a house to be sold again, making the sample for creating an index not very rich (Wood, 2005). Finally, housing prices are based on list of characteristics very frequently not available, so often, only the price of the house and some characteristics are available. Consequently, the index is highly driven by the available datasets, and different datasets produce different index. Due to these challenges, researchers have attempted to construct housing price indices with different methods to produce the most accurate indicators that can provide useful readings. The following sections discuss in more detail the main three methods used to construct housing price indices.

2.1.1 Hedonic regression method

The hedonic regression method assumes that the characteristics of a good can reflect its price (Wood, 2005). Heterogeneous goods, such as houses, therefore, can be measured based on their characteristics. Even though these characteristics cannot be sold separately, they can be used to determine a value of the house (Wood, 2005). Such characteristics include the location, building structure, age, built-up areas and number of bedrooms of houses. These are the main drivers of supply and demand and implicitly contribute to the housing prices. This method uses regression techniques to estimate these characteristics' marginal contribution to prices. These characteristics are the explanatory variables for price and are presented as dummy variables that take the value of 1 if the characteristic exists in the house and 0 otherwise.

The hedonic regression method is considered to be superior to other methods, and if the sample characteristics are sufficiently detailed, it can be adjusted for changes in the mix of the sample or the quality of individual houses. However, this method has some drawbacks that need to be taken into consideration. This method requires a tremendous amount of information that might not be available, and if data are available for some but not all variables, it might produce bias in the findings.

The equation also contains many explanatory variables that could create the risk of bias. Many variables might pose the risk of multicollinearity and increase the standard errors of the regression coefficients, thus changing the measurement of the price. As well, omitting some important variables might give more weight to other variables and produce less accurate measurements of price changes. For example, if the fitted kitchen is common but has not been included in the model, the price might be higher than what it is worth. In addition, the subjective nature of some housing characteristics makes it difficult to determine their relative importance. Also, it is not easy to sufficiently control differences in some characteristics, primarily location. Finally, the data required makes the method to implement hedonic regression method expensive.

One critical drawback of using the hedonic model is the possible influence of heteroscedasticity. Many studies have not accepted the assumption of a linear relationship between the price of houses and the characteristics of houses. Fletcher et al. (2000a) summarised this issue as follows. Heteroscedasticity refers to the unequal variations in the disturbance term of the model. This can occur due to variance between different types of properties (detached, semi-detached, terraced) or between the ages of different houses. The existence of heteroscedasticity in an ordinary least squared (OLS) model means that the model estimators do not provide the best linear unbiased estimators (BLUE) because the model did not reach the minimum variance; moreover, the variance that was calculated using standard OLS is biased. However, Goodman (1995), Fletcher et al. (2000a) and Stevenson (2004) believe that if the form of heteroscedasticity can be estimated, the use of generalised least squares (GLS) theory would provide a better estimate.

Adair et al. (1996) studied the 1992 Belfast housing market using a sample size of around 1000 homes; they confirmed the existence of differences in the submarkets within the market under study. They used a multiple regression model to identify the differences between submarkets based on the house price structure within Belfast. By considering location within the city (inner, middle and outer) and property type (detached, semi-detached, terraced), they identified nine submarkets. They found that differences exist in the submarkets based on location and property types. However, they raised the concern of having “over-fragmentation” of the market due to segmenting the market into a number of submarkets. Thus, they noted that, in some cases, using a macro-level analysis might provide better findings than using a disaggregation model.

Goodman and Thibodeau (1995) used 8500 transactions of single-family houses in Dallas, Texas to examine the relationship between house prices and depreciation; they found a non-linear relationship between these variables. They used a hedonic model with age and living space as the explanatory variables and a logarithm of price as the dependent variable. They concluded that heteroscedasticity exists in many types of housing models. They refused the assumption of a linear relationship between price and age, and they found that the level of depreciation decreased over time and the vintage effect cannot be ignored; thus, a linear relationship is not possible. Goodman and Thibodeau (1997) controlled for the neighbourhood effect by dividing the submarkets based on elementary schools. Stevenson (2004) reported a similar finding in a study on the Boston market from 1995 to 2000 with about 6500 observations. Stevenson (2004) studied Boston because of the existence of long historical data, which provided access to a decent number of old houses so the influence of age could be studied. Like Goodman and Thibodeau (1997), Stevenson (2004) used GLS to study the relationship between house price and age, but he also used estimated generalised least squares (EGLS), similar to Fletcher et al. (2000a), who presumed that heteroscedasticity may be caused by variables other than age. Although Stevenson (2004) found no evidence that living space caused heteroscedasticity, like Fletcher et al. (2000a), he found that the age of a house caused heteroscedasticity in his model.

Segmentation of a submarket can reduce the effect of heteroscedasticity; however, Fletcher et al. (2000b) sought to identify which characteristics best differentiate submarkets and to determine how best to measure these differences. Jones et al. (1999) reviewed 20 or more papers that tried to determine the existence of submarkets, but found that there is little agreement on how submarkets are defined. Based on that, Fletcher et al. (2000b) focused on addressing the issue of submarket segmentations in applying a hedonic approach to house price estimates. They compared an aggregate model with a disaggregate model using house location, house types and house age, with a sample of 19951 properties. Using forecasting with a 10% out-of-sample forecasting sample, they found that the disaggregate model based on the age and type of house had fewer forecasting errors than the aggregate model, while the disaggregate model based on location had more errors. Interestingly, they commented that, in a case in which all possible cross-dummies related to property type, property age or property location were used, aggregate model was expected to yield exactly the same predictions as those produced separately by disaggregate models. However, the possibility of having all the required information available is very low.

The existence of heteroscedasticity in the hedonic model to be used to construct a housing price index will produce biased outcomes, so care is needed when constructing it. Moreover, it is not easy to identify or remove the heteroscedasticity effects in some of the house characteristics, such as age, location and living space

2.1.2 Repeat sales method

The repeat sales method is considered to be the simplest econometric method and utilises information only from properties that have been sold more than once. Bailey, Muth and Nourse (1963) first propose this method as a generalised form of chained matched methodology, applied earlier by Wyngarden (1927) and Wenzlick (1952) to construct real estate indices. Many parties use this method, such as Standard and Poor’s Case-Shiller Home Price Index in the US, Residex Index in Australia and UK Land Registry Index.

The repeat sales method is much simpler than the hedonic regression method as it requires only three inputs from sales transactions: the price, sell date and address of the property. This method is based on matched properties, but it is difficult to use standard matched model methodologies due to the infrequency of resales in each period. This method, therefore, uses a stochastic model to explain the changes in the price of houses that have been sold repeatedly. Dummy variables are used to determine the point in time when each house sell takes place, and then a regression model is estimated based on the pool data across the sample period.

This method, like others, has advantages and disadvantages. The method is less data intensive and requires only the price, date and the address of each sell transaction, which are easy to obtain in many countries. As well, this method based on matched properties does not require controlling for period-to-period differences in the sample as it refers to the same properties at different times. The results are also essentially reproducible, allowing for continued treatment of outliers and corrections for heteroscedasticity.

However, the repeat sales method is also considered to be inefficient as it uses only some house sales transactions for houses sold more than once. The index then becomes less efficient due to the small number of transactions used, but the efficiency improves as the number of transaction increases. Thus, this method does not require a lot of information about house characteristics but does require a lot of transactions to be efficient.

In addition, the assumption that using match-properties can control for differences in properties is questionable. The assumption of constant value ignores the influence of depreciation and renovation on some sample properties. This issue can be overcome if additional information about house status or renovations is available; however, such data are often not available. This problem leads to another issue in this method: the impossibility of separating the price indices for land and structures. As well, this model is subject to sampling bias. This could happen when one category of houses has more frequent transactions then others and consequently dominates the index reading. For example, if a high number of transactions involves low-quality houses, while the prices of high-quality houses increase more slowly, this results in upward price bias. It might also lead to the risk of data cleaning, or excluding atypical data, such as outliers. For example, the repeat sales method might exclude repeated sales of the same house within one year as they might include some distressed sales (Clapp and Giaccotto, 1998; Steele and Goy, 1997). This method is sensitive to data availability, so stratification by area, price or type to improve efficiency is not possible due to the lack of transactions in these smaller categories.

The repeat sales method is not different from the hedonic method, and it is vulnerable to the consequences associated with heteroscedasticity in the model. Goodman and Thibodeau (1998) examined whether heteroscedasticity is related to the age of houses or the length of time between two sales transactions, or both. Using about 2000 transactions from 1991 to 1993 in Dallas, Texas, they segregated houses based on zones and ages. Similar to their earlier findings, Goodman and Thibodeau (1995, 1997) found that heteroscedasticity in repeat sales is a function of the age of a house and the length of time between the two sales transactions. Applied to a different market with a longer horizon and a sample size of about 11000 pairs of repeat sales, Chau et al. (2005) studied the Hong Kong market from 1991to 2001 and found that the impact of age on the price of a house is non-linear.

Cannaday et al. (2005) acknowledged the risk of heteroscedasticity in a repeat sales model; they proposed a way to control for the impact of age on a housing price index using a multivariate repeat sales model. They used four independent samples from different cities in the United States (US): Champaign-Urbana with 5235 repeat sales from 1979–1993, Cleveland with 72527 repeat sales from 1971–1993, Miami with 187739 repeat sales from 1971–1993 and San Francisco with 13768 repeat sales from 1971–1993. Interestingly, because people in the US tend to move to different states more frequently than people in other countries, this could be the reason for the large number of repeated sales transactions. When comparing a standard repeat sales model to a multivariate repeat sales model, Cannaday et al. (2005) found the later to be statistically significant from the former, indicating the improvement in accuracy when controlling for the impact of the age of the houses. The standard repeat sales model seems to underestimate the price appreciation of old houses while overestimating the price appreciation of newly built houses.

Dombrow et al. (1997) and McMillen and Thorsnes (2006) raised the issue of the impact of renovation and improvement in houses between the two sales transactions in the repeat sales model. Dombrow et al. (1997) focused on detached single family houses in the state of Louisiana in the US. They limited their sample to repeated transactions accrued in 1985–1993 of around 400 pairs of transactions. They noted that, in the repeat sales model, aggregation is subject to bias in two ways: first, it is subject to misspecification by omitting one of the characteristics attributed to the value of the houses and, second, it is subject to parameter instability when the value of the characteristics changes during the study period. They also noted another concern for bias in repeat sales, which is the impact of the size of a house in relation to its price and how the sizes of different houses have a different impact on prices. Thus, using a combination of different sizes to form an index based on the repeat sales model is subject to bias. Therefore, they suggested being cautious about including time, space and property attributes when using a repeat sales model. McMillen and Thorsnes (2006) studied the single family housing market in Chicago from 1993–2002 using about 12000 pairs of transactions. Interestingly, they had access to housing data in which they could segregate houses that had a building permit, meaning they could distinguish houses that were renovated or improved from houses that were not. By omitting 10.7% of the data associated with houses that had a building permit, the appreciation of the price index dropped over the 10-year period from 77.8% when using all the data to 68.9% when using only houses that had not been renovated or improved. Similar to Dombrow et al. (1997), McMillen and Thorsnes (2006) found that changes in houses between the two sales transactions can affect the index performance. McMillen and Thorsnes (2006) concluded that unobserved renovation or improvement is more significant in a repeat sales model than a hedonic model, due to the type and sample size.

2.1.3 Central tendency methods

This method is considered to be the simplest and measures changes in price based on the central of tendency by taking the mean or median of observations in each period (Prasad, and Richards, 2008). Housing prices are found to have positive skewed distributions, so some researchers prefer to use the median rather than the mean (Prasad, and Richards, 2008). The simplicity of this method has an important drawback: the noisy estimates for price changes. This problem can be observed when a class of properties or a region is the major observation in the properties mix in period N, while in other periods around period N, other classes of properties or other regions dominate the transactions and consequently heavily influence price changes. In other words, the median or mean index is inaccurate for price changes due to significant changes in the composition of the houses sold in subsequent periods. This leads to sample selection problems and bias in the constructed index. To overcome this major issue, the central tendency methods use a stratification technique when constructing a price changing index. The sample is divided into many subsamples based on specific criteria, such as geographic location, average price and land area (Prasad, and Richards, 2008). This, to some extent, controls for changes in the composition or quality mix of the properties sold.

Due to stratification, this method takes two steps to be constructed. First, the researcher separates the total sample into sub-sample or strata based on the selected criteria. Different researchers use different criteria for separating the total sample according to what they assume are the most important factors to accurately represent price changes and reduce bias. Second, the aggregate of the stratums is used to construct the price change index. This step can be as simple as summing the unweighted stratums or by giving a different weight to each stratum based on existing methodologies, such as the Laspeyres and Paasche price indices. Further explanations of the stratification criteria and the weighting methodologies are in methodology section.

The central tendency methods have their own advantages and disadvantages. In addition to being very simple to implement and explain, this method can be adjusted based on the selected criteria, is reproducible and can produce different indices based on location. However, a few drawbacks need to be considered. First, this method cannot take into account the depreciation of the houses, which is a very important factor in house prices. Second, it also ignores the influence of renovated houses in the sample. These two issues, depreciation and renovation, significantly reduce the accuracy of the index unless houses are stratified by age and renovation status, which is challenging to do. This raises the third disadvantage of this method; the need for further information about the houses sold. At first, this method seems simple, but reducing and stratifying the changes in properties requires knowing the characteristics of houses sold to divide them into sub-samples based on these characteristics. Last, the limitations of stratification are important to consider as the sample cannot support many stratifications due to the limited number of transactions in each period or the sometimes empty observations in sub-samples.

2.2 Comparison of the methods

Most researchers agreed that no one method best suits all datasets, but different situations require different methods, and each method has strengths and weaknesses. Abraham and Schauman (1991) study the US residential sector and suggest that the repeat sales methods can overestimate changes in house prices as it ignores the effect of house improvements. Observing expenditures on houses in the selected sample, Abraham and Schauman (1991) find the growth rate is biased by 0.5–1.0% every year. Many studies report huge amounts of wasted data from the repeat sales methods. Case and Shiller (1989) find that the repeated sales method used only 4% of the data over the selected period, Case and Quigley (1991) 11%, and Hwang and Quigley (2004) 38%. Clapp, Giaccotto and Tirtiroglu (1991) therefore, also conclude that the repeat sales method performs poorly in the short and the long term.

Rappaport (2007) compares the aggregate price movement from 1990 to 2006 to the three methods discussed earlier using existing US indices: the National Association of Realtors' (NAR) method based on the median method; the Office of Federal Housing Enterprise Oversight's (OFHEO) House Price Index (HPI) based on the repeat sales method; and the

Census Constant Quality Index (CCQI) based on the hedonic method. One issue to consider in this comparison is that the CCQI index is based on only new houses. From this comparison, he observes different behaviour in each index. First, the NAR shows the fastest long-term growth index, which he suggests might be as it captures the increased quality of the housing stock. Second, the CCQI shows slower growth than expected theoretically as this method does not control for differences in location, making this index subject to downward bias. Third, the HPI displays the fastest growth from 1999 on, which the author suggests might result from upward bias from a failure to control renovations which were then undergoing a boom. Fourth, the NAR records the highest short-term volatility, possibly due to seasonality. The CCQI shows moderate volatility, and the HPI very smooth growth. These results do not mean that the NAR and CCQI are less accurate as they might reflect the true behaviour of price changes or capture the short-term compositional shift Rappaport (2007).

Prasad and Richards (2006) introduce a new stratification method to improve the central tendency methods for constructing housing price indices then compare the new stratification method to regression-based methods, such as the hedonic and repeat sales methods. Their study focuses on Australian cities and compares quarterly data from the second quarter of 1993 to the third quarter of 2005. Hansen's (2006) hedonic and repeat sales indices are used to construct three indices using the median method. First is the non-seasonally adjusted (NSA) median with standard stratification based on geographical location or stratification by city. Second, the seasonally adjusted (SA) median is like the NSA median index but controls for seasonality by using the X12 seasonal adjusting programme introduced by the US Census Bureau. Third, the mix adjusted measure (MAM) introduces new stratification based on sorting suburbs according to their median price over 2000–2004. It is worth noting that even using a different period for sorting returns the same sorting results as the suburbs show consistent movement over the entire period, but different countries or cities do not necessarily do so. The purpose of introducing this kind of stratification is to control for composition changes in each stratum (Prasad and Richards, 2006).

Interestingly, when comparing these three median methods, Prasad and Richards (2006) find that the new stratification system, MAM, significantly reduces volatility from the first two methods. NSA also significantly reduces volatility from SA. When comparing the three median methods with the two regression-based methods, MAM produces worthwhile findings. MAM shows very high correlation in price measures to regression methods: a 0.97 correlation to the hedonic method and a 0.90 correlation to the repeat sales method. In addition, they create a trend based on the mixed averages of the indices and find that MAM shows similar deviation levels from trend to regression methods, while the other two median methods have higher deviations. This paper highlights the importance of careful stratification when using central tendency methods and confirms their ability to produce comparable indices if well-constructed.

Wu et al. (2014) also run a comparison of the three most used methods to construct housing indices in the China market. They select only newly built houses in one large city, whose name they may not divulge, and construct four monthly indices for 2004–2009: unweighted mean, weighted mean, repeat sales and hedonic indices. They find that the hedonic method outperforms the other methods as it controls for the quality level and the effect of developers' price behaviour. They assume that the mean method is downward biased as it does not control for quality differences, and the repeat sales also shows downward bias due to developers' price behaviour. They also find that the gap between the hedonic method and the mean method is high during in periods of rapid growth in housing prices but is small periods of slower growth or stability. They consider this to be evidence of the bias caused by non-constant quality in the mean method. Interestingly, the performance of the weighted and unweighted mean indices was highly correlated with small variances over the entire period. Last, they find that the repeat sales method is by far less accurate than other methods and shows the expected very smooth movement.

Mark and Glodberg (1984) study many alternative methods for housing price indices and construct 11 indices for two Canadian cities, Fraser and Kerrisdale, from 1957 to 1979. Eight of the 11 indices used the hedonic method with some differences; one used the unweighted mean, one the median method, and one the repeated sales method. A few findings are worth mentioning. First, even within each method, the researcher can make modifications to improve the accuracy of the index. This is shown in the results of hedonic method indices as only 3 of 8 reflect major changes in the market. Second, the central tendency methods can produce similar findings as complicated methods, such as the hedonic method. Based on the findings, the authors conclude that indices constructed from the central tendency methods move close to indices based on the hedonic method and similarly reflect both upward and downward movements. Third, the median index outperforms the mean index in expensive areas, while no differences in these indices are found in a moderate income neighbourhood. This is inconsistent with the literature as the main reason for using the median instead of the mean is to avoid the influence of extreme-value transactions. Last, the repeat sales method fails to provide accurate reading as the major cuts in data leave only data on houses sold more than once.

Crone and Voith (1992) focus their study on sales of single-family houses in Pennsylvania from 1973 to 1988. They have two main objectives in their study: first, to compare the accuracy of indices using different methods, including the mean, median, restricted hedonic, unrestricted hedonic and repeat sales methods, and second, to explore the effect of data availability on those indices' performance by reducing the sample data used. The data sample is selected based on only houses sold more than once to ensure that the repeat sales method has a similar number of observations as other methods, ending up with approximately 15,000 observations.

To run the tests, Crone and Voith (1992) divide the sample into two sub-samples, the first to estimate the indices and the second to test the accuracy of the price appreciation estimates. In the preliminary findings, the five indices all have similar high and low appreciation, so no single index always shows the highest appreciation or the lowest appreciation. To achieve the first study aim, the researchers use the second half of the data to run an out-of-sample test to predict the error of the appreciation rate of each index and then compare the rates to measure the accuracy of the estimates. To do so, the researchers use two error measurements: mean squared prediction error (MSPE) and mean absolute prediction error (MAPE). The MSPE results show that all the indices have statistically significant differences from the median index, indicating that they give more accurate predictions. Also, all the parametric methods indices outperform the mean method index at the 0.05 significance level. Last, the parametric methods indices have no significant differences in their accuracy estimates. Some findings from MAPE are different. Although the median still shows the least accuracy compared to the rest, it is not statistically different than the unconstrained hedonic index. Also, the two hedonic indices are statistically not different that the mean index. Finally, the repeat sales index is the most accurate index and has statistically significant differences from all the other indices, including the two indices using hedonic methods. Overall, the parametric indices consistently produce more accurate estimates than non-parametric indices.

The second study aim is to test the influence of data size on the performance of the five indices. To do so, they randomly generate from the full sample 20 sub-samples each approximately half the size of the full sample, and another 20 sub-samples each approximately a quarter of the full sample size. The full sample here represents the first half of the sample used to generate indices estimations, while the second half is used to test the accuracy of the indices. These 40 sub-samples are run and compared to the general predictions from each method. They find that both non-parametric indices are much sensitive to sample size than parametric indices in both MSPE and MAPE tests. They also find that the repeat sales method outperforms the hedonic method in the MAPE test but not the MSPE test. Finally, it is clearly shown that in all indices, the quarter of data are less accurate than half of the data, and half of the data are less accurate than the full data. They conclude that parametric methods yield the most accurate estimations, and the repeat sales methods is the most accurate among them (Crone and Voith, 1992).

Crone and Voith (1992) study raises two issues to consider. First, the researchers do not use stratification to improve the non-parametric methods, which might have produced much better estimates. Second, the use of selected data limited to only houses sold more than once took advantage of other methods that do not loss large amounts of data, as required by repeat sales.

This paper does not provide any further details about the differences between the models used to construct indices, as the study did not aim to conduct a comparison. Instead, this paper focused on the capability of the central tendency methods and how it can be improved to provide effective indices. Although this non-parametric method is underestimated and not used as frequently as parametric methods, it is very flexible and it can be improved in different ways. This method is not only simple and flexible enabling it to be improved, it is important to consider it for markets with limited data were the only choice to construct indices is by using this method. Further details about this are provided in the methodology section.

3.0 Research questions

This section lays out the main research questions and the objectives to be achieved based on their answers. The paper aim is to construct a number of indices for targeted markets which do not have any indices as of this research. The paper objective is also to show how using different methods and techniques can improve the performance of the indices developed. The six research questions are as follows:

Do indices based on median as the centre of tendency generate more accurate predictions than mean-based indices?

The debate on the performance of the mean and median methods as centre of tendency is an ongoing issue in this field. The median is found to be less influenced by outliers, but this method could backfire when the number of observations for each city in a specific period is small. This paper uses different scenarios to test the performance of the mean and median methods, including some with low and higher observations. These include not only different levels of volume to test differences in performance but also many other methods to compare the mean and the median as centre of tendency. The details of all these methods are explained in methodology section. By finding the best centre of tendency, this will help take the next step of constructing indices in the right direction. If not solved appropriately, this issue will produce highly volatile indices and affect the tests performed for the following methods, including weighting, sub-sampling and stratification.

Do indices based on only land transactions generate greater volatility predictions than indices based on only housing transactions or indices based on a mix of both?

The main challenge facing researchers in the real estate field is the heterogeneity nature of properties, which is significantly influenced by the characteristics of the buildings (quality, built-up area, number of bedrooms). However, as explained from the literature, lands prices can have greater volatility than houses. In this paper with an adequate number of transactions based on empty residential land, it is very interestingly to test how indices based on land transactions only perform and whether they provide less accurate forecasting. To our knowledge, this is the first paper in MENA region to create housing indices based on only empty residential lands and to compare them to other indices based on houses within the same country and the same cities. Answering this question will clarify how heterogeneity affects housing price indices and whether indices based on only land transaction, on only house transactions or on both perform the best.

Which weighting methods are suitable and perform the best?

The literature on indices weighting uses many methods to give different weights to groups or stratum in samples. In this research, we first test whether the weighting method on emerging market can be improved compared to unweighted method (sometimes called equal weight methods). Then, we compare different weighting methods to see which best suits the market under study. The challenge of low frequencies of transaction in some cities or during some periods could minimise the effectiveness of some weighing methods, while others might yield better findings. Also, each housing market has a different composition of houses with different prices, quality and sales frequency, so certain weighing methods might suit one market better than others. The details of this question are discussed in methodology section.

Can the use of sub-samples of data provide more accurate indices?

The answer to this question is among the most important findings in this research. Testing this argument is interesting as it has always been questioned whether having more information provides better findings. As a class of assets, real estate is influenced by its heterogeneity, which causes difficulties constructing highly stable indices not affected by outliers and continued volatility. Proving the validity of competitive or accurate indices based on sub-samples would be worthwhile. Three different approaches to using sub-sample are tested and are explained in methodology section.

Does lower data frequency provide more accurate indices?

In cases such as Kuwait with few monthly transactions, it is interesting to test the performance of data with lower frequency, such as quarterly data, to more observations in each period. This might help reduce the volatility in the centre of tendency among periods or provide better performance indices in comparison to monthly indices.

Can indices with stratification based on long-term mean prices perform competitively with indices based on stratification by city?

Stratification greatly contributes to the improvement of central tendency indices. In addition to stratification by city, we consider another stratification method: by the long-term mean price of cities. If this stratification method outperforms or has similar performance as stratification by city, it will open the doors for further stratification methods that might overcome, for example, the limitation of small volume in stratification by city.

4.0 Data

Kuwait has no housing index, so data were collected from the Ministry of Justice's Department of Property Registrations. The data in Arabic cover approximately 60,000 transactions from February 2004 through March 2017. These transactions are in data, including PDF and Microsoft Excel files, and contain the property type, exact date, price, plot size and city name of transactions. Some transactions have more details about the house address, but the availability of such data is irregular, so we use only these 5 main factors.

Before constructing any index, the data need to be organised efficiently. First, we convert the language used from Arabic to English and upload the data to an Excel file. Second, we organised the transactions not on their specific date but on the month or quarter of the transaction. Third, as commonly done in Kuwait, the measurement uses the price per land square meter as each transaction price is divided by the plot area. For instance, if a house with 400 square meter plot is sold for K.D. 200,000, then it is measured as 500 price per square meter (psm). All residential plots in Kuwait have the same built-up area, 210% of the land size, so it is acceptable to record the measurement in price per square meter. Fourth, each city is separated and has its own two sets of time series data, one for only house transactions and one for only land transactions. In some countries, it is uncommon to sell houses and land plots at the same time, but in Kuwait, as well as many emerging countries, the practice is common. These time series data show all the transactions that happened at each specific point in time (monthly or quarterly) and the number of transactions that happened at each point in time from February 2004 through March 2017. Last, we include all the cities in the same district in one Excel sheet, producing six Excel sheets for specific districts with cities. Although the cities are organised by district, they still have independent time-series data. Organising all the transactions in this way makes it easier to take the following steps to construct indices.

One additional step starting the process of constructing the indices is data cleaning. First, transactions for other kinds of residential units, such as apartments, and other classes of properties, such as investment properties, are excluded. The paper aim is to study the housing sector, so it is best to use only single-family homes, which constitute the vast majority of residential units in Kuwait, and not include apartments. Table 1 summarises the housing data used.

Table 1: List of cities in Kuwait with their stocks and transactions volumes

	City	Stock	Transaction Volume Lands/Houses			City	Stock	Transaction Volume Lands/Houses	
	Alasima district				40	Alferdous	3,693	0	606
1	Alshuwaikh	368	16	29	41	Alandalos	2,593	102	667
2	Abdullah Alsalem	1,157	43	209	42	Abdullah Almobarak	5,092	0	414
3	Alshamiya	854	14	141	43	Alardiya	3,459	55	439
4	Alfaiha	1,042	41	230	44	Alfarwaniya	1,727	98	143
5	Alnuzha	775	20	145		Aljahra district			
6	Alrawda	1,633	81	312	45	Aljahra	1,183	58	181
7	Alodailiya	882	42	199	46	Alayoon	2,007	0	327
8	Alkhaldiya	809	43	188	47	Alnaeem	968	0	95
9	Kaifan	1,614	53	355	48	Alnaseem	1,148	0	140
10	Alsurra	2,333	90	392	49	Alqairawan	1,632	0	143
11	Qurtoba	2,283	116	285	50	Alqaser	1,743	4	241
12	Alyarmouk	1,299	63	218	51	Alwaha	1,836	0	354
13	Aldaeya	818	26	139	52	Jaber Alahmad	3,146	0	141
14	Aldasma	1,027	22	171	53	Saad Albdullah	7,613	0	985
15	Alqadeseya	1,103	40	258		Mobarak Alkaber district			
16	Almansoreya	406	7	64	54	Sabah Alsalem	6,259	15	564
17	Qurnata	543	72	62	55	Mobarak Alkaber	3,755	2	227
18	Alsolaibikhat	1,308	23	176	56	Alqurain	2,812	0	298
19	Aldoha	1,439	5	180	57	Alqosoor	3,185	2	281
	Hawali district				58	Aladan	3,815	1	245
20	Alsalam	2,234	750	300	59	Alfontas	842	116	133
21	Alshohada	1,472	386	275	60	Alfonaitees	567	2,821	37
22	Alzahra	2,287	936	444	61	Almasela	N/A	749	15
23	Hotten	1,829	268	213	62	Almasayel	374	426	30
24	Alsudeeq	N/A	599	47	63	Abofatera	828	4,278	85
25	Aljabriya	3,512	246	745		Alahmadi district			
26	Alshaeb	713	31	98	64	Alaqila	1,456	943	559
27	Alsalmiya	4,243	49	100	65	Aldhahar	2,660	0	364
28	Bayan	3,526	72	421	66	Alfahaiheel	1,821	71	157
29	Mishrif	2,275	94	313	67	Ali Alsalem	3,968	0	516
30	Mobarak Alabdullah	993	119	63	68	Almahbola	1,406	115	16
31	Salwa	3,938	276	1,001	69	Almanqaf	2,894	544	447
32	Alromaithiya	2,782	173	561	70	Alriqqa	2,426	0	358
	Alfarwaniya district				71	Alsabahiya	3,299	10	476
33	Sabah Alnaser	2,082	68	345	72	Hadiya	1,243	201	211
34	Khaitan	2,451	17	435	73	Jaber Alali	3,148	0	245
35	Ashbeliya	1,581	1187	475	74	Alwafra	375	0	323
36	Alrehab	1,356	0	127	75	Alkhiran	N/A	1,288	3
37	Alrabya	1,105	8	212	76	Sabah Alahmad Sea City	N/A	13,211	285
38	Alomariya	1,182	0	218	Total	76 cities	149,097	31,287	22,047
39	Aljaleeb	2,870	81	1,150					

Note: * Stocks represent the number of plots in a city, ** Transaction volume is from February 2004 till March 2017
N/A: Not available / Not accurate
Sources: The public Authority for civil information and Ministry of Justice

Second, unfortunately, many transactions are recorded with inaccurate information, mostly the price or plot size. For example, many transaction prices are recorded as 0 or extreme prices multiple times the average house prices in a city. As well, the plot size recorded might be well below the minimum regulated plot size in that city or unrealistically large. All these transactions are considered to be useless, and approximately 6,000 transactions are deleted.

In addition, we attempt to clean the data from transactions that are major outliers. To do so, we review all of the 54,000 transactions and delete approximately 600 transactions. Data cleaning targeting major outliers does not exclude all outliers as the variation in prices in each city make it hard to set boundaries to what prices are acceptable or outliers. This variation is clearly influenced by the heterogeneity of real estate and a main challenge facing researchers when constructing real estate indices.

5.0 Methodology

In this section, we describe the methodologies used. This section falls into four parts. We explain why we choose the central tendency methods, the methodology used to measure the accuracy of the indices, the methodology used to improve the indices performance and finally the grouping of the indices.

5.1 Rationale for the central tendency methods?

In a market with an accurate database, it would not be easy to choose between methods to construct the housing prices index; rather, the researcher might construct many indices using all three methods discussed. However, most of the emerging markets had little data with few details. Kuwait, the market under study, is not different than other emerging market and has limited data, so only the central tendency methods could be applied to construct housing price indices. This does not mean that the indices constructed are useless or inaccurate but require more effort to produce indices that reflect actual house price movement.

The flexibility to adjust this method based on the selected criteria or stratification can significantly improve the indices using this method. The small size of Kuwaiti cities make stratification by city easy, enabling further improvement of the indices constructed. As the houses in the cities studied were built at roughly the same time, stratification by city might also allow control over house age.

In addition, even with the available information, the usefulness of repeat sales is questionable due to the nature of the Kuwait market. First, the number of transactions is very low compared to the total number of houses in Kuwait, making the chances of having an adequate number of houses sold more than once nearly impossible. In other words, if the average of annual sales transaction is approximately 2,500 transactions, and the total number of houses in Kuwait is 150,000 units, this does not allow an adequate number of repeated sales. Second, the Kuwaiti market has a housing shortage, and neither companies nor non-GCC residents may buy houses in Kuwait, so most buyers are owner-occupiers who tent to keep houses for a long time. This also questions the validity of repeated sales transactions.

5.2 Method to measure indices performance

Measuring the performance of housing indices is challenging, especially without a true index for comparison. Alternatively, researchers such as Crone and Voith (1993), Prasad and Richards (2006), Prasad and Richards (2008) and Jiang, et al. (2015) use forecasting methods to compare each index's out-of-sample forecast to its actual series. In other words, they divide the period into two sub-periods, one a training period and the other a testing period. They then use only training period information to forecast the remaining period and then compare the results to the testing period actual series. The lower the error in the forecasting mean the higher the index is capturing underlying housing price movement (Prasad and Richards, 2006). The literature includes seven common tests to measure forecasting accuracy: mean error (ME), mean absolute error (MAE), mean percentage error (MPE), mean absolute percentage error (MAPE), mean squared error (MSE), root mean square error (RMSE) and Theil's U (Wilson and Keating, 2009). They are all used to measure of forecasting errors and can be illustrated as follows:

A_t = Actual value in period *t*

F_t = Forecast value in period *t*

n = Number of period used in the calculation

Mean error (ME) = $\frac{\sum(A_t - F_t)}{n}$ (1)

Mean absolute error (MAE) = $\frac{\sum|A_t - F_t|}{n}$ (2)

Mean percentage error (MPE) = $\frac{\sum[(A_t - F_t)/A_t]}{n}$ (3)

Mean absolute percentage error (MAPE) = $\frac{\sum|(A_t - F_t)/A_t|}{n}$ (4)

Mean squared error (MSE) = $\frac{\sum(A_t - F_t)^2}{n}$ (5)

Root mean square error (RMSE) = $\sqrt{\frac{\sum(A_t - F_t)^2}{n}}$ (6)

Theil's U = $\frac{\sqrt{\sum(A_t - F_t)^2}}{\sqrt{\sum(A_t - A_{t-1})^2}}$ (7)

For all but the seventh model, lower values indicate better forecast accuracy, while the seventh has a different way to measure performance. For Theil's U, a value of 0 means the model is performing perfectly with no errors, and when U > 1, the model forecast is better than the simple naïve model. However, when U < 1, then the model forecast is less accurate than the simple naïve model, and when U = 1, then the model is performing as well as the simple naïve model (Wilson and Keating, 2009).

Researchers use different sets of these tests. For example, when testing for different product indices, only MAPE and Theil's U can be used as the rest can only test the same products (Wilson and Keating, 2009). Also, some tests need to be used with caution as they might yield biased outcomes. For instance, in the ME and MPE tests, bias can occur as positive error values off-set negative error values, resulting in a low error rate that indicates a false high forecasting accuracy. RMSE is considered to be the most common test used for forecasting and used by Jiang, et al. (2015). To test housing indices, we consider it to be the main test to measure the accuracy of indices' forecasts. In addition, we use the MAE and MAPE tests to support the RMSE findings and the standard deviation of each index from its mean to observe and compare the volatility of each index.

To run any forecasting, researchers must select the most appropriate model for the training period to provide the most accurate forecast. Examples of these models include the naïve, moving averages, exponential smoothing, regression-based trend, time series decomposition and Autoregressive Integrated Moving Average (ARIMA) models. Selection of those models is based on the data patterns, number of observations and the length of forecasting horizon (Wilson and Keating, 2009). Given our simple need to run forecasting that compares of indices' performance, regression-based trend is the most appropriate and simplest model that can achieve the aim of these tests. Here, we regress each index by its long-term trends in only the training period, then run the forecast for the test period and compare the results to the actual outcomes.

The sample period covers major shifts in trend, such as the business boom in 2006, financial crisis in 2008 and oil price dropdown in 2015, so we follow Prasad and Richards (2006) and find it better to compare the performance of indices during a period with no structural break. Therefore, the sub-sample used to test the indices' performance is February 2009 to February 2015, the training period is February 2009 to February 2014, and the testing period is March 2014 to February 2015.

5.3 Methods to improve indices' performance

The central tendency methods are considered to be the simplest method to construct an index. However, it is vulnerable to the heterogeneity of the properties studied, which will produce a poor index that might not provide any useful readings. Therefore, various techniques, approaches and criteria are used to significantly improve the performance of the central tendency (mean or median) index. In this section, we explain the differences between those techniques, approaches and criteria, and in the next section, we will apply, test and evaluate their performance.

5.3.1 Centre of tendency methods

This method, central tendency methods, is based on the measurement of the central tendency of the distribution of housing prices in each period, so researchers use either the mean or median to best find the point in the central tendency for each period in the time-series data. A serious issue with the use of the mean is its potential to produce noises in outliers (Mark and Goldberg, 1984). A single outlier observation can significantly bias the average of the observations in a specific period. This influence differs dramatically based on the number of observations included in the mean for that period, for instance, the number of houses sold in a month or a quarter. Also, the housing price distribution is positively skewed due to the nature of housing prices; very expensive houses commonly are sold regularly, but inexpensive houses or houses with a zero value are not. Consequently, most researchers use the median instead of the mean (Haan and Diewert, 2011).

The median, though, will not always provide the better reading and still has drawbacks when compared to the mean. Due to the small number of sales transactions compared to the existing housing stock, the median method is expected to yield very noisy estimate (Haan and Diewert, 2011). The chances that a house is in the mix of houses sold at one point in time compared to earlier or subsequent period are expected to lead to high volatility. Also, if a certain type of houses is traded more frequently for some time, it might result in long-term systematic error or bias. However, the issues related to changes in housing mix are minimised when using stratification technique (Haan and Diewert, 2011), but the efficiency of using the median method for very low levels of transactions needs to be tested and compared to the mean method. Median and mean price indices have shown seasonal fluctuation when tested in the Australian market (Prasad and Richards, 2008), but this fluctuation vanished when the stratification technique is adopted. Interestingly, Prasad and Richards, (2008) find that adjusting for seasonality reduces noise by 40%, while stratification reduces noise by 70%. Note that seasonality issues are not considered in this research.

To compare the performance of the mean and the median as a measure of central tendency, we construct a number of indices using the mean method and the median method. Those indices have different characteristics, including property type, weighting technique, period frequency and stratification technique. Tables 2–5 present the details of each index.

5.3.2 Types of property

An interesting comparison is between the performance of indices based on land-only transactions (empty residential plots), house-only transactions and a mix of both types of transactions. The main challenge facing researchers of real estate is the heterogeneous nature of properties, which is significantly influenced by the characteristics of the buildings (e.g., build quality, location, or number of bedrooms). These differences can significantly influence indices that use the non-parametric central tendency method. The question we consider is whether using the non-parametric central tendency method for land-only transactions will yield less volatile indices?

Davis and Heathcote (2007) and Davis and Palumbo (2008) researched the issues related to indices for land-only transactions. They decomposed the aggregate value of housing stock by assuming that a property is a bundle of two components, structure and land. They then extracted the weighted average growth rate for each component. By explicitly controlling for the structural value as its replacement cost, and after accounting for depreciation, they considered the remaining value of the property to be its land value. They argued that, although structure and lands of properties are traded as single transactions and not separately, the two components can have different price movements as a result of different influences. From the demand side, residential house structures are valued as capital input in home production and leisure activities, while land is valued based on location, facilities and amenities. From the supply side, structures are a measurable cost that can easily be reproduced while lands are not so easily measured. This means that changes in demand for housing will impact the price of structure or lands differently, and that the price of land will carry more influence due to its inelasticity.

Davis and Heathcote (2007) used sample quarterly data from the US housing market from 1975 to 2006. They found that land values increased faster than structural values and had higher volatility. Land prices were 2.8 times as volatile as real GDP, 2.2 times as volatile as real home prices, and 3.3 times as volatile as real structure prices. They also found that the land share value of residential properties changed over time and across locations and that the higher the land share value, the higher its volatility. They concluded that most of the volatility in residential property prices comes from volatility in the land prices and not from volatility in the structural prices.

Davis and Palumbo (2008) analysed data from 46 large US cities between 1984 and 2004, and had similar findings. They highlighted the significant growth in land prices compared to structural prices in most of the cities included in their study. The annual real growth rate of land reached 4.2 and 4.7 percent on the East and West coasts respectively, while construction costs fell on average by 0.3 percent and 0.8 percent, respectively. They also noted the increase in land share values from 1984 to 2004: On the East coast, land accounted for 38 percent of property value in 1984 and this had risen to 64 percent by 2004. Similarly, on the West coast, land accounted for 55 percent of property value in 1984 and this rose to 74 percent by 2004. They reached a similar conclusion to Davis and Heathcote (2007) that land accounts for most of the volatility present in house price indices.

Sirmans and Slade (2012) expanded the topic by including commercial and industrial properties, as well as residential properties, into their study. Using a sample of 130,000 transactions in the US from 1991 to 2009, they selected cities that had previously been used to construct other housing indices such as the S&P/Case-Shiller Housing Price Index; the Davis/Heathcote/Lincoln Institute Residual Land Price Index; and the NCREIF retail, office, and industrial appraisal and transaction-based indices. They found that the S&P/Case-Shiller Housing Price Index and the Davis/Heathcote/Lincoln Institute Residual Land Price Index had less volatility than indices based on land-only values. They also found that indices based on residential lands outperformed other land-based indices in term of growth rate and speed. Indices based on residential lands showed higher correlation to the S&P/Case-Shiller Housing Price Index and strong joint causality existed between them.

Another study that covers commercial and residential land prices is by Nichols et al. (2013). These researchers used a sample of 180,000 transactions from the early 1990s to 2011 from 23 US metropolitan statistical areas (MSAs). Residential land prices were found to have higher volatility than structural prices in all 23 MSAs. Residential land prices also showed a three times greater growth rate compared to structural prices between 2002 and the peak just before the 2008 crisis. They ascribe this to the relative elasticity of structural supplies compared to the inelasticity of land supplies, and believe that this might be the reason for the greater volatility in land prices in coastal cities. Furthermore, they found that residential land prices are greater than commercial land prices, and that the growth rate of residential land prices from 2002 until the 2008 peak was 167 percent. This exceeded commercial land price growth rates by 30 percentage points. Finally, during the 2008 crisis, residential land prices dropped 10 percentage points more than commercial land prices.

To run a comparison, a number of indices have been constructed based on only houses, only land and a mix of both. We will construct an independent series of average price and volume for land and houses in each city when the data are available. Then, these series, as explained, are gathered to construct indices for only land transactions and only house transactions. Last, we simply construct the mixed index based on the average of the two indices based on lands transaction and on house transactions.

5.3.3 Weighting methods

To improve the accuracy of the central tendency methods, most researchers adopt the technique of weighting each stratum, group or city by not only on the price of each period but also the volume of transactions in each period. The logic behind giving different weight to each stratum, group or city is to indicate their relative importance. For example, giving the same weight to a city with few transactions and rapid growth and to another city with high transactions and moderate growth would produce a misleading index (Brooks and Tsolacos, 2010). Therefore, in this research, we use three methods of weighting plus the method of equal weight, in which all the stratums, groups or cities have the same weight in the aggregate index. The methods are explained below.

5.3.3.1 Equally weighted method (unweighted method)

This method gives no weight to any stratum, group or city, so the results are based only on the mean or median price of each period for these stratums. This method is simple and easy but grants the same importance to all cities (Brooks and Tsolacos, 2010). For example, this method assigns equal weight to Wales and south-eastern England, even though the latter has many more transactions. This produces a misleading index for changes in housing values throughout the UK. Although using this method is not preferable, we consider it and compare its performance to the other three methods that use weighting.

5.3.3.2 Base-weighted method (Laspeyres method)

Introduced by Laspeyres (1871), this method measures changes in prices or inflation for groups of items by giving them different weights based on the transaction volume in the base period, which is normally the first period in the sample, such as first month or year, as explained in formula (8). This method is considered to be simpler than other weighting methods as it only requires the transaction volume for the base period (Pink, 2009). The Laspeyres method has a fixed based, so it ignores changes in the market over time. This mean that if city A has the highest transaction volume in the base period but other cities become more important and have higher transaction volume in later periods afterward, the Laspeyres index does not account for these changes (Brooks and Tsolacos, 2010). Rappaport (2007) concludes that the Laspeyres index thus overstates price growth. Here is how Laspeyres index is constructed:

$$\text{Laspeyres}_t = \frac{\sum(P_{C,t} * Q_{C,0})}{\sum(P_{C,0} * Q_{C,0})} \qquad (8)$$

Where P and Q represent the average price and the quantity, respectively, 0 and t the time (base period =0) and (current period = t), and C donate the city, with 76 cities. Although this method neglects changes in market demand for the goods studied, it requires little information, only the volume for the base period and the price over the whole period.

5.3.3.3 Current-weighted methods (Paasche method)

Unlike Laspeyres, Paasche's (1874) method assigns weight to each period and changes in them based on the transaction volume in each city. This requires much more information than the Laspeyres method, including the efficiency volume for each city in each period. The Paasche method reflects not only price changes but also the weighting changes over time. Here is how the Paasche index is constructed:

$$\text{Paasche}_t = \frac{\sum(P_{C,t} * Q_{C,t})}{\sum(P_{C,0} * Q_{C,t})} \qquad (9)$$

Where P and Q represent the average price and the quantity, respectively, 0 and t the time (base period =0) and (current period = t), and C the city, with 76 cities. The changes in the quantity and volume of transactions over time are considered in the weight given to each city. Thus, cities with high transactions have higher weights equivalent to their transaction volume over the overall volume for each period.

5.3.3.4 Mixed-weighted method (Fisher method)

The Fisher (1922) method is simply the geometric mean of the Laspeyres and Paasche methods. Diewert (1997), Haan and Diewert (2011) and Hill (1988, 1993) prefer this method and produce fairly smooth indices compared to the Laspeyres and Paasche methods as it uses most of the available information on price and volume. Here is how the Fisher index is constructed:

$$\text{Fisher}_t = [\text{Laspeyres}_t * \text{Paasche}_t]^{1/2} \qquad (10)$$

As the average of two methods, the Fisher method has the advantage of capturing changes in the composition of goods. Also, it moderates the growth rate when compared to the Laspeyres method (Aizcorbe, 2014).

5.3.4 Data frequency

The frequency of data is critical in constructing a reliable index, especially for assets such as real estate with heteroscedasticity. Also, only few frequencies (monthly, quarterly, semi-annual and annual) can be used with real estate, which has a low number of transactions compared to the total housing stock. The process and cost of sales transactions all make it impossible to have a higher frequency than monthly data. Semi-annual and annual data would be very challenging to apply due of the data limitations. Therefore, the comparison is limited to monthly and quarterly data. The reasons for comparing monthly and quarterly data frequencies are explained by Brooks and Tsolacos (2010); Ivancic al et (2011); Aizcorbe (2014) and other researchers. Monthly data provide better measurements of inflation but are highly affected by seasonality. Quarterly data are also affected by seasonality but less so than monthly data. The challenge to solve the problem of seasonality is not discussed in this paper. Monthly data are found to produce higher noise due to the high frequency and the influence of heteroscedasticity (housing quality, seasonality and frequency of a property type in specific periods). Quarterly data provide smoother outcomes but reduce the observations to a third, which also can decrease the accuracy of the indices. These findings cannot favour one frequency over the other; therefore comparison tests should be run to determine which frequency, monthly or quarterly, provides more accurate estimation. In addition, we believe data quality can play significant role in the comparison of different frequencies. Low volume monthly data leads to the use of quarterly data, which in the worse expected to provide better readings.

To compare these two frequencies, we construct a number of pair indices based on the criteria listed in this section (tables 2–5). Each pair of indices has the exact same criteria, but one uses monthly data, and the other quarterly data. Monthly data indices are converted to quarterly indices by taking the third observation of each quarter in the monthly observations time-series data. Table 3 presents details of each index.

5.3.5 Sub-sample data

Using sub-samples, such as excluding cities to improve the indices, it might not seem sensible as more data should make the index results more accuracy. However, the unique characteristics of real estate as an asset class might make it more realistic to construct indices with selected sub-samples rather than the full sample. The following sections describe the three sub-samples selected to test whether they can improve the indices' accuracy or at least achieve acceptable accuracy compared to indices using the full sample of data.

5.3.5.1 Exclusion of Sabah Al Ahmad sea city

Sabah Al Ahmad sea city is a unique city in Kuwait and needs careful consideration. This city has witnessed approximately 13,000 transactions of empty residential lands (small plots) but only about 300 transactions of existing built houses. This number of transaction is high for one city, and of 76 cities in the country, Sabah Al Ahmad sea city accounts for a quarter of all transactions in Kuwait from early 2004 through early 2017. Although the area is zoned residential, a few issues might lead to its exclusion from the Kuwait housing indices constructed. First, as of this research, it is the only Kuwaiti city to be located away from other urban areas in the waterfront chalets areas in southern Kuwait (The black circle in Kuwait map page 34). Second, it takes an hour of driving to reach Kuwait City, which is not convenient for daily trips in Kuwait. Finally, it cannot be considered to be a target city for first-time home buyers due to its remote location and lack of amenities and public services.

We, therefore, consider Sabah Al Ahmad sea city to be more of a market for second, weekend or vacations homes rather than permanent residences. The transactions in this city thus were not driven by housing buyers but by those seeking a vacation home, investors purchasing homes for weekend rentals and property traders who quickly flipping properties and land. Excluding this city, therefore, should not negatively affect the performance of the indices constructed but instead might improve them and reduce the noise and volatility driven by different categories of property buyers.

5.3.5.2 Sabah Al Ahmad sea city only

By itself, Sabah Al Ahmad sea city accounts for a quarter of sales transactions in Kuwait, so it is interesting to measure the performance of sales in this city alone over the time and whether indices based on only its transactions can accurately represent its housing market performance. Also, almost all the transactions are based on land sales, so this index might show interesting performance. The heterogeneous of real estate is reduced significantly as most of its characteristics do not exist in empty land.

5.3.5.3 High-frequency cities only

Based on Prasad and Richards (2008), we assume that expensive cities with high growth and low frequency might influence the indices or at least create noise; therefore, constructing indices based on selected cities might yield interesting outcomes. To tests this assumption, another group of indices based on selected cities with high-frequency transactions have been constructed. These indices have only two inclusion criteria for cities: first, they must be among the top 75% cities by total transactions, and second, they must have a number of transactions not less than the number of periods, which is 158 months. Based on these criteria, we have 16,000 transactions based on land in 17 of 76 cites and 15,000 transactions based on houses in 51 cities. Thus, we exclude 22,000 transactions (13,000 from Sabah Al Ahmad) of the total 53,000 transactions over the entire study period. All the steps in the process are the same as for the indices already constructed.

5.3.6 Stratification

Stratification is an important technique to organise data based on the similarities expected to best help form the indices (geographic location, house size, property type). So far in this research, we stratify by cities, so each city stands has its own average price and number of transactions. We select this method after reviewing the details of transactions and find that stratifying by city best captures similarities, such as average price and house type and size.

This paper also considers new stratification suggested by Prasad and Richards (2006) that builds stratums based on cities' long-term mean prices. Next, the data has been grouped by long-term mean price and merge their transactions, with each group in one column. Thus, instead of taking each city's average price and transaction volume, the new stratification method has a number of cities with similar long-term mean prices in one column and then finds their mean and transaction volume. With this method, we end up with five stratums, each with a number of cities with similar long-term mean prices.

5.4 Constructed indices and grouping

To test for improvement in performance, we construct 74 indices, each with at least one characteristic different from the other indices. For simplicity, we do not compare each one to the rest but group those of a kind to simplify the comparison and yield clear findings.

Table 2 breaks down the first 30 indices by various characteristics: cleaned of major outliers, centre of tendency based on the mean or the median method, weighting method used, and index based on land, house or mixed transactions. In this group of indices, two characteristics are fixed: the stratification method and data frequency.

Table 3 compares data frequency, so it has the same indices as the first group but with the lower quarterly frequency. This group does not include the first six indices that are not cleaned of major outlier transactions, resulting in a total of 24 indices.

Table 4 shows the third group constructed by testing the performance of indices based on sub-samples of the data, as explained. The first six indices test the performance based on the exclusion of Sabah Al Ahmad sea city. The next two indices are constructed based only on Sabah Al Ahmad sea city. This index contains only one city but around 13,000 transactions, about quarter of all transactions in Kuwait. The last six indices are constructed based only on cities with high frequency of transactions. All the indices in this group are based on data cleaned of major outliers, monthly frequency and the Fisher weighting method. The only differences between those indices are the centre of tendency (mean or median) and the property type (land only, houses only or a mix of both).

The last group in Table 5 is based on a new stratification method. All the indices constructed so far (indices 1–68) are based on city stratification, in which each city is taken by itself and its centre of tendency and transactions volume for each observation period (monthly or quarterly) are extracted. The new stratification approach suggested by Prasad and Richards (2006) is based on the long-term mean price. To have an adequate number of comparisons to the new stratification method, we construct six indices, three with the mean as the centre of tendency and three with the median. Two of the six are based on only land transactions, two on only houses and two on a mix of both. All six indices exclude Sabah Al Ahmad sea city, are based on Fisher weighting and have monthly data.

Table2 : Indices main characteristics (Indices 1 -30)

Index	Cleaned from major outliers	Central of tendency method	Weighting method	Stratification	Data frequency	Property type (lands or Houses)	Special condition
Index 1	No	Mean	Unweighted	By city	Monthly	Lands only	
Index 2	No	Mean	Unweighted	By city	Monthly	Houses only	
Index 3	No	Mean	Unweighted	By city	Monthly	Lands and Houses	
Index 4	No	Median	Unweighted	By city	Monthly	Lands only	
Index 5	No	Median	Unweighted	By city	Monthly	Houses only	
Index 6	No	Median	Unweighted	By city	Monthly	Lands and Houses	
Index 7	Yes	Mean	Unweighted	By city	Monthly	Lands only	
Index 8	Yes	Mean	Unweighted	By city	Monthly	Houses only	
Index 9	Yes	Mean	Unweighted	By city	Monthly	Lands and Houses	
Index 10	Yes	Median	Unweighted	By city	Monthly	Lands only	
Index 11	Yes	Median	Unweighted	By city	Monthly	Houses only	
Index 12	Yes	Median	Unweighted	By city	Monthly	Lands and Houses	
Index 13	Yes	Mean	Laspeyres	By city	Monthly	Lands only	
Index 14	Yes	Mean	Laspeyres	By city	Monthly	Houses only	
Index 15	Yes	Mean	Laspeyres	By city	Monthly	Lands and Houses	
Index 16	Yes	Median	Laspeyres	By city	Monthly	Lands only	
Index 17	Yes	Median	Laspeyres	By city	Monthly	Houses only	
Index 18	Yes	Median	Laspeyres	By city	Monthly	Lands and Houses	
Index 19	Yes	Mean	Paasche	By city	Monthly	Lands only	
Index 20	Yes	Mean	Paasche	By city	Monthly	Houses only	
Index 21	Yes	Mean	Paasche	By city	Monthly	Lands and Houses	
Index 22	Yes	Median	Paasche	By city	Monthly	Lands only	
Index 23	Yes	Median	Paasche	By city	Monthly	Houses only	
Index 24	Yes	Median	Paasche	By city	Monthly	Lands and Houses	
Index 25	Yes	Mean	Fisher	By city	Monthly	Lands only	
Index 26	Yes	Mean	Fisher	By city	Monthly	Houses only	
Index 27	Yes	Mean	Fisher	By city	Monthly	Lands and Houses	
Index 28	Yes	Median	Fisher	By city	Monthly	Lands only	
Index 29	Yes	Median	Fisher	By city	Monthly	Houses only	
Index 30	Yes	Median	Fisher	By city	Monthly	Lands and Houses	

Notes: no special condition

Table 3: Indices main characteristics (Indices 31 -54)

Index	Cleaned from major outliers	Central of tendency method	Weighting method	Stratification	Data frequency	Property type (lands or Houses)	Special condition
Index 31	Yes	Mean	Unweighted	By city	Quarterly	Lands only	
Index 32	Yes	Mean	Unweighted	By city	Quarterly	Houses only	
Index 33	Yes	Mean	Unweighted	By city	Quarterly	Lands and Houses	
Index 34	Yes	Median	Unweighted	By city	Quarterly	Lands only	
Index 35	Yes	Median	Unweighted	By city	Quarterly	Houses only	
Index 36	Yes	Median	Unweighted	By city	Quarterly	Lands and Houses	
Index 37	Yes	Mean	Laspeyres	By city	Quarterly	Lands only	
Index 38	Yes	Mean	Laspeyres	By city	Quarterly	Houses only	
Index 39	Yes	Mean	Laspeyres	By city	Quarterly	Lands and Houses	
Index 40	Yes	Median	Laspeyres	By city	Quarterly	Lands only	
Index 41	Yes	Median	Laspeyres	By city	Quarterly	Houses only	
Index 42	Yes	Median	Laspeyres	By city	Quarterly	Lands and Houses	
Index 43	Yes	Mean	Paasche	By city	Quarterly	Lands only	
Index 44	Yes	Mean	Paasche	By city	Quarterly	Houses only	
Index 45	Yes	Mean	Paasche	By city	Quarterly	Lands and Houses	
Index 46	Yes	Median	Paasche	By city	Quarterly	Lands only	
Index 47	Yes	Median	Paasche	By city	Quarterly	Houses only	
Index 48	Yes	Median	Paasche	By city	Quarterly	Lands and Houses	
Index 49	Yes	Mean	Fisher	By city	Quarterly	Lands only	
Index 50	Yes	Mean	Fisher	By city	Quarterly	Houses only	
Index 51	Yes	Mean	Fisher	By city	Quarterly	Lands and Houses	
Index 52	Yes	Median	Fisher	By city	Quarterly	Lands only	
Index 53	Yes	Median	Fisher	By city	Quarterly	Houses only	
Index 54	Yes	Median	Fisher	By city	Quarterly	Lands and Houses	

Notes: no special condition

Table 4: Indices main characteristics (Indices 55 -68)

Index	Cleaned from major outliers	Central of tendency method	Weighting method	Stratification	Data frequency	Property type (lands or Houses)	Special condition
Index 55	Yes	Mean	Fisher	By city	Monthly	Lands only	Excluding Sabah Alahmad Sea City
Index 56	Yes	Mean	Fisher	By city	Monthly	Houses only	
Index 57	Yes	Mean	Fisher	By city	Monthly	Lands and Houses	
Index 58	Yes	Median	Fisher	By city	Monthly	Lands only	
Index 59	Yes	Median	Fisher	By city	Monthly	Houses only	
Index 60	Yes	Median	Fisher	By city	Monthly	Lands and Houses	
Index 61	Yes	Mean	Fisher	By city	Monthly	Lands only	including Sabah Alahmad Sea City ONLY
Index 62	Yes	Median	Fisher	By city	Monthly	Houses only	
Index 63	Yes	Mean	Fisher	By city	Monthly	Lands only	Selected cities (high frequency)
Index 64	Yes	Mean	Fisher	By city	Monthly	Houses only	
Index 65	Yes	Mean	Fisher	By city	Monthly	Lands and Houses	
Index 66	Yes	Median	Fisher	By city	Monthly	Lands only	
Index 67	Yes	Median	Fisher	By city	Monthly	Houses only	
Index 68	Yes	Median	Fisher	By city	Monthly	Lands and Houses	

Notes:

Table 5: Indices main characteristics (Indices 69 -74)

Index	Cleaned from major outliers	Central of tendency method	Weighting method	Stratification	Data frequency	Property type (lands or Houses)	Special condition
Index 69	Yes	Mean	Fisher	Long-term mean price	Monthly	Lands only	Excluding Sabah Alahmad Sea City
Index 70	Yes	Mean	Fisher	Long-term mean price	Monthly	Houses only	
Index 71	Yes	Mean	Fisher	Long-term mean price	Monthly	Lands and Houses	
Index 72	Yes	Median	Fisher	Long-term mean price	Monthly	Lands only	
Index 73	Yes	Median	Fisher	Long-term mean price	Monthly	Houses only	
Index 74	Yes	Median	Fisher	Long-term mean price	Monthly	Lands and Houses	

Notes:

6.0 Findings

In this section, we discuss the findings from constructing 74 indices, each with its own characteristics but all from the same dataset, to clearly determine which methods or techniques can be used to improve the accuracy of indices. Also highlight which indices found to be reliable and suitable for further studies.

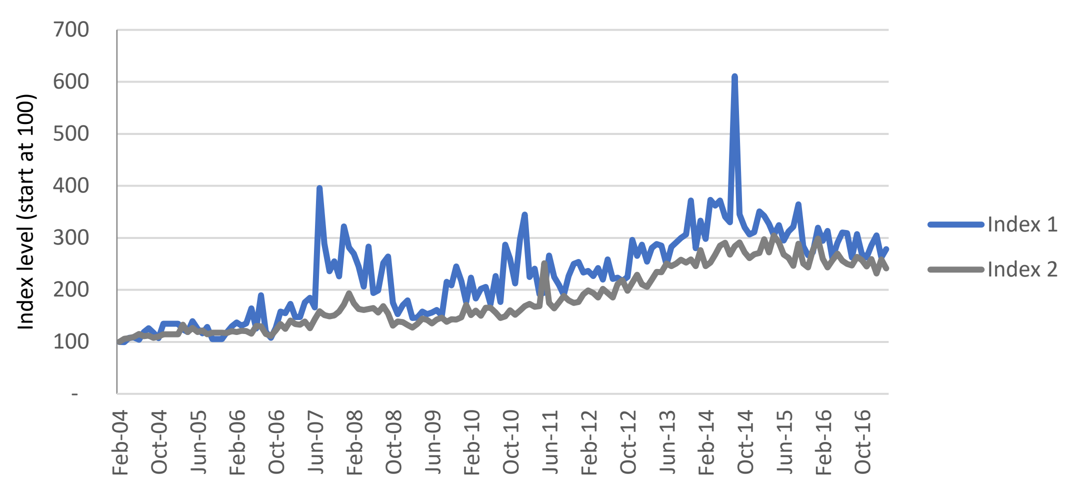
Reviewing the descriptive statistics (in Table 26 in the appendices) generated from all 50 monthly indices, we note the following. First, it is clear that compared to indices based on only houses and on lands and houses, indices based on only lands transactions have higher i) average compound growth rates, ii) average returns and iii) standard deviations of returns. Second, indices based on only houses and indices based on lands and houses consistently have similar average compound growth rates, average returns and standard deviations of returns. Interestingly, all the different methods, except for property type lands/houses, show no signs of differences from each other. They have similar average compound growth rates, average returns and standard deviations of returns. Additional tests, including autocorrelation and seasonality tests, were performed for all indices. We found that all the indices have autocorrelation signs in level and first differences, but none show signs of seasonality in level and first differences. Even when testing the transaction volume over the years, there are no signs of seasonality.

The quarterly indices findings (Table 27 in the appendices) are somewhat different than the monthly findings. Unlike the monthly indices, the quarterly indices do not show consistent differences in the i) average compound growth rates, ii) average returns and iii) standard deviations of returns when comparing indices based on land, on only houses and on lands and houses. In other words, all three types of indices (lands, houses, mix) have similar i) average compound growth rates, ii) average returns and iii) standard deviations of returns. When considering other methods, no signs of differences are noted between the three types of transactions. When testing for autocorrelation, all the indices show signs of autocorrelation in level, while in the first difference, only 10 indices had autocorrelation signs. When testing for seasonality, no indices show signs of seasonality in level, while in the first difference, only three indices based on lands only transactions have seasonality signs.

6.1 Base indices

The base indices are the first 12 indices. Half are cleaned of major outliers, and half are not. As it can be seen in chart 1 and Table 6, the outlier sales transactions clearly influence the performance of the indices, especially indices 1 and 4.

Chart 1: housing price indices 1 and 2



Eliminating the influence of outliers is a critical challenge, especially in real estate datasets in which heteroscedasticity plays an important role in price variations. To reduce the influence of such noise, we clean the data of the approximately 600 major outlier transactions, which certainly removes some but not all the outliers. This results add a significant improvement in performance when comparing index 1 to index 7, which has the same characteristics but is cleaned of the major outliers. RMSE is reduced to a quarter, MAE and MAPE by about half, and SD by 12.5%. Similar results are found when comparing index 4 to index 10, which have similar characteristics as indices 1 and 7 but are based on the median as the centre of tendency. The indices based on house transactions, such as indices 2 and 8 and indices 5 and 11, show improvement but less improvement than among indices based on land transactions. Last to consider are the base indices based on a mix of land and house transactions, including indices 3 and 9 and indices 6 and 12. In both cases, based on the mean or the median as the centre of tendency, cleaning out major outliers improves forecasts and reduces RMSE by a third, with similar improvements for MAE, MAPE and standard deviations. Overall, removing outlier results in improvement in all pairs, except the second pair which shows a minor reduction in RMSE when cleaned of major outliers. Also, when comparing the forecast performance of all 12 indices, we find that index 12 has the lowest RMSE, MAE and MAPE, while index 8 has the lowest standard deviation.

Table 6: Forecasting accuracy tests and standard deviation for indices 1-12

Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 1	93.24	53.15	12.07	74.03
Index 7	23.87	20.91	6.72	59.19
Index 2	18.87	14.79	5.21	49.29
Index 8	20.70	15.82	5.51	48.44
Index 3	27.45	20.66	6.70	51.59
Index 9	19.29	15.03	5.11	50.87
Index 4	101.76	44.18	9.02	77.18
Index 10	23.67	21.02	6.81	58.62
Index 5	18.01	14.16	4.98	49.16
Index 11	17.40	14.44	5.08	48.67
Index 6	27.82	18.20	5.80	51.90
Index 12	16.83	13.76	4.72	50.98

Notes: Pairs are formed based on inclusion and exclusion of major outliers' transactions

6.2 Centre of tendency methods

As mentioned, the mean method as the centre of tendency is influenced by outliers and can induce higher volatility in indices; therefore, many researchers recommend using the median instead of the mean to avoid this drawback. However, in a case such as Kuwait with a low frequency of transactions in each city, indices based on the median as the centre of tendency might have higher volatility than indices using the mean. Table 7 compares 15 pairs of indices using the mean and the median as the centre of tendency. In each pair, the indices have the exact same characteristics with only one difference, which is the use of the mean or the median as the centre of tendency. Details about the characteristics of each index can be found in tables 2–5.

Table 7: Forecasting accuracy tests and standard deviation for indices 1-30

Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 1	93.24	53.15	12.07	74.03
Index 4	101.76	44.18	9.02	77.18
Index 2	18.87	14.79	5.21	49.29
Index 5	18.01	14.16	4.98	49.16
Index 3	27.45	20.66	6.70	51.59
Index 6	27.82	18.20	5.80	51.90
Index 7	23.87	20.91	6.72	59.19
Index 10	23.67	21.02	6.81	58.62
Index 8	20.70	15.82	5.51	48.44
Index 11	17.40	14.44	5.08	48.67
Index 9	19.29	15.03	5.11	50.87
Index 12	16.83	13.76	4.72	50.98
Index 13	27.08	21.91	7.77	48.69
Index 16	29.09	23.52	8.42	47.37
Index 14	17.51	13.62	4.90	49.15
Index 17	17.62	13.77	4.91	49.85
Index 15	15.78	13.60	4.89	48.36
Index 18	15.19	12.80	4.62	48.03
Index 19	35.84	28.70	11.63	52.91
Index 22	47.81	38.53	17.28	53.62
Index 20	20.13	17.70	6.22	50.27
Index 23	17.09	15.79	5.58	50.96
Index 21	24.26	21.14	8.02	50.18
Index 24	29.90	23.86	9.59	50.38
Index 25	25.92	20.39	7.84	49.15
Index 28	30.22	22.93	9.45	48.29
Index 26	16.49	13.27	4.74	49.40
Index 29	14.39	11.78	4.21	50.08
Index 27	16.25	14.50	5.31	48.55
Index 30	16.67	14.43	5.45	48.25

Notes: Pairs are formed based on different central of tendency methods

Among the indices based on only house transactions, the indices based on the median outperform the indices based on the mean in RMSE, MAE and MAPE 4 times out of 5 and have almost the same level in the fifth. However, when comparing indices based on only land transactions, the results are not as suggested by the theory of using the median. As noted, land has much higher volatility than houses in indices not cleaned of major outliers, while cleaning major outliers significantly reduces volatility. Thus, indices based on the median are expected to outperform indices based on the mean, but this is not found.

All five pairs based on only land transactions show lower RMSE for the indices based on the mean. This might be influenced by large outlier transactions, considering that the MAE and MAPE might provide better finding. RMSE is based on the square of errors, so it is found to be more sensitive to data series with higher error rates and gives higher weights to large errors. MAE and MAPE, therefore, might show more stable results when influenced by large outlier transactions. Interestingly, of the five pairs, the only pair in which the MAE shows opposite results to RMSE is the first pair based on data not cleaned of major outliers, suggesting that the indices based on the median have lower MAE and MAPE but higher RMSE. For pairs based on mixed transactions of land and houses, the results have three pairs with similar RMSE, while one pair has better results for the index based on the mean, and one has better results for the index based on the median. However, the MAE and MAPE results show that 4 of the 5 pairs have lower MAE and MAPE for indices based on the median, and one with the opposite result. It is worth noticing that the standard deviation levels of indices in each pair are relatively close.

Overall, although most comparisons show lower error in the indices based on the median, it is still difficult to conclude that the median as the centre of tendency is always more accurate than the mean as it still not small number of results show the opposite. It is worth mentioning that lower numbers of transaction could negatively affect both indices based on the mean and indices based on the median.

6.3 Property types

The main issue in real estate field is the heterogeneity of every single property, making the information available less valid. Consequently, the construction of time series data is more volatile and requires advanced methodologies with large information to reduce the influence of property heterogeneity. Here, we compare the performance of indices based on only land transactions and expect much volatile indices than indices based on only house transactions. Land sales have less heterogeneity as they do not have most of the characteristics that influence the value of the property, however as noted from the literature land price account for most of the houses price volatility. We find in consistent with literature that indices based on only house transactions significantly outperform indices based on only land transactions in all pairs regardless of the method used for the centre of tendency or the weighting method in all tests, such as RMSE, MAE and MAPE.

Table 8: Forecasting accuracy tests and standard deviation for indices 7-30

Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 7	23.87	20.91	6.72	59.19
Index 8	20.70	15.82	5.51	48.44
Index 9	19.29	15.03	5.11	50.87
Index 10	23.67	21.02	6.81	58.62
Index 11	17.40	14.44	5.08	48.67
Index 12	16.83	13.76	4.72	50.98
Index 13	27.08	21.91	7.77	48.69
Index 14	17.51	13.62	4.90	49.15
Index 15	15.78	13.60	4.89	48.36
Index 16	29.09	23.52	8.42	47.37
Index 17	17.62	13.77	4.91	49.85
Index 18	15.19	12.80	4.62	48.03
Index 19	35.84	28.70	11.63	52.91
Index 20	20.13	17.70	6.22	50.27
Index 21	24.26	21.14	8.02	50.18
Index 22	47.81	38.53	17.28	53.62
Index 23	17.09	15.79	5.58	50.96
Index 24	29.90	23.86	9.59	50.38
Index 25	25.92	20.39	7.84	49.15
Index 26	16.49	13.27	4.74	49.40
Index 27	16.25	14.50	5.31	48.55
Index 28	30.22	22.93	9.45	48.29
Index 29	14.39	11.78	4.21	50.08
Index 30	16.67	14.43	5.45	48.25

Notes: Sets are formed based on different types of properties

When comparing the performance of the indices based on only houses to the indices based on a mix of houses and land, 5 of the 8 sets of the indices based on a mix of houses and land have lower RMSE, while the remaining three indices based on only houses have lower RMSE. However, in cases when the indices based on a mix of lands and houses perform better than the indices based on only houses, the differences are not huge as are the differences between the indices based on only land transactions compared to the indices based on only houses. For example, in the fourth set of indices 16, 17 and 18, the index based on only houses has 14% more errors than the index based on a mix and has 60% fewer errors than the index based on only land. MAE and MAPE are lower for the indices based on only house transactions compared to the indices based on a mix of houses and land in all the sets using this weighting technique.

The standard deviations show relatively similar performance, with no index type dominating the others. The only two exceptions are the first two sets based on the unweighted method. The indices based on only land have significantly higher performance than the other two indices.

Overall, the forecasting performance of the indices based on only house transactions are more accurate than the indices based on only land transactions and sometimes better than indices based on a mix of land and houses. Using the MAE and MAPE tests, the indices based on only house transactions have lower errors than indices based on land transactions all eight times, while when compared to indices based on a mix on houses and lands, they have lower errors only 4 of 8 times. This gives us confidence to rely on indices based on only house transactions.

6.4 Weighting methods

Weighting is an important technique to produce a more accurate index expressing the closest value to the actual value. We give more weight to cities with higher importance and less weight to cities that cause noises due to limited transactions and high price volatility or high growth rate. As explained, weighting is related to the transactions volume in each stratum or city in this research. Selecting the weighting method is critical, and weighting methods influence index performance differently.

In this research, as seen in Table 9, we find that Laspeyres weighting results in limited improvement compared to the unweighted method. In all six sets, the Laspeyres weighting indices have forecasting errors very close to the unweighted indices, and this can be clearly noted in the MAE and MAPE tests. In cases such as this research, this finding is expected as the Laspeyres method simply assigns weight based on the base period in which most cities have small numbers, such as 1–3 transactions monthly. The base period transactions in early 2004 is not as high as in 2006–2007 or 2009-2011; therefore, the weighting is not effective and does not change for cities that witness high transaction in later years compared to cities with fewer transactions.

The median indices show worse performance when using weighting technique for the indices based on only land transactions compared to the unweighted technique. While when using the indices based on only house transactions, the median indices' performance improves when using the weighting technique compared to the median using unweight technique. The same performance is witnessed when using the mean as the centre of tendency; therefore, neither the mean not the median is superior to the other all four weighting methods.

Table 9: Forecasting accuracy tests and standard deviation for indices 7-30

Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 7	23.87	20.91	6.72	59.19
Index 13	27.08	21.91	7.77	48.69
Index 19	35.84	28.70	11.63	52.91
Index 25	25.92	20.39	7.84	49.15
Index 8	20.70	15.82	5.51	48.44
Index 14	17.51	13.62	4.90	49.15
Index 20	20.13	17.70	6.22	50.27
Index 26	16.49	13.27	4.74	49.40
Index 9	19.29	15.03	5.11	50.87
Index 15	15.78	13.60	4.89	48.36
Index 21	24.26	21.14	8.02	50.18
Index 27	16.25	14.50	5.31	48.55
Index 10	23.67	21.02	6.81	58.62
Index 16	29.09	23.52	8.42	47.37
Index 22	47.81	38.53	17.28	53.62
Index 28	30.22	22.93	9.45	48.29
Index 11	17.40	14.44	5.08	48.67
Index 17	17.62	13.77	4.91	49.85
Index 23	17.09	15.79	5.58	50.96
Index 29	14.39	11.78	4.21	50.08
Index 12	16.83	13.76	4.72	50.98
Index 18	15.19	12.80	4.62	48.03
Index 24	29.90	23.86	9.59	50.38
Index 30	16.67	14.43	5.45	48.25

Notes: Sets are formed based on different weighting methods

The Paasche method has the worst performance in all the sets, especially the sets based on only land transactions. This method, which assigns weight based on current volume, seems to be affected by this characteristic. Higher weight might influence the volatility of those cities with high volume transactions, making this method produce the highest forecasting errors.

The indices based on the Fisher weighting technique record the fewest errors in all 30 indices. They also have the fewest errors in some sets, while in other sets, they are closest to the lowest error indices. However, it is worth mentioning that the performance of the Fisher weighting method worsen significantly when used with the indices based on only land transactions. The volatility in land transactions seems to cause serious noises in the indices using the weighting methods. The standard deviations of all indices have similar performance, with two 2 exceptions when used with the unweighted indices based on only land transactions and either the mean or the median.

Overall, based on the paper findings so far, we consider the sets based on only house transactions to be the most sustainable sets. In Table 9, these are the second and fifth sets, in which the indices based on Fisher weighting are more accurate than the rest based on RMSE, MAE and MAPE. Although the Laspeyres method has better accuracy on the unweighted method, the Fisher method is the most accurate.

6.5 Data frequency

The aim of this comparison is to obtain more accurate and stable indices based on lower frequency. Quarterly data have three times the data in monthly observations, so it is expect to see smother indices as the merger of three months of transactions should provide relatively less volatile outcomes for each quarter. As explained, quarterly indices are similar to the approach of monthly indices but with three months instead of one month. Each year has four independent quarters, so we do not use the moving average technique. These quarterly indices are compared to the third observation of monthly indices. In other words, we take the observation of March as the first-quarter observation, the June observation as the second-quarter observation, and so on.

Table 10 has 24 pairs, each with a monthly index converted to a quarterly index, as explained, and another index constructed on a quarterly basis. The two indices in each pair have exactly the same characteristics. Their only difference is how the observations are in each period are calculated, one monthly, and the other quarterly.

The main finding to consider is the improvement the quarterly indices provide. Of 24 pairs, 14 show that indices based on quarterly observations have lower RMSE, MAE and MAPE, seven pairs have closer outcomes to indices based on monthly observations, and the remaining three pairs show worse performance. The best performance of both frequencies is found in pair 11, as shown in chart 2. Interestingly, the indices based on quarterly observations show significant reduction in forecasting errors in many cases. This is clearly seen in pairs 2, 3, 5–7, 10 and 12.

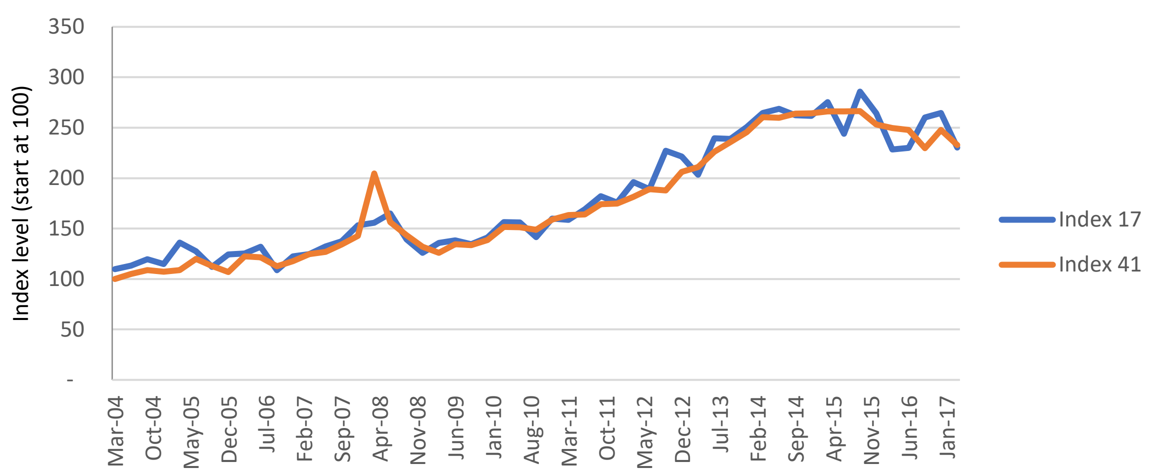
Table 10: Forecasting accuracy tests and standard deviation for indices 7-30 and 31-54

Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation	Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 7	24.00	21.13	6.56	61.09	**Index 19**	35.09	32.71	12.64	53.99
Index 31	25.37	21.44	6.45	65.56	**Index 43**	39.19	28.28	10.94	61.62
Index 8	27.41	18.38	6.11	51.19	**Index 20**	24.21	19.42	6.68	51.96
Index 32	15.70	12.87	4.65	47.40	**Index 44**	17.22	15.92	5.69	50.87
Index 9	25.99	18.83	6.15	53.53	**Index 21**	18.71	16.79	6.21	51.60
Index 33	16.95	13.21	4.53	52.28	**Index 45**	22.81	18.72	6.92	55.60
Index 10	26.41	24.04	7.52	61.01	**Index 22**	57.87	51.87	22.61	55.31
Index 34	24.26	19.83	5.98	66.37	**Index 46**	48.07	39.95	15.92	62.89
Index 11	21.08	16.36	5.64	50.44	**Index 23**	17.15	14.96	5.31	51.16
Index 35	13.07	11.18	4.08	47.23	**Index 47**	14.61	13.95	5.03	51.51
Index 12	21.79	16.09	5.36	53.00	**Index 24**	30.05	28.02	11.14	51.23
Index 36	14.82	11.54	3.99	52.44	**Index 48**	28.63	20.53	7.81	55.73
Index 13	34.73	33.02	10.93	53.63	**Index 25**	20.99	17.85	6.22	52.63
Index 37	20.04	15.32	4.71	62.11	**Index 49**	21.47	19.72	6.46	60.67
Index 14	9.68	6.95	2.58	48.91	**Index 26**	15.50	11.72	4.25	50.17
Index 38	10.57	8.32	3.15	47.44	**Index 50**	15.50	14.69	5.48	49.05
Index 15	15.58	14.15	5.04	49.87	**Index 27**	13.47	12.73	4.59	50.42
Index 39	11.87	9.28	3.26	52.30	**Index 51**	15.91	13.89	4.89	53.54
Index 16	40.29	37.94	12.57	53.50	**Index 28**	26.49	23.24	8.58	52.02
Index 40	19.90	16.45	5.07	64.11	**Index 52**	25.67	22.25	7.45	61.17
Index 17	7.47	5.30	1.99	48.87	**Index 29**	11.23	9.72	3.60	49.75
Index 41	9.46	8.16	3.11	47.51	**Index 53**	13.97	13.74	5.16	49.41
Index 18	16.93	15.95	5.69	49.59	**Index 30**	13.67	12.03	4.45	49.68
Index 42	10.92	9.29	3.28	53.12	**Index 54**	17.53	15.39	5.50	53.69

Notes: Pairs are formed based on different data observation frequency

Another important finding concerns the method used as the centre of tendency (mean or median). In cases of quarterly observations which have three times more observations than monthly observations, we do not find adequate support that either the median or the mean is better. The tests results in Table 10 show similar performance in most cases.

Chart 2: pair 11 (quarterly and monthly observations)



As noted, the indices based on only land transactions consistently have more errors regardless of the methods or techniques used; see pairs 1, 4, 7, 10, 13, 16, 19 and 22. The indices based on only house transactions have the lowest RMSE, MAE and MAPE, as in pairs 8, 11, 14, 17, 20 and 23. Quarterly indices clearly show high standard deviations in many indices based on only land transactions. Otherwise, standard deviations overall and among the indices within each pair have relatively similar performance.

Overall, we find that the indices based on quarterly observations provide good forecasts with low errors, mostly lower than or close to the indices based on monthly observations. However, as the indices based on monthly observations and quarterly observations have relatively similar performance, then using monthly observations might be considered to be better as they provide three times more data than quarterly observations, which can be helpful for improving index performance and studying market performance or national economic performance.

6.6 Sub-sample data

The use of more information or data has been considered to be an advantage for generating better findings. However, in the real estate field characterised by heterogeneity, low frequency and the influence of expensive properties, it is worth considering using sub-samples instead of all the available transactions. The aim of doing so is to reduce noise affecting the overall performance of the indices constructed. Here, we conduct three tests of whether the use of sub-samples can provide better performance. First, to test all the transactions available except for those in Sabah Al Ahmad sea city. Second, to test only transactions in Sabah Al Ahmad sea city. Last, to test only cities with high transaction frequency.

6.6.1 Exclusion of Sabah Al Ahmad sea city

We first attempt to test whether indices' performance can be improved by cutting some the available data by excluding transactions in Sabah Al Ahmad sea city. The reason for giving this city serious consideration is that it accounts for a quarter of all sales transactions in Kuwait over the sample period. Also, it is the only city in Kuwait characterised not by permanent residents but by second vacation homes. Third, approximately 13,000 transactions in the city involve empty land, and only 300 houses, indicating that they are most probably driven by land traders (short-term investors flipping land without developing it), not end users.

Table 11: Forecasting accuracy tests and standard deviation for indices 25-30 and 55-60

Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 25	25.92	20.39	7.84	49.15
Index 55	19.18	15.81	5.57	50.28
Index 26	16.49	13.27	4.74	49.40
Index 56	16.59	13.30	4.75	49.33
Index 27	16.25	14.50	5.31	48.55
Index 57	15.04	13.39	4.78	49.30
Index 28	30.22	22.93	9.45	48.29
Index 58	20.19	16.16	5.91	47.59
Index 29	14.39	11.78	4.21	50.08
Index 59	14.48	11.90	4.25	50.05
Index 30	16.67	14.43	5.45	48.25
Index 60	12.81	11.02	3.99	48.59

Notes: Pairs are formed based on inclusion and excluding of Sabah Alahmad sea city

To test the performance of these new indices (indices 55–60), we select the best six indices constructed so far. These are cleaned of major outliers, have a monthly frequency and are based on the Fisher weighting method. Three are based on the mean as centre of tendency , and three on the median. Two indices are based on only land transactions, two on only house transactions, and two on a mix.

Table 11 supports two clear findings. First, the vast majority of Sabah Al Ahmad sea city transactions involve land, so we find no influence on pairs based on only house transactions (pairs 2 and 5). Second, the exclusion of Sabah Al Ahmad sea city significantly improves the performance of the indices based on only land transactions (pairs 1 and 4) and consequently the indices based on a mix (pairs 3 and 6). The standard deviations showed similar performance across the indices. This mean that indices using a sub-sample with 25% less data can perform better than indices using the full sample of data.

6.6.2 Inclusion of only Sabah Al Ahmad sea city

In contrast the sub-sample in section 6.6.1, this section constructs two indices based only on observations of Sabah Al Ahmad sea city. Although it is challenging to build country indices based on one city, the large number of transactions in this city drives our interest in testing the possibility that one city with a large number of transactions accounting for a quarter of all the country's transactions can yield acceptable accuracy. This city has insufficient transactions for houses, so we construct only indices based on only land transactions, one using the mean as the centre of tendency and one the median. When working with one city, weighting techniques are not valid, so the comparison is against unweighted indices 7 and 10.

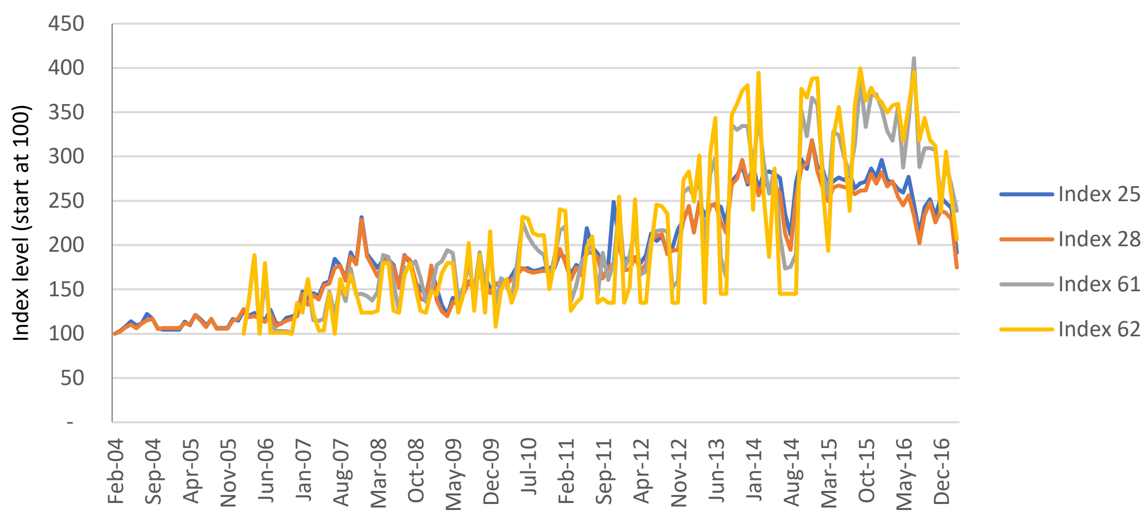
Table 12: Forecasting accuracy tests and standard deviation for indices 7, 10, 61 and 62

Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 7	23.87	20.91	6.72	59.19
Index 61	65.89	56.46	24.17	62.90
Index 10	23.67	21.02	6.81	58.62
Index 62	98.98	87.84	45.62	81.69

Notes: Pairs are formed based on all cities index against Sabah Alahmad sea city only

From Table 12 and chart 3, it is obvious that it is impossible to produce indices based on this city only, event with its high number of transactions. The volatility is extremely high, possibly caused by the land categories, with the front properties on the sea and the back not facing the sea. This information is not available, so each transaction would have to be reviewed and categorised by price. This would require much work and might not provide that indices as adequate as those already constructed. We, therefore, find that this method cannot be proven to provide better indices' performance than those with full data sample.

Chart 3: Sabah Alahmad sea city indices



6.6.3 Inclusion of only cities with high-frequency transactions

The last experiment of for sub-sample data is to construct indices based on only selected cities. As explained the main inclusion criteria are they must be among the highest 75% of total transactions and have a number of transaction no less than the number in observation period. The details of the process are explained in methodology section. The aim of this data cut is to see if noise can be reduced and highly accurate indices produced. It is also of interest to test whether cutting more than 40% of the observations can produce performance competitive with that of indices with the full sample of observations.

Table 13: Forecasting accuracy tests and standard deviation for indices 55-60 and 63-68

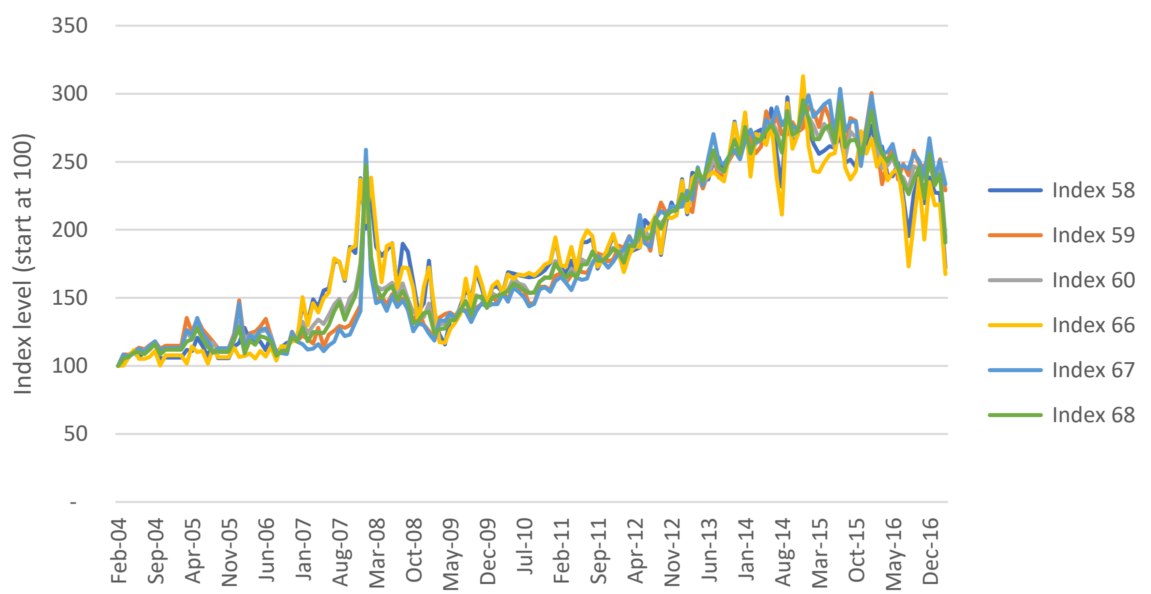
Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 55	19.18	15.81	5.57	50.28
Index 63	22.22	18.98	6.91	49.04
Index 56	16.59	13.30	4.75	49.33
Index 64	15.68	12.86	4.55	52.27
Index 57	15.04	13.39	4.78	49.30
Index 65	13.95	12.37	4.40	50.46
Index 58	20.19	16.16	5.91	47.59
Index 66	25.66	21.32	8.27	45.93
Index 59	14.48	11.90	4.25	50.05
Index 67	13.76	11.56	4.09	52.98
Index 60	12.81	11.02	3.99	48.59
Index 68	12.67	10.89	3.94	49.46

Notes: Pairs are formed based on all cities index against high frequency cities only

Table 13 contains the new group based on only high-frequency cities compared to the group of indices excluding Sabah Al Ahmad sea city (indices 55–60). We exclude Sabah Al Ahmad sea city due to its noise, as explained. We find that the indices based on the selected cities outperform the other indices in 4 of 6 pairs by fractions. In the remaining two pairs based on only land transactions, they still have similar performance.

Interestingly, one of the new indices, index 68, has the lowest RMSE, MAE and MAPE in all 50 indices constructed based on monthly frequency. Overall, we find that careful selection of data can support competitive indices regardless of the amount of the data lost to reduce noises. Chart 4 give additional support to the performance of the new indices, which clearly have lower volatility while still capturing major events in the sample period.

Chart 4: Inidces based on selected cities



6.7 Stratification

The aim of using different stratification methods is to determine the best stratification method or alternatives that provide acceptable accuracy. As explained, the new stratification method groups cities with similar long-term mean prices together. Thus, Kuwait's 75 cities, excluding Sabah Al Ahmad, fall into five stratums, each with abundant data in monthly observations.

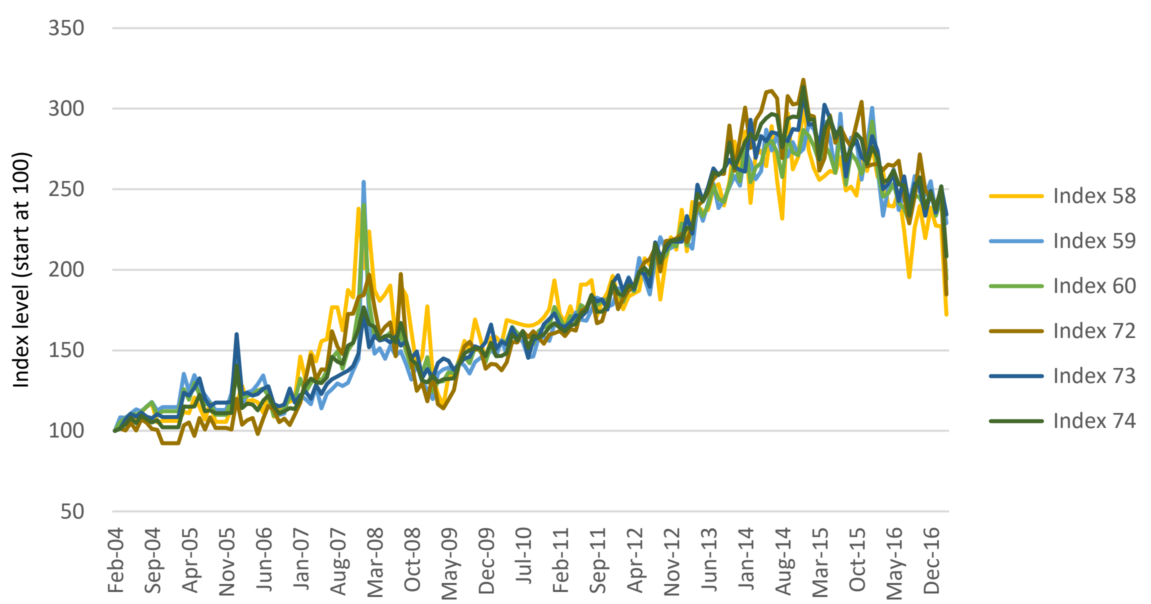
Table 14: Forecasting accuracy tests and standard deviation for indices 55-60 and 69-74

Indices	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Standard Deviation
Index 55	19.18	15.81	5.57	50.28
Index 69	23.49	21.71	7.43	56.13
Index 56	16.59	13.30	4.75	49.33
Index 70	17.77	14.40	5.17	49.43
Index 57	15.04	13.39	4.78	49.30
Index 71	19.56	17.58	6.20	51.83
Index 58	20.19	16.16	5.91	47.59
Index 72	27.63	24.75	8.12	60.45
Index 59	14.48	11.90	4.25	50.05
Index 73	16.03	14.63	5.09	52.32
Index 60	12.81	11.02	3.99	48.59
Index 74	21.16	19.15	6.49	55.99

Notes: Pairs are formed based on by city stratification and by long term mean price methods

Table 14 presents the group of indices constructed based on city stratification and the new group of indices constructed based on long-term mean price stratification. The new stratification method does not outperform stratification by city. However, the new stratification method does perform well, especially in the indices based on only house transactions, which are considered to be more stable compared to the indices based on only land transactions or a mix of lands and house transactions. Although the new stratification does not show better performance than the indices based on city stratification, its SD, RMSE, MAE and MAPE fall within the boundaries of the earlier indices constructed based on city stratification, as in table 14 and chart 5. Another issue we consider in this new stratification is superior performance by either the mean or the median as the centre of tendency method, especially as the new stratification has higher number of observations for each stratum each month. However, no differences in performance are noted between the first three pairs based on the mean and the other three pairs based on the median. Last, as with all the indices, the new stratification has the best performance with the indices based on only house transactions, and the worst performance with the indices based on only land transactions.

Chart 5: Indices based on stratification



7.0 Conclusion

Simple methodologies for constructing indices, such as the central tendency methods, have a proven ability to provide adequate indices with low forecasting errors. Flexibility to adjust the method significantly improves the indices' performance, increases forecasting accuracy, makes the indices more stable and might produce similar accuracy to more complicated methodologies, such as the hedonic and repeat sales methods. This might be tested in markets with available data.

This paper yields three main findings. First, we find the heteroscedasticity of real estate is not the major challenge when producing highly volatile indices but other factors driven by the land price in indices based on only land transactions. Land sales are expected to have high volatility even though they do not have most housing characteristics, so it is not surprising that the indices based on only land transactions show high volatile indices, while the indices based on only house transactions show moderate volatility. This difference could result from the influence of property traders who quickly flip land or the high frequency of land sales in some cities.

Second, reducing the sample size to select a sub-sample has proven its ability to produce superior performance in several ways. The indices' performance improves significantly when excluding Sabah Al Ahmad sea city, which we believe has been influenced by land transactions and is considered to be less a city for primary residences but more an ocean city of luxury and vacation homes. Second, indices' performance also improves significantly when constructing the indices based on high-frequency cities to avoid the influence of low-frequency cities with high volatility and costs. The only case in which the sub-sample indices perform worse is in the indices based only on Sabah Al Ahmad sea city.

Third, stratification by city and long-term mean prices both significantly improve the performance of the central tendency methods. Although city stratification shows slightly better performance, the performance of the alternative indices stratified by long-term mean prices is competitive. This stratification method could provide better performance in certain cases as it collects large numbers of transactions for every period, reducing the potential influence of outliers compared to the other stratification method.

We also find that the mean and median methods as the centre of tendency do not perform differently in all different scenarios. Even when using the alternative stratification methods, neither the median nor the mean achieves superiority. Also, the indices based on quarterly observations perform better than the indices based on monthly observations. Last, inconsistent with the literature, the Fisher method returns the best performance among all the weighting methods, while the Paasche method seems to be highly influenced by volatility, and the Laspeyres methods shows moderate performance, highly similar to the unweighted method.

Although it is not possible to construct indices based on advanced parametrical methodologies, the performance of the flexible central tendency methods supports stable indices for the Kuwait housing market that have a high level of accuracy and clearly capture major events. This suggests that housing indices can be developed other emerging markets without data on many details of housing.

Overall, this paper overcame one of the main challenges hampering the development of research in emerging markets: data limitation brought on by the lack of indices to measure performance. This is critical for evaluating and studying any market and efforts to highlight their main difficulties and how to resolve them. The way this paper adopted different methodologies can be used in other markets to overcome their limitations; for example, large counties like Saudi Arabia can use a sub-sample of houses sold in the capital to produce housing indices, while smaller countries can adopt the long-term average mean price to provide a better reading index. Indices constructed in this paper are the cornerstone of this thesis. Forthcoming papers will use them and to aid in our understanding of the Kuwaiti market. Not only Kuwait, but any emerging market, must have reliable indices suitable for evaluating their markets' performance, highlighting their main challenges and providing suggestions and recommendations. These will be used in the next portions of this thesis.

8.0 Limitations

- The limited availability of data on houses sold prevents comparing our findings from the central tendency methods to the results from other advanced methods, such as the hedonic or repeat sales methods.
- Approximately 600 transactions as major outliers are deleted manually by us not based on any methodologies or technique.
- The excluded observations simply are more extreme than the other observation, leading us to cut them. Kuwait has 76 cities, but many other have insufficient transactions or are very new without a sufficiently period to study.

End of
The First Paper

Chapter three- Second Paper

Modelling Housing Market Fundamentals and the Response to Major Events

Abstract:

This paper seeks to understand the dynamics of housing sectors in emerging markets using Kuwait as an example. We used the housing affordability index and the price-to-income multiplier to construct a measurement of housing affordability performance. Then, used the error correction model (ECM) to model the housing market using 158 monthly observations from 2004 until 2017. The use of the ECM for two reasons: first, to overcome the obstacle of non-stationary variables, and second, to develop an accurate understanding of the market dynamics and how the market corrects to equilibrium. To improve the performance of the ECM, we implemented several adjustments: using quarterly data instead of monthly data; rolling over sub-samples; and smoothing data on three-month, six-month and twelve-month moving average periods. Last, dummy variables have been used to study the impacts of regional and local major events, such as political issues, legislation changes and terrorist attacks. First, it has been found that affordability has worsened over time, such that housing in Kuwait is now "severely unaffordable" (equivalent to London in the UK, San Diego in US and Toronto in Canada). Second, it has been found that the housing market is significantly driven by supply shortages, high demand, high oil prices, inflation and interest rates. Last, it has been found that the Kuwait housing market negatively interacts with the Kuwait Stock Exchange (a risky investment) and the gold market (a safe investment). Thus, the housing market is an alternative investment for investors interested in both risky and safe investments. After smoothing the housing price index (HPI) to reduce volatility, we also found that the lagged HPI positively influences housing prices, indicating the existence of speculation. The monthly and quarterly models for the full sample showed that the market returns to equilibrium rapidly: in approximately seven months. Last, we found that Kuwait's housing market is not affected by all regional events or local political events, but is affected by legislation and terrorist attacks. This paper is the first paper of its kind on the Kuwait housing market, and it provides a valuable foundation for future research on this market and similar markets in the region. Despite our limitations with respect to data and the need to adjust for some outliers, it is possible to draw several conclusions. First, markets in such situations can only be improved by increasing the housing supply. In Kuwait, the Ministry of Public Works is currently the main developer of raw lands. However, this situation needs to change to include the private sector, since the Ministry of Public Works has a limited capacity and cannot provide the number of plots required to meet the current demand. Second, Kuwait's housing market is at risk because of Kuwait's dependence on a single source of income: oil. Since oil production represents 95% of Kuwait's income, we found that oil prices have a significant impact on Kuwait's housing market. Therefore, a drop in oil prices may affect not only housing prices, but also major housing development plans requiring huge budgets.

1.0 Introduction

Houses are essential for families and are often considered families' most valuable assets. Unsurprisingly, most governments worldwide consider the housing sector a top priority, not only because they need to provide accommodation to their citizens, but also because this sector is inextricably linked to other economic sectors. In other words, the housing sector can affect other sectors and the entire economy. Therefore, it is essential to understand the fundamental drivers of the housing market, to evaluate its performance over the years and to determine optimal solutions for current issues. The Kuwait housing market, the target market of this paper study, is a unique market with interesting features that will be explained below.

Government intervention is an extremely important market driver that can have strong positive or negative impacts on the housing sector. Kuwait is characterised by a serious mismatch between housing supply and housing demand. As a result, prices have increased rapidly over the last 15 years, reaching levels beyond the purchasing ability of low- to median-income citizens. The government recently decided to address this housing shortage as part of its major development plan: Kuwait Vision 2035. Specifically, the government has allocated land in different locations throughout Kuwait to the development of approximately 340,000 housing units over the next 20 years (Real Estate Association, 2015). The number of houses to be added is two times the current total number of houses in Kuwait. Therefore, the initiative represents a significant shift whose consequences for the rest of the country need to be studied carefully. In particular, the housing initiative could have serious negative consequences that have not yet been studied by the government. All government studies on housing focus on issues related to solving the housing demand problem and addressing the supply shortage; none have considered the consequences of the initiative on housing prices and the economy in general. To examine these issues, it is necessary to evaluate current housing prices in Kuwait and determine what drives housing prices. It is also essential to understand the main factors that have influenced this market over the last 15 years. This paper is the first to study the Kuwait housing market from an academic perspective.

To examine these issues, we must evaluate current housing prices in Kuwait and determine what drives them. It is also essential to understand the main factors that have influenced this market over the last 13 years. This paper is the first to study the Kuwait housing market from an academic perspective. It uses the housing indices constructed in the first paper to study the dynamics of the Kuwaiti housing market. As Kuwait is, in many ways, similar to many emerging countries, mostly those in the Middle East and North Africa, understanding these market dynamics will provide some interesting guidelines for those countries, including details on the main challenges facing their housing markets and possible solutions.

The main study aim is to gain a clear understanding of the housing dynamics in Kuwait. This is achieved by studying the factors that drive housing prices in this market. This study is not limited to economic and demographic factors but extends to the impacts of events on housing markets, such as political developments, terrorist attacks and changes to the tax system. Such events cannot be ignored when analysing market dynamics as they play significant roles in market performance. In a related matter, this paper will first construct housing affordability indices for the Kuwait market to further understand the consequences of changes in housing prices for individuals in that market. Also, solutions to improve housing affordability in Kuwait can be drawn from the findings on the drivers of housing prices. It, therefore, is important to understand the market dynamics, along with the relationship of housing prices to individuals' income and ability to buy houses.

2.0 Literature Review

To understand housing in a specific market, it is important to highlight the main issues influencing that market. Although there are no studies on the Kuwait housing market, it can be useful to review the research on other countries. This literature review first examines housing issues in other counties and assesses their affordability index performance. This can help understand what drives affordability in their markets and what is expected to influence affordability in Kuwait. It also seeks to understand the main factors influencing housing prices in different markets, such as economics, politics, policies and wars. The findings highlight the main issues driving the housing market and affecting affordability in Kuwait.

2.1 Housing Affordability

Housing affordability is a hot topic within housing studies, since housing and shelter are relevant to all individuals. Housing affordability is an issue that has not been solved in many countries, and it can significantly impact individuals' lifestyle. The individuals most affected by housing affordability issues are those at the lowest level of income and young people with limited income. Housing affordability is affected by many factors, as discussed below.

Before discussing housing affordability itself, it is essential to understand the indices used to measure housing affordability. These indices, regardless of the specific approaches used, measure the relationship between housing prices and people's incomes in a specific area over time. Researchers use several different methodologies to construct housing affordability indices. Among the most useable are the Housing Affordability Index (HAI) and the Price-to-Income Ratio (PIR). The HAI measures the ratio between average household income and the income required to qualify for a loan to buy a house of average price in a specific area (Pink, 2009). The PIR is the ratio of the average house price to the average household income. When constructing the different indices, researchers use different income categories . For example, in the UK, some researchers have used first-time buyers' income, while others have targeted lower income people, regardless of their age. Furthermore, differences in the type of property, measurement (mean or median) central tendency and house class used can all affect readings of housing affordability. Such issues and differences among studies will be discussed below. The methods of measuring housing affordability are described in more detail in the methodology section.

Policy makers and governments use housing affordability indices to evaluate their plans and housing market interventions and to determine ways to improve market performance. Lower housing affordability indices indicates a reduction in individuals' ability to buy houses or qualify for mortgages. Lower affordability particularly affects individuals who do not own houses when they retire, since paying rent out of retirement income can significantly affect their budget and quality of life (McLaren et al., 2016). Furthermore, housing affordability can impact a country's stability and economic growth. For these reasons, solving the housing affordability issue is a primary concern for the government, and housing affordability has been studied extensively by both scholars and professionals in the real estate market, who use housing affordability information to evaluate housing issues, make business decisions and help policy makers improve local housing.

Although housing affordability methodologies are not a primary focus of this research, it is necessary to review the literature on housing affordability in general, since most of the issues related to housing affordability are important for understanding housing markets in general. This literature review considers housing affordability studies in Australia, the UK, Australia, Singapore, the US, Korea, China and Malaysia.

The UK has a long history of housing issues, including, primarily, rapid increases in housing prices and a shortage of supply (UKHR, 2016). As Hilber (2015) noted, the UK affordability crisis started in the 1960s and was still an issue upon publication of his report. He argues that the UK's slow supply of housing, despite population and real income growth, is influenced by the nation's planning system and that it has serious consequences on housing prices and housing affordability. As of 2014, the UK had the second-most expensive house price per square meter in the world (Hilber, 2015). Consequently, new house sizes in the UK are 40% smaller than those in other European countries with similar population densities (Hilber, 2015). Furthermore, the rapid increase in prices has worsened housing affordability in the UK, resulting in a PIR of 5.0 for the whole of the UK and a PIR of 8.5 for Great London. According to Poon and Garratt (2012), the UK's affordability PIR was 2.9 in the 1970s, 2.8 in the 1980s, 3.0 in the 1990s and 4.0 in the 2000s. Poon and Garratt (2012) had findings similar to those of Hilber (2015) and added that the average age of first-time buyers had increased from 30 years old in the 1980s, to 34 years old in 2004 to 38 years old in 2010 (Poon and Garratt 2012; Smith et al., 2010)

Australia is another example of a country struggling with affordability issues. Worthington (2012) studied this market by using the HAI method to measure housing affordability from 1985 to 2010, targeting first-time buyers. His findings showed huge fluctuations every couple of years, but a clear downward trend over time. Specifically, he found that Australia's HAI decreased from around 200 in 1985 to around 100 in 2010. These results suggest that the average Australian can barely afford to buy an average house. Worthington (2012) argued that this reduced affordability was due to economic growth, population growth, lower interest rates and the housing supply's slow response to increasing demand.

Housing affordability issues are not limited to the developed market. Zhang et al. (2016) studied 157 cites in China's housing market from 2002 to 2009 and noted the following. First, during the 2000s, 35 major cities in China showed rapid growth in housing prices, recording an average annual real appreciation of 17%. This growth was driven by the growth in the economy, which was, on average, about 10% annually. In markets with limited investment opportunities and attractive returns, investors found it worthwhile to invest in housing, which increased pressure on supply. This worsen China's affordability index, which rose from PIR 3.26 in 2002 to PIR 4.22 in 2009. Zhang et al. (2016) also referred to a report by E-house China R&D Institute, which found that the PIR of these 35 major cities reached 10.2 in 2013. Other researchers have attributed this rapid growth in prices to population growth and people moving from small cities to major ones (Garriaga et al., 2014). Zhang et al.'s (2016) main finding was that income inequalities drive investors to buy multiple houses, creating "ghost cities" that drive prices and reduce housing affordability for people with low or limited income.

Malaysia is another example of a developing country with housing affordability issues. Hashim (2010) studied two different states in Malaysia: Selangor, which is considered the country's most developed state, and Kelantan, which is undeveloped. Interestingly, the affordability index increased in Selangor from HAI 125 in 1995 to HAI 141 in 2006 and in Kelantan from HAI 77 in 1995 to HAI 196 in 2006; however, Hashim (2010) attributed this improvement to lower mortgage constraints and lower interest rates, not any real improvement in housing prices. Since the HAI method can be influenced by those factors, it is worth examining changes in median house prices and median incomes in the two studied cities. From 1995 to 2006, median house prices changed by 80% and -11% and median incomes increased by 60% and 77.5% in Selangor and Kelantan, respectively. In Selangor, therefore, it is clear that the HAI measurement method influenced the findings concerning the change in the affordability index, since the median house price growth was faster than the median income growth for the studied period. This conclusion is supported by Hartwich (2017), who used the PIR method and more recent data to consider Malaysia as a whole. He found that the PIR was about 4.4 in 2014: slightly higher than the UK, which is considered very unaffordable. Both studies used a ratio of median income to median house price without targeting lower-income individuals. Hashim (2010) argued that this approach provides less reliable affordability findings.

Kim and Cho (2010) studied the Korean housing market, which is considered a special case. In 1986, when housing demand was very high, housing affordability in Korea was PIR 11.0, and that in Seoul was PIR 19.0. To address this issue, the government decided to intervene in the housing market and provide an additional two million housing units—around half of the existing houses at that time—in four years. By initiating such a huge program and controlling the prices of new housing units, housing affordability improved to PIR 8.0 and PIR 14.0 in Korea and Seoul, respectively, in 1991. Then, in the early 2000s, Korea witnessed income growth followed by mortgage regulations, which further improved the housing affordability index, especially using the HAI method, which is highly sensitive to mortgage and interest rates. Using the HAI method, Korea improved to HAI 100 in 2009 from around HAI 80 in 2000, and Seoul improved to HAI 200 in 2009 from around HAI 100 in 2000. While when using the PIR, Kim and Cho (2010) found that the country's housing affordability worsened following the new mortgage system in 2000. Due to low interest rates and rapid growth in housing prices, Korea's PIR remained at PIR 4.0 from 2000 till 2009, while Seoul's PIR reached 10.0 in 2009 from around PIR 6.0 in 2000.

Housing affordability in Singapore is interesting because of the country's unique housing system. Singapore has among the highest household ratios in the world, with about 90% of Singaporeans owning homes. Furthermore, approximately 80% of Singaporean households own housing provided by the Housing Development Board of Singapore (HDB) (McLaren et al., 2016). This achievement is the accumulation of five decades of hard work focused on ensuring access to housing for all Singaporeans (McLaren et al., 2016). However, Singapore's market—which is that of a small, developed country with limited lands and rapid economic and population growth—does not support a stabilization of housing prices in relation to income. Yuen et al. (2006) studied the ability of Singaporean households that owned public houses to sell their homes and move to private houses. By interviewing 400 households in the year 2000, the authors examined owners' ability to move to private houses using two measurements: housing affordability, which they defined as a household's ability to pay its mortgage instalments, and accessibility, which they defined as a household's ability to pay its required down payment. They found that, although 80% of Singaporeans own public houses, approximately 34% could have afforded to move to a median-priced apartment, and 47% could have afforded to move to a moderately low-priced apartment; however, almost none could afford to move to detached houses at median and moderate price levels.

They also found that, in their sample, 42% had sufficient access to move to median-priced apartments, and 50% had sufficient access to move to moderately low-priced apartments; however, almost none had sufficient access to move to detached houses at median and moderate price levels. Yet, they found that only 16% both had sufficient access and could afford to move to median-priced apartments, and 34% had sufficient access and could afford to move to moderately low-priced apartment, but none had sufficient access and could afford to move to detached houses at median and moderate price levels. This problem related to moving to larger housing units is critical, since families grow and need more space over time. Another study by Abeysinghe and Gu (2011) constructed a housing affordability index for the Singaporean market based on the ratio of lifetime income to house price. They argued that using current income can bias the index by ignoring future income; therefore, they included expected future income, which they discounted at 5%. Like Yuen et al. (2006), they found that affordability is worsening over time. For example, in 1975, the lifetime income of a low-income individual was equivalent to 2.8 times the value of private property, while in 2007, the same individual's lifetime income was equivalent to only 0.8 times the value of the same private property. One can also consider the value of a low-income individual's lifetime earnings in relation to the resell of apartments from public houses. In 1990, a low-income individual's lifetime earnings were equivalent to 6.0 times the price of an average apartment in a public house, while in 2007, a low-income individual's lifetime earnings were equivalent to only 3.8 times the same housing unit. Hartwich (2017), who used more recent data, found that Singapore has a PIR of 4.8, which is considered very unaffordable. Hartwich (2017) commented that, although Singapore housing is not affordable, it is actually good when compared to that of similar major cities around the world, such as Hong Kong, London, Vancouver, San Francisco, Sydney, Melbourne and Auckland. They attribute this to the Singapore government's strong regulation and control of the housing market.

Finally, the 13th Annual Demographia International Housing Affordability Survey (ADIHAS), conducted in 2017, covered approximately 406 housing markets, including all of the US states, the UK, Australia, Hong Kong, Japan and New Zealand. Specifically, it examined the affordability of these markets from a PIR perspective, setting several ratios as indicators for affordability. The most affordable category, "Affordable", referred to countries with a PIR of 3.0 or lower; "Moderately Unaffordable" referred to PIRs between 3.1 and 4.0; "Seriously Unaffordable" referred PIRs between 4.1 and 5.0; and "Severely Unaffordable" referred to PIRs greater than 5.0. The report covered several housing issues, some of which are relevant to this research. Since affordability is influenced by median income and median house price, it is possible to observe differences among markets within the same country. For example, of the 262 US housing markets considered in the

ADIHAS (2017), 82 were affordable, 36 were severely unaffordable and the rest were in between. Racine, WI, had a PIR of 1.8, while Santa Cruz, CA, had a PIR of 11.6. Similar discrepancies can be observed when comparing London to other UK cities, Sydney to other Australian cities and Kuala Lumpur to other Malaysian cities. The study also found that the majority of major cities with populations of more than five million are severely unaffordable. Demand in those cities seems to be driven by population growth, job opportunities. Another interesting finding relates to cities with more and less restrictive land use. Specifically, with a few exceptions, of the 50 cities with more than two million residents, those with lower scores (more affordable) had fewer land restrictions. This result supports Hilber's (2015) findings relating to the UK market, as well as the findings of other studies on Australia and certain US cities. Based on its 13 published reports, ADIHAS (2017) concluded that housing affordability is worsening all over the world. To address this issue, governments worldwide need to take more action to make houses more affordable for people with low and median incomes.

The studies discussed in this section illustrate that housing affordability is a serious matter for individuals, corporations and governments. Expensive houses reduce family incomes, lower living standards and raise poverty rates (ADIHAS, 2017). These results impact individuals first, but ultimately affect governments and the economy in general. Therefore, it is important to understand what drives the housing market and to develop solutions to control or stabilise fluctuations.

2.2 Factors influencing the housing market

The factors influencing housing prices differ from one market to another and over time. As a result, every market is unique and responds to its own mix of influences, which may affect the market at different times (with different lags). This section reviews the main factors influencing housing markets in different countries by examining a representative selection of the extensive research on this topic.

2.2.1 Economic performance

The first factor to consider when examining housing prices is economic growth, which is measured using GDP and/or individual-level measures, such as income growth. In a study of 15 countries, Adam and Fuss (2010) found that increases in real income, construction costs and short-term interest rates have positive impacts on housing prices, while long-term interest rates have a negative impact. Kasparova and White (2001) and Iacovello and Minetti (2003) found similar results. A recent study by Bełej and Cellmer (2014) observed the city of Olsztyn in Poland between 2001 and 2011 with a focus on the following variables: GDP, inflation rate, interest rate, unemployment rate and number of new dwellings. Consistent with previous studies, they found that GDP is highly positively correlated to housing prices, while inflation and number of new dwellings have a cyclic relationship and interest rate and unemployment have a negative relationship. Bełej and Cellmer (2014) also considered the lags of different factors and found that different variables have their strongest influences after different time lags. For example, the strongest relationship between housing price and interest rate can be observed at 36 months, that between prices and inflation occurs at 13 months, that between prices and unemployment rate occurs at 7 months and that between prices and GDP occurs immediately. Similar trends have been observed in the Australian housing market. For example, the Select Committee on Housing Affordability in Australia (SCHAA) (2008), the Organisation for Economic Co-operation and Development (OECD) (2011) and Worthington (2012) all noted that Australia's strong economy in the 1990s and 2000s improved household income and housing quality and drove investors toward the housing market, all of which increased housing prices.

2.2.2 Inflation

Another important factor to consider in relation to housing prices is inflation. This factor is particularly important from the perspective of policy makers seeking to reduce or control housing price increases. Inflation has been found to significantly affect not only housing prices, but also household consumption and the economy in general (Kuang and Liu, 2015). A recent study by Weida and Peng (2015), which tested 35 major cities in China from 1996 to 2010, found a high correlation between inflation and housing prices, but also found that inflation has a greater impact on housing than housing has on inflation. This finding is consistent with earlier studies by Bond and Seiler (1998), Kenny (1999) and Case and Shiller (1990), all of which found that inflation positively influences housing prices in different markets, including the US, China and Ireland. Some studies have also found that housing prices can be used to forecast inflation. Interestingly, both Shiratsuka (1999) and Qiu (2011) found that housing price changes causes inflation, while Goodhart and Hofmann (2000) and Filardo (2000) found that housing prices are useful in predicting inflation. However, other studies have found no evidence that inflation affects housing prices. For example, in a study using 168 different economic indicators, including real estate pricing, to predict inflation, Stock and Watson (1999) found no positive evidence.

2.2.3 Interest rate

Many researchers have studied the influence of interest rates on housing prices; however, they have observed different findings. Some studies have found that interest rates negatively affect housing prices. For example, Mcgibany and Nourzad (2004) studied the US market and found that increased interest rates negatively influence housing prices only in the long term and have no effect in the short term. This is in consistent with Taylor (2009), who found that low interest rates contribute heavily to the recent boom and bust in the US. This relationship is especially evident when considering areas with inelastic housing supply, since such markets are unable to quickly respond to increased purchasing activity on the part of both renters and investors, leading to price bubbles. By contrast, high interest rates may reduce the demand for mortgages. Looking at Australian market, SCHAA (2008), the OECD (2011) and Worthington (2012) all found that, during times of low inflation, interest rates fall and lenders compete to make mortgage terms more attractive, all of which drive housing demand from both owner-occupiers and investors.

By contrast, Shi et al. (2014) found that housing prices were positively correlated to interest rates in the New Zealand market from 1999 to 2009. This finding is interesting because most studies have found a clear negative relationship between interest rates and housing prices. However, Shi et al.'s (2014) results could be explained be several variables, such as a supply shortage, regulation changes and the expectations of investors and homeowners concerning housing prices. The observed positive relationship could also be due to Mcgibany and Nourzad's (2004) findings showing that raising interest rates can have different impacts. Specifically, though high interest rates reduce demand, causing prices to drop, raising interest rates also increase supply costs, which could cause prices to increase. Ultimately, housing prices will rise or fall based on which of these two factors—supply or demand—is most dominant.

2.2.4 Housing Mortgage

Another important factor influencing the housing market is the availability of mortgages and their terms and restrictions, such as the minimum down payment, the length of the mortgage period. Many governments have tried to influence the housing market by relaxing or restricting the minimum required down payment for the sake of improving the market or controlling it. Chu (2014) tested the US market for the period from 1995 to 2005 and found that housing prices are very sensitive to down payments. He further found that reduced down payments and increased income explain a significant portion of the increase in housing prices for that period. This finding is similar to that of Kiyotaki et al. (2011), who found that houses ownership increased from 64.08% to 89.92% when down payments decreased from 20% to 10%. A similar study by Sommer et al. (2010) found that ownership increased from 66% to 81%. Chu (2014), Hwang et al. (2010) and Bełej and Kulesza (2015) also found that the down payment influences housing prices in different markets, including the US, Korea and Poland. To take advantage of this relationship, many governments have tried to influence the housing market through changes in mortgage regulations. However, Hwang et al. (2010) and Rahman (2010) raise an important issue regarding the relaxation of mortgage terms: specifically, although such initiatives give people in rental markets access to homeownership and improve the housing market for a period of time, they can also causes bubbles followed by crises except in markets with perfectly elastic supply, which is true of very few countries. They concluded that this is exactly the phenomenon that caused the 2008 mortgage crisis in the US. Similarly, the mortgage system in Korea experienced a turning point when the government allowed commercial banks to provide mortgages to households in the early 2000s (Kim and Cho, 2010). In their competition to lend to prospective homeowners, these banks offered various mortgage products, which opened up access to the housing market, shifted the demand curve and caused a rapid increase in housing prices. In just a few years, the outstanding mortgage debt in Korea increased from 10 percent of GDP to 35 percent (Kim & Renaud, 2009). This example illustrates the influence mortgages have on the housing market.

2.2.5 Major global events (politics, wars and terrorist attacks)

It is believed that today's markets, especially today's financial markets, are integrated and that news or events in one market can significantly impact other markets. Property markets are certainly not isolated from major national or foreign events, such as instability, wars or terrorist attacks. Since this paper focuses on Kuwait, it is necessary to consider recent events in Kuwait and in the Middle East and North Africa (MENA). Although there is a lack of studies on the impact of these events on the housing market, we will consider the impact of such events on the economies of their respective countries and their financial markets, whenever possible.

Mousavi and Ouenniche (2014) studied the impact of the revolutionary movements collectively called the Arab Spring in MENA on 53 financial markets throughout the globe. They included financial market from six regions: developed countries, developing countries, MENA, Asia, Europe and Latin America. They also tested the impact of these events on oil and gold. To conduct their study, they select four major revolutionary events: those in Tunisia, Egypt, Libya and Yemen. Interestingly, they found that these events significantly influenced the market volatility (including for oil and gold) of all six regions. An earlier study by Nikkinen et al. (2008), which focused on how 53 global financial markets reacted to the September 11 attacks, noted that not all markets had similar reactions to the event. Except for MENA, all regions—developed countries, Europe, Latin America, Asia and transition countries—exhibited a significant drop in returns immediately after the event, followed by a significant rebound over longer period (three to six months). However, all regions also exhibited significantly increased volatility after the event. The authors suggested that these results depended on the level of integration among the studied markets. Last, they compared the September 11 attacks to other financial events, such as the 1987 crash and the 1997 Asian crisis, and noted that, unlike after these other financial events, financial markets quickly rebounded following the attack event. They attributed this result to either the market becoming more resilient or the possibility that political and terrorist shocks have different impacts than economic and market shocks.

Chan and Wei (1996) observed another example of differing market reactions to political and economic events in the Hong Kong market. In the Hong Kong financial market, some stocks are categorized as blue-chip stocks (stocks controlled by Hong Kong and British businessmen), while some are categorized as red-chip stocks (stocks controlled by enterprises owned by the People's Republic of China [PRC]). To conduct their test, Chan and Wei (1996) examined news headlines related to Sino-British confrontations or cooperation events published on the first page of *South China Morning Post*, one of the major newspapers in Hong Kong. Days in which such headlines were published were considered "events". Although the authors found that both blue-chip and red-chip stocks exhibited significant volatility on event days, they found that only blue-chip stock returns were vulnerable to political news, while red-chip returns exhibited no reaction. Based on these findings, the authors suggested that red-chip stocks are considered by the market to be a safe haven.

An earlier study by Abadie and Gardeazabal (2001) sought to measure the impact of terrorist activities on the economy by comparing Basque Country in Northern Spain with comparable areas within Spain that lacked terrorist activity. They found that Basque Country had, on average, a 10% less GDP gap per capita than other areas. They also found the drop in per capita GDP was associated with the intensity of terrorist activity over the sample period from the 1960s to the 1990s. They concluded that these terrorist activities resulted in Basque Country, one of the richest regions in Spain, to drop from having the third-highest per capita GDP in the 1970s to the sixth-highest per capita GDP in the 1990s.

Using the CAC, Dow Jones and FTSE indices, Schneider and Troeger (2006) studied the reactions of three US financial markets to wars in other countries. Specifically, they examined the impacts of the 1991 Gulf War between Kuwait and Iraq and the conflict among Palestinians, Israel and former Yugoslavia. They found that financial markets typically react negatively to international crises, but also noted that Wall Street exhibited some conflicted reactions to events in the Gulf. They attributed this discrepancy to the fact that markets have different sensitivities to political events, which might result in different reactions in different financial markets.

Chau (1997) studied how the political uncertainty associated with the 1997 repossession of Hong Kong by Mainland China affected Hong Kong real estate markets. He found that the 1983 reveal of the 1997 repossession issue increased the risk premium of Hong Kong investments, specifically in non-residential real estate. Interestingly, despite the uncertainty surrounding what would happen after 1997, the residential sector in Hong Kong exhibited a far smaller risk premium increase than other real estate sectors over the sample period (1978 to 1994). The author attributed this to the dual nature of the residential sector, since residential homes can serve as both investment goods and self-consumption goods. Overall, he found that, despite the uncertainty surrounding what would happen in 1997, investors had high levels of confidence in the Hong Kong market is strong. As a result, the risk premium associated with real estate market gains gradually increased following the 1983 announcement of the 1997 repossession, though, as of 1994, they had not returned to the pre-1983 level. He concluded that, if the concerns surrounding the 1997 repossession proved unnecessary, then, in 1997, the Hong Kong market would readjust, risk premiums would go down and real estate prices would increase.

2.2.6 Speculation and investment

Speculators, second-home buyers and other investors in the housing sector are among the sector's primary price influencers. Wheaton and Nechayev (2008) examined how prices increased in 59 markets in the US from 1998 to 2005 in response to such demand fundamentals as income, interest rate and population. They found that actual prices are far higher than the level explained by the fundamentals, indicating the possible existence of a bubble. Interestingly, they attributed this discrepancy to two new influences in the US market: cheap credit availability and second-home buyers. They found that most of the differences between fundamentals and actual prices occurred in larger markets, markets with many second-home and speculative buyers and markets with the highest indicators related to sub-prime mortgage activities.

In another study, Case and Shiller (2003) suggested that bubbles result from unrealistic expectations about future housing prices influenced by speculative feedback and social contagion (Escobari et al., 2013). In addition to testing for market fundamentals, Case and Shiller (2003) developed and distributed a questionnaire examining the factors that influence home purchasers. Using a sample of approximately 700 new purchasers in different US states, they found that excitement, word of mouth and exaggerated expectations of future housing values play significant roles in purchasers' decisions and can produce housing bubbles. For example, while expectations of price increases may motivate investment buyers, shocks to the market could cause price crashes. Furthermore, home buyers with high expectations are unlikely to consider the risks associated with buying houses or the consequences of a drop in the real estate market. Surprisingly, the authors observed that this factor—the expectation of future price growth—was present in roughly 90% of the sample and that most potential home buyers expected an average yearly growth of at least 10% for the next 10 years. As a result, many homeowners bought houses based on the assumption that they would be unable to afford future prices. Together, all of these factors can significantly influence the housing market, increase instability and ultimately create a housing bubble followed by a crisis.

2.2.7 Housing Supply

Housing supply is an important variable that always influences the housing market. Yan (2014) explained that when the market demand faces shocks due to population growth, income growth or reduced mortgage costs, housing prices will increase, unless the market has high supply elasticity (unless the market is capable of quickly responding to demand). Consistent with this finding, Ball et al. (2010), Caldera and Johansson (2013) and Wang et al. (2012), as well as many other researchers, have conducted studies on different markets, regions and countries and found that supply inelasticity causes rapid increases and volatility in housing prices. For example, Glaeser et al., (2008) found that, due to heavy zoning restrictions, US coastal states exhibit higher price volatility than other states. Zoning restrictions affect supply elasticity and increase the likelihood of housing bubbles. Ball et al. (2010) and Glaeser (2008) argued that bubbles are less likely to occur in markets with high supply elasticity because of the availability of new supply.

Ihlanfeldt and Mayock (2014), by contrast, suggested that supply elasticity has an ambiguous effect on housing prices. On one side, higher supply elasticity could result in overbuilding during boom periods, which could produce significant excess inventory followed by a major decline in prices following the boom periods. However, on the other side, higher supply elasticity means less price appreciation during boom periods, which might be followed by minor corrections after the boom periods. The difference between these two possibilities might be highly related to timing and the market itself, since a market that is inelastic during a boom period might drop heavily after the boom if supply elasticity significantly improves. This finding is consistent with Stevenson and

Young (2013), who found that a recent increase in supply elasticity in the Irish market could be among the factors causing prices to fall after a boom.

It is important to understand what influences the responsiveness of housing supply to price or demand increases. Caldera (2013) classified these factors into two groups: policy factors, such as policies related to land use and planning, and non-policy factors, which are related to geographical or demographic conditions. The vast majority of the literature clearly suggests that land use and planning policies can affect housing markets.

The UK, for example, is a market with very heavy restrictions on land use and planning. According to Poon and Garratt (2012), the UK has witnessed a sharp decrease in housing supply since the 1960s, with volume of new houses dropping from 400,000 per year to half of that in the late 1980s. Hilber (2015), Cheshire (2014), Cheshire et al. (2014), Hilber and Vermeulen, (2010) and Overman (2012) all attributed this drop and the resulting affordability crisis to the UK's planning system, mainly in London and the Southeast. Hilber (2015) explained that the UK re-implemented the Town and Country Planning Act of 1947, which he called "extraordinarily rigid by world standards". Because of this shift, the UK faces a long and complicated planning process involving green belt areas, strict height controls, a lack of fiscal incentives to develop at the local level, "not in my backyard" behaviours and local political involvement (Hilber, 2015). Australia also has a complicated planning system, which drives a less elastic housing supply (Worthington, 2012). All three tiers of Australia's government are heavily involved in housing planning and land zoning. As in the UK, Australia's complicated system, long process and government involvement have caused the housing supply to be very inelastic.

In addition to the just-mentioned political factors, it is worth reviewing the non-political factors, including geographic and demographic conditions. Worthington (2012) showed that Australia has a high population concentration in its main cities and explained that these cities face challenges due to geographical constraints. For example, Sydney has an ocean on the east, mountains on the west and national parks on the south and north, limiting development to a narrow space in the northwest and southwest. In some cases, the supply of housing is limited not only by land restrictions, but also the condition of the lands to be used for housing development (Worthington, 2012). Compared to Australia, Kuwait has few geographical constraints other than the oil refineries, which cannot be near residential areas. However, more than 89% of Kuwait's geographic area is free land; therefore, the oil refineries should not be considered a main cause of the supply shortage. However, though Kuwait is currently using only 11% of its land, the rest is not yet suitable for development, since it lacks infrastructure, water, electricity and facilities. Furthermore, these unused lands are not zoned and are fully owned by the government. Until recently, most of the open lands were restricted by either the Ministry of Oil or the Ministry of Defence, which was one of the main reasons for having low supply in the last years. Experts in the Kuwait housing sector consider this controlled supply shortage in housing supply to be the main factor causing the continued increase in housing prices over the last two decades. Furthermore, although there is a secondary market, it is largely insignificant with respect to the overall housing supply because sellers are usually simultaneously looking for replacement houses and because the number of houses in the secondary market is far lower than the accumulated demand.

2.2.8 Demographic

Population growth is among those factors that significantly influence housing prices. Since population is the main driver for housing demand, population growth in an area with a slow supply response will increase prices. When studying the Australian housing market, Worthington (2012) noted that, unlike other large countries, such as the US, the UK or Canada, Australia has a very high urban concentration in few cities. In Australia, 57 percent of the population lives in the five largest cities, compared to 18 percent in the US and 27 percent in the UK (Callaghan, 2010). Natural growth, movement from small cities and immigration all increase the demand for housing in these major cities. Worthington (2012) found that, in this situation, population growth significantly influences housing price growth, especially during periods when supply has been inelastic. Mankiw and Weil (1989) studied the US market over a longer time period to test the impact of demographics on housing prices. Interestingly, they found that demographics can drive housing prices not only upward, but also downward. For example, in the 1950s, population growth pushed housing prices upward; in the 1960s, a population drop reduced housing prices; and in the 1970s, the population grew again, causing housing prices to jump. The authors found that a population increase of one percent causes a corresponding housing price increase of five percent. Bracke (2013), who studied 19 OECD countries from 1970 to 2010, similarly found that population growth is a main driver for housing price increases.

The majority of the literature focused on markets, such as the US, UK, Australia and Canada, which have a large population; however, it might be worth considering other markets with smaller populations and determining whether demographics has a clear influence on housing prices. Caldera and Johansson (2013) studied 21 countries, some of which have a population size that is relatively similar to Kuwait and other emerging countries. Belgium, Sweden, Denmark, Finland, Ireland, Switzerland and New Zealand are some of the countries included in the study by Caldera and Johansson (2013). With the exception of Finland, all the other countries showed that the growth of the population had a statistically significant impact on the housing prices.

2.2.9 Government tools

2.2.9.1 Policies

All factors influencing the housing market are impacted to some degree by government intervention. Some of these impacts are positive. Taking the UK as an example, Tsai (2014) tested the influence of monetary policy on housing prices between 1986 to 2011. Specifically, he sought to determine whether monetary policies related to the supply of money and short-term interest rates affect housing prices. He found that easing monetary policy significantly affected housing prices and could cause a housing price bubble if the overall macroeconomic condition was not considered. The World Banks' (1993) strategy to improve low- to medium-income housing options in China used similar principles to propose major changes in housing regulations. This strategy focused on improving demand by developing property rights and mortgage financing and improving supply by providing infrastructure, regulating land and promoting development. This strategy improved the housing market and allowed the private sector to contribute to the housing sector.

However, some government interventions have the opposite effect on the housing market. Interestingly, Cao and Keivani's (2013) study of the 1993 World Bank strategy for China found that, although the strategy improved the housing market, it also influenced speculative behaviour and housing investment, which affected housing prices. Therefore, the Chinese government implemented new initiatives to slow down the housing market by reducing the number of certain buyers (but not those targeted by the World Bank strategy). Specifically, China implemented three new policies after 2004: taxes on property transactions, occupation and ownership; changes in mortgage terms, such as down payment requirements and interest rates; and purchasing restrictions on buyers who own more than one property. Cao and Keivani (2013) found that these policies significantly impacted the housing market. Ultimately, they concluded that the World Bank's strategy alone is insufficient to solve housing issues and that collaboration between the market and the government is also necessary.

In another example, the Singaporean government took action to address the rapid increase in housing prices resulting from a population increase, low interest rates and high liquidity (Phang et al., 2014). First, the government recommended reviewing the land supply regime, not to reduce land availability, but to allocate land to the right categories. Second, the government provided alternative investment options, such as Real Estate Investment Trusts (REITs), to reduce the investment pressure on housing demand. Last, the government introduced a property tax and a seller stamp duty to discourage multi-unit and foreign buyers. Together, these policies had a major impact on the housing market. A similar situation can be observed in the Hong Kong market. La Grangei and Pretorius (2002) examined the effect of government policies to provide affordable rental houses in the private rental market between 1983 and 2000. They found that this strategy seriously decreased activity in the private rental sector, causing the private rental market to drop from 43% in 1983 to 28% in 2000. This example shows how a strategy to provide affordable rental houses, which was not intended to affect the private rental market, had a significant negative impact. In sum, it is important for governments to consider the entire macro-economy when implementing policies, since some policies could have a major negative effect on different sub-markets.

2.2.9.2 Taxation system

Governments use different kinds of real estate taxes to influence the market, such as stamp duties, income taxes, capital gains taxes (CGT). In Singapore, to discourage public households from selling their houses shortly after purchasing, the government introduced a penalty stamp duty for vendors (Maclaren et al., 2016). According to this duty, sellers must pay an additional 16 percent stamp duty if they sell an apartment in the first year of owning it, 12 percent if they sell in the second year, 8 percent if they sell in the third year and 4 percent if they sell in the fourth year. Similarly, the UK recently introduced a CGT on non-residents selling residential units after April 2015 (HM revenue & customs, 2016). This act ensures that non-residents, who used to have an advantage over locals, are treated the same as UK residents. Ultimately, the CGT was designed to reduce the attractiveness of foreign investment trading in the residential sector.

Taxes can also have the opposite effect: they can be reduced in order to attract local or foreign property buyers. For example, in Australia, the government exempts first-time buyers from a stamp duty up to $24,990 (Maclaren et al., 2016). Quayes (2010) tested the impact of the introduction of CGT relief in the US on sales volume and found that the relief initiative significantly increased sales by 28% in five years. In Malaysia, to promote the development of high-end properties in Kelantan, the government offered stamp duty exemptions, eliminated the CGT and offered individual income tax relief on loan interest for properties with values greater than RM180,000 (Hashim, 2010).

2.2.9.3 Mortgage regulation

Governments can also control the housing market using mortgage regulations. As noted before, in their study of the Korean market, Kim and Cho (2010) showed that the government's policy allowing commercial banks to provide mortgages to households drove the housing market and increased housing prices, household wealth and lifestyle. These results are often government objectives, since governments seek to help individuals buy houses and have better lives. However, sometimes, the government seeks to reduce housing prices or reduce the demand pressure on housing. Park et al. (2010) studied the Korean government's policy to stabilise housing prices after years of rapid increase by examining different markets, some of which were considered "hot markets" and some of which were considered "cold" with respect to housing market strength. By reducing the mortgage ratio from 60% to 40%, the government immediately reduced the demand pressure on prices, but only in cold markets. Hot markets, by contrast, were not significantly influenced. Although the initiative achieved the government's goal, Park et al. (2010) expressed their concern that it could also reduce the ratio of houses sold to houses for sale, which could reduce prices instead of stabilising them.

Governments can also intervene when a market is about to collapse or already in crisis. Scanlon (2011) studied government reactions to the global crisis in 2008, focusing specifically on their interventions in mortgage lending to reduce housing crises. They found that few actions had been taken. Governments and central banks tried to encourage new borrowers to take out loans and to help those borrowers who were struggling to make payments avoid foreclosure. Governments also increased the money supply and reduced interest rate: for example, the US Federal Fund reduced rates from 5.26 in March 2007 to 0.18 percent in May 2009; the Bank of England reduced rates from 5.75 percent in July 2007 to 0.5 percent in May 2009; and the European Central Bank reduced its refinancing rate from 3.75 percent in October 2008 to 1.0 percent in May 2009. In addition, many central banks purchased mortgage loans, bonds and mortgage-backed securities, all of which helped lenders and borrowers in the housing market survive the crisis.

2.2.9.4 Support (first-time buyers)

Governments can also intervene in the housing market by providing support to specific types of individuals, such as individuals with lower incomes and first-time home buyers. Some of the countries best known for providing such support are the UK, Australia and Singapore. In the UK, the government provides home buyers a variety of support options. For example, first-time buyers can take out a 20% (40% in London), five-year interest-free loan from the government to buy a property worth a maximum of 600,000 pounds, as long as they can afford to pay the 5% deposit. These home buyers borrow the remaining loan amount from the market. The government also guarantees that commercial lenders will lend buyers up to 95% of the property value, as long as the buyers can pay the remaining 5% using their own funds. This scheme, which was called the Help to Buy program, expired in 2016. In Australia, first-time buyers receive a $7,000 grant and are exempted from duties up to $17,990, totalling $24,990 in government support (Worthington, 2012).

In Singapore, the support structure is different because the government acts as a housing developer, developing affordable apartments to be sold to first-time buyers at a price 20% lower than the market value (McLaren et al., 2016). Those apartments are categorised as public housing and provided by the Housing Development Board of Singapore (HDB). Although individuals buy such apartments under 99-year lease-holds, the government offers home owners the option to upgrade, sell, downgrade or even sub-let their apartments. HDB buyers receive long-term loans at a rate of 2.6 percent (Phang & Helble, 2016). In 2012, the Singapore government extended the loan repayment period to 35 years (Maclaren et al., 2016). In addition, the Central Provident Fund (CPF) plays a significant role in Singapore’s housing market. This fund not only provides funding to Singaporeans who are retiring, but also helps Singaporeans buy homes. Singapore citizens can use the CPF to buy homes in two ways: to pay their 20% down payment or to pay monthly mortgage instalments. This is useful, since accumulated CPF amounts are often high. Employers contribute approximately 15% to 20% of employees’ income, while employees contribute 20% (Maclaren et al., 2016). This funding source is clearly useful and has helped many Singaporeans purchase homes (Maclaren et al., 2016).

Hilber (2015), Poon and Garratt (2012) and other researchers have commented that, though the various forms of government housing support influence the demand side of housing and increase people’s access to housing, they do not solve the main problem in the housing market, which is an inelastic housing supply. Furthermore, such measures might attract housing investors rather than first-time buyers.

In sum, governments and policy makers can implement various measures to influence the housing market. Though these actions are important for stabilising and improving the housing market, they may also have unwanted consequences in the short or long term.

3.0 Research questions

This section identifies the main research questions and objectives. The paper aim is to study and evaluate the Kuwait housing market as an example of housing in emerging markets. The five research questions are as follows:

How does housing affordability change over time in the targeted market?

To understand the housing market in Kuwait, it is essential to determine how the housing market moves in relation to citizens' income and housing affordability. Answering this question will provide a good foundation to the literature on the Kuwait housing market, and the findings offer insight into the demand side of housing. The constructed Housing Affordability Indices are the first such indices to be constructed for Kuwait.

What drives housing prices in the targeted market?

The main objective of this paper is to understand what drives the Kuwait housing market. This question evaluates the challenges and problems in this market and seeks to find solutions and develop predictions about future market performance. Such information is critical, especially given Kuwait's major development plan, Kuwait Vision 2035, which seeks to double the existing number of houses in Kuwait.

Can adjustments to data, such as the use of quarterly data, rolling over and smoothing, improve housing modelling?

Modelling housing on a high frequency (a monthly frequency) is challenging, and results might be highly influenced by short-term fluctuations. This could result in less accurate findings, no findings or even incorrect findings. Therefore, to ensure the accuracy of the readings and the consistency of the findings, we construct a different model with the following adjustments: quarterly frequency data, a rolling period of 10 years (four sub-samples), and smoothing the HPI at three different levels: 3-, 6- and 12-month moving averages.

Is the housing market in the targeted market influenced by speculation and investment?

It is interesting to consider the influence of non-owner occupier in the Kuwait housing market. Do investors play a significant role in this small market, which suffers a serious shortage of houses? Although the Kuwait housing market is a closed market, limited to Kuwaitis and GCC residents only, is it considered an alternative investment? Answering this will provide additional insight into the market and address whether further actions related to housing investment need to be taken. To answer this question, we consider two alternative investments: the Kuwait stock exchange (a risky investment) and gold (a safe investment). also consider the lagged HPI, which used to provide readings of speculation in the housing market.

How sensitive is housing in the targeted market to local and regional events?

Since houses are illiquid assets, meaning that buyers normally keep them for longer than other kinds of assets, it is interesting to explore market confidence in this sector in relation to major events happening in Kuwait and in the region. Those events include political events (the Arab Spring), changes in presidency, changes in taxes and terrorist attacks. Specifically, we explore whether these local and regional events influence the housing market in any direction.

4.0 Data

Collecting data in emerging markets is challenging because of the limited availability of data and potential issues of confidentiality. We sourced some of our data from official governmental websites and other data from a related party, which collected the data manually. Unlike most similar studies, which use quarterly or annually data, the present paper studies the housing market on a monthly frequency. Since data for many variables tend to be available only at lower frequencies (quarterly or annually), we replaced these variables with appropriate proxies, such as GDP, housing supply, demographics. The sample begins in February 2004 and continues through March 2017. Further details about the data and their sources are as follows:

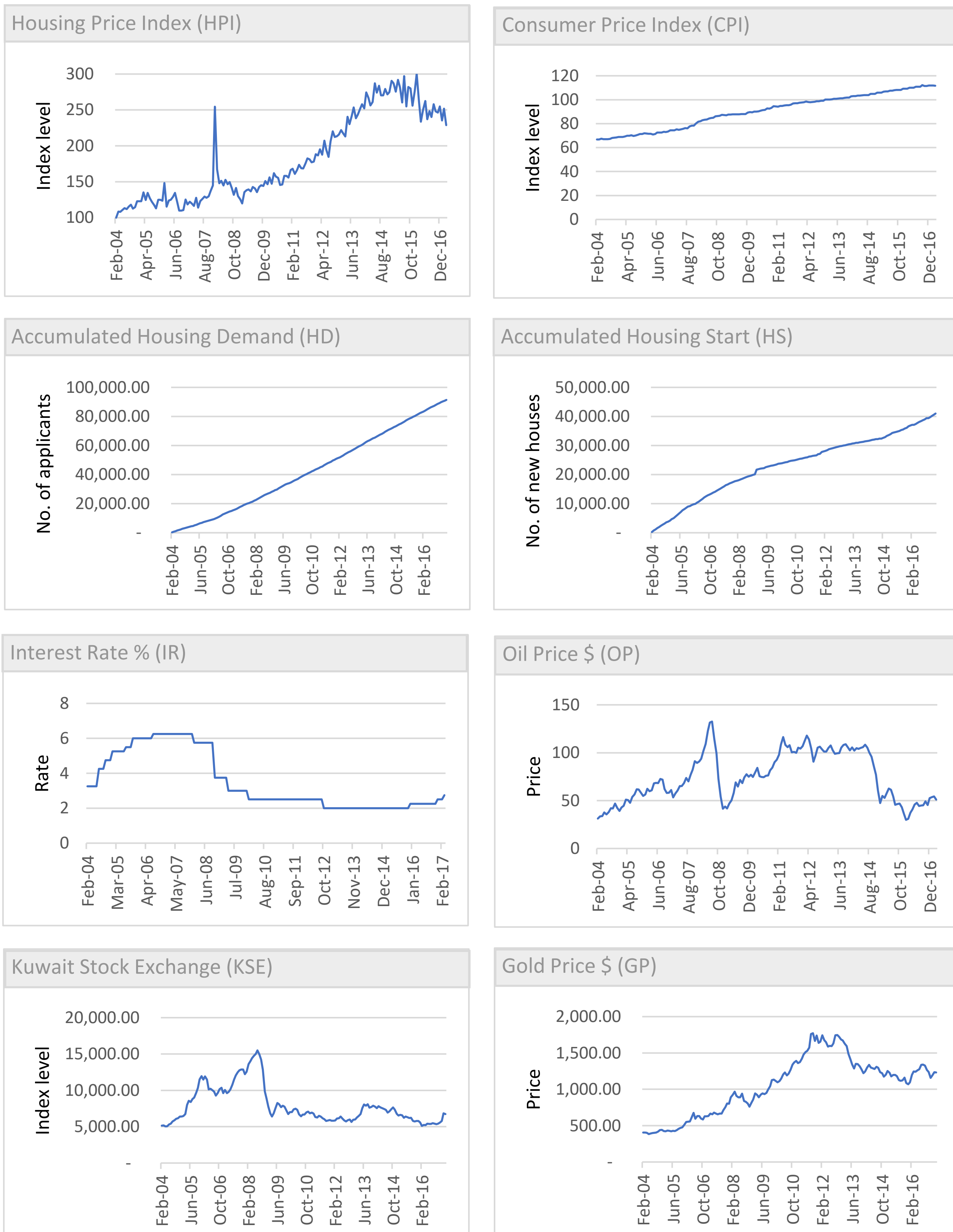
HPI and transaction volume

The HPI, the dependent variable in this research, was selected from the 74 indices constructed in paper one. The index selected was index number 59, one of the lower root mean squared error indices. This index is based on the median tendency using the Fisher weighting method for houses transactions in all Kuwait cities excluding Sabah Alahmad. The transaction volume of houses sold was collected after removing outliers and transactions from Sabah Alahmad Sea City. The resulting index comprises 158 monthly observations. The transactions used to construct the index were collected from the Kuwaiti Ministry of Justice.

Oil prices

In a country like Kuwait, in which oil production accounts for 95% of the national income, it is logical to use oil price as a proxy for national economic performance or GDP. This approach allows us to study housing market at a higher frequency, using monthly observations. Using data collected from the World Bank, we calculated the simple average of three spot prices for crude oil (petroleum): the Dated Brent, the West Texas Intermediate and the Dubai Fateh, priced in US dollars per barrel. The graphic below illustrates that oil prices grew steadily at the beginning of our observation period, then dropped significantly in 2008. A similar cycle then began, with another major drop at the end of 2014.

Graph 1: HPI and explanatory variables



Income

Since this paper targets Kuwaitis, we turned to the Kuwait Public Institution For Social Security (KPISS) to find information on income for all Kuwaiti with jobs. The KPISS supplied annual reports for 2004 onward. Each report lists income by age group and sector (government, petroleum and private sectors). It has been found that, in 2015, approximately 74.1% of Kuwaitis were working in the government sector, while 7% and 18.9% worked in the petroleum and private sectors, respectively. Based on these data, we chose to use only the incomes of individuals working in the government sector (not considering the other two sectors). Since we use income to construct our affordability indices, we must consider two things: first, that the vast majority of Kuwaitis work in the government, and second, that the income of workers in the government sector is far lower than the income of workers in the other two sectors; therefore, sector is a reliable representation of the majority of lower- to middle-income people in Kuwait. For example, in 2015, the average male aged 36 to 40 working in the government sector earned K.D. 1,360, while the same type of individual working in the private and petroleum sectors earned K.D. 2,010 and K.D. 2,620, respectively (KPISS, 2015). The income measure includes individuals' primary source of monthly income and any additional income (support, allowances). Since our paper focuses on housing, an asset typically associated with families rather than singles, we extrapolated family income by assuming that both parents work in the government sector. Therefore, we added the average female income to the average male income for each age category. Further details are provided in the findings section.

Housing demand

In most housing research, authors use demographics to reflect expected housing demand or measure the influence of demand on housing prices. In this research, we will use a unique measurement for demand that has not yet been considered: the accumulated number of monthly applicants to the Public Authority of Housing Welfare in Kuwait (PAHWK), starting from February 2004. Interestingly, this number is the most accurate representation of Kuwait housing demand, as it only lacks the demand from short- and long-term investors. This perfectly suits the Kuwait market for the following reasons. First, Kuwait is a closed market that is generally limited to Kuwaitis; therefore, there is no need to study the factors attracting foreign buyers, since there are none. Second, single male and female Kuwaitis tend to live with their parents until they get married. Last, all Kuwaitis who get married and do not already own a house have the right to apply to PAHWK to get a house, land and an interest-free loan. Therefore, the monthly applicants to the PAHWK is a closed representation of housing demand in Kuwait. Data on applicant numbers were collected from the PAHWK on a monthly basis. These data show that the number of applicants is relatively stable each month, exhibiting steady growth with no fluctuation.

Housing starts

To measure the supply side of housing with high frequency and accuracy, we sought data on the number of new houses supplied with electricity from the Ministry of Electricity. These data communicate the number of houses coming onto the market and are more accurate than data on the number of applications approved to start construction (available from the municipality of Kuwait), since construction can take anywhere from 18 to 36 months. Therefore, to ensure accuracy, we used the accumulated number of houses supplied by the Ministry of Electricity, with our dataset beginning in February 2004.

Other variables

Other important variables that were already measured at high frequency include the Consumer Price Index (CPI; to represent inflation), and interest rates, all supplied by the Central Bank of Kuwait. Another important variable is the Kuwait All Stocks Index from the Kuwait Stock Exchange (newly named Kuwait Bursa). Last, we considered the price of gold as a variables that might influence housing prices in either direction. We collected historical data on gold prices from the World Gold Council official website.

5.0 Methodology

In this section, we describe the methodologies used in this research. This section is arranged in three parts. First, to explain the methodologies used to construct the housing affordability indices. Second, to explain the methodologies used to model the housing market. Last, to explain the methodologies used to test the events influencing the housing market.

5.1 Housing affordability indices

As mentioned in the literature review section, two of the most useful ways to measure housing affordability are the Housing Affordability Index (HAI) and the price-to-income multiplier (PIR).

5.1.1 Housing affordability index (HAI)

The HAI measures the ratio between average household income and the income required to qualify for a loan to buy a house of average price in a specific area (Pink, 2009). This index is influenced by many factors, including family incomes, house prices, interest rates and mortgage restrictions concerning income instalments and maximum loan period. The formula to calculate HAI is as follows:

$$\text{Average house price} = Average\ house\ price\ per\ square\ meter * 400\ square\ meters \quad (1)$$

$$\text{Required loan} = Average\ house\ price - (Government\ interest\ free\ loan + Equity\ deposit) \quad (2)$$

$$\text{Monthly payment} = Required\ loan * \ (R/12)/(1-(1+R/12)^{-180}) \quad (3)$$

$$\text{Qualifying family income} = Monthly\ payment/40\% \quad (4)$$

$$\text{Average family income} = Average\ male\ income + Average\ female\ income \quad (5)$$

$$\text{HAI} = (Average\ family\ income\ /\ Qualifying\ family\ income) * 100 \quad (6)$$

where average house price is taken from the previous paper, specifically from the indices constructed using long-term mean price stratification. We selected the second-lowest stratum of house prices based on housing transactions from 31 of the 76 studied cities. Since affordability indices are reported on a yearly frequency while housing price indices are reported on a monthly frequency, we took the average price for the full year starting in January. The reason for selecting the second-lowest price stratum rather than the first-lowest is that the first-lowest stratum contains only eight cities with prices lower than those of standard houses in Kuwait (due to poor quality and poor location). Since the calculation was made per square meter, it was necessary to select an acceptable average house size to calculate the average house price. We believe that 400 square meters is the smallest acceptable and the most common plot size. Although there are houses on 250 square meter plots, these are very few. Furthermore, using houses on plots larger than 400 square meters would exaggerate the average house price. The required loan was calculated as the house price after deducting the down payment, which is assumed to come from an interest-free government loan of K.D. 70,000 and an equity deposit from family savings. Calculating the correct equity deposit is challenging. Therefore, we run two scenarios: one with no equity deposit and the other with an equity deposit equal to one year of the average family income. It is important to note that saving a full year of family income might take a very long time, especially for members of young families who are in the beginning of their careers and have many expenses and financial commitments.

Monthly payment is a standard calculation of the amount to be paid back to a lender over a specific time based on the agreed interest. We assumed that all loans are paid back based on the maximum mortgage period offered by the Central Bank of Kuwait, which is 15 years. Therefore, to calculate monthly payment, we used 180 months. The Central Bank of Kuwait also restricts the maximum monthly financial commitment to 40% of income. To calculate qualifying income we assumed a family in which neither the husband nor the wife has any financial commitments. Therefore, the qualifying income cannot be more than the monthly payment divided by 40%.

Last, to construct the HAI, we divided family income (assuming both parents work) by qualifying income, then multiplied by 100. The number generated from the index is meaningless; it simply indicates that scoring 100 or more means that a family is qualified to receive a loan to purchase a house of average price.

To illustrate housing affordability in Kuwait, we ignored the Central Bank of Kuwait's restriction on the maximum loan any individual can take, which is K.D. 70,000. Family loans that exceeded K.D. 140,000 were recorded from 2013 to 2016.

5.1.2 Price-to-income multiplier (PIR)

The PIR is the ratio of the average house price to the average household income.

$$\text{PIR} = Average\ house\ price/(Average\ family\ income * 12) \quad (7)$$

This method simply compares the annual income of a family to the average house price. It ignores other factors, such as mortgage terms and regularity restrictions, which can change over time and affect a family's ability to buy a house. The index constructed using this method is used to measure and compare markets and counties. It is also used to categorise the housing affordability level, as explained earlier in the literature section.

5.2 Modelling the housing market using the error correction model (ECM)

Selecting an appropriate model is highly dependent on the data used and their behaviour. All known models for modelling housing prices require stationary variables. However, if the HPI or any targeted independent variables are non-stationary, the resulting findings are subject to bias. To determine the stationarity of our variable, we first tested all variables (including HPI) for their unit roots and found, as shown in Table 1 (in the findings section) that most of the variables are non-stationary at level, but stationary at their first difference, meaning they are all I(1). The most appropriate model for this situation is the Error Correction Model (ECM), which solves the problem of non-stationary and differentiates between long- and short-term dynamics.

The ECM, as its name implies, corrects short-term deviations from the equilibrium relationships of series, revealing the Granger causalities that exist in the co-integrated system. An important property of I(1) variables is that in I(0) variables might have a linear and co-integrated relationship. Consider the following regression model:

$$y_t = \beta X_t + u_t \tag{8}$$

where $X_t \sim I(1)$ and $Y_t \sim I(1)$ have a linear relationship and (Y_t - βX_t) has a stationary error term. If the error term is stationary ($u_t \sim I(0)$), then these series are co-integrated. This mean equation (8) makes sense because the two series do not drift away from another and exhibit a linear relationship in the long run (Engle and Granger, 1987). In other words, in the short term, time series are expected to deviate from the other series; however, in co-integrated time series, changes or shocks eventually vanish, and the relation returns to its long-term equilibrium level.

5.2.1 Steps to develop the ECM

The first step in the modelling is specifying the independent variables that will be used to model the housing market. The literature on housing and general finance and economic studies specify a number of variables that act as drivers of the housing market, including GDP, interest rate, inflation, demographics and housing supply. To stabilise these variables, we used their natural logs in all calculations (except in the case of the interest rate). Further details about the variables used in this study were provided earlier in the data section.

The second step is to test the stationarity of all variables. As mentioned earlier, non-stationary series cannot be used with most known models; therefore, the present paper uses the ECM. The ECM can be used with non-stationary variables that become stationary at their first difference. In the present research, we measured stationarity using the Augmented Dickey-Fuller (ADF) test, as follows:

$$\Delta y_t = \beta_0 + \Delta\beta_1 y_{t-1} + \ldots + \Delta\beta_p y_{t-p} + \gamma y_{t-1} + \delta_t + u_t \qquad (9)$$

where δ is the coefficient for the time trend. Model (9) determines whether each variable has a trend. This was also checked graphically and by using an autoregressive test. This information improves the accuracy of the unit root test.

The third step is to construct the long-run model for the housing market using a simple ordinary least squares (OLS) regression to regress the HPI on selected explanatory variables, as follows:

$$y_t = \beta_0 + \beta_1 X_{1t} + \ldots + \beta_k X_{kt} + u_t \qquad (10)$$

where y_t is the dependent variable, $X_{1,t} \ldots X_{k,t}$ are the independent variables and u_t is the error term (also used as an error correction term later in the ECM). Once the best model is found, it is essential to test the error term's stationarity. As Malpezzi (1999) explained, if the true long-term error of two or more variables that are individually non-stationary is stationary, then the variables are integrated.

The fourth step is to find the relationship between the variables and determine whether they are cointegrated or not. To accomplish this, we first run all the variables through a vector autoregressive (VAR) model and extract the best lag length for the relationship. Measurements for best lag length are taken from different criterion tests, such as the Akaike information criterion (AIC) test, the Schwarz information criterion (SC) test and the Hannan-Quinn information criterion (HQ) test. Selecting the right order of lag is critical for the next test for cointegration. For time series data involving several variables, it is necessary to use the Johansen test and to select the appropriate lag interval and data criteria (whether or not to allow for linear trends). If the test indicates the existence of an integration relationship between the variables, we can move to the next step; otherwise, the ECM is not appropriate for the data.

The fifth step is to construct the ECM using the same variables, but at their first difference. Furthermore, we add the error term from the long-term model (10) from one lag before, as follows:

$$\Delta y_t = \beta_0 + \beta_1 \Delta X_{1t} + \ldots + \beta_k \Delta X_{kt} + \gamma u_{t-1} + \varepsilon_t \qquad (11)$$

where Δy_t is the change in the dependent variable, $\Delta X_{1,t} \ldots \Delta X_{k,t}$ are the changes in the independent variables and u_t is the error correction term. Note that the ECM in (11) can be expanded to include different lags for any of the dependent and independent variables, but at their difference (not at their level).

The last step is to run diagnostic tests on the ECM to check its validity. The first test is the normality test. In order to draw inferences from the model residuals, these must be normally distributed. The most common test for normality is the Bera-Jarque test, which compares the estimated skewness and kurtosis of the model error to those of a normal random variable. Since the null hypothesis assumes normality, significance in the test indicates non-normality in the model error distribution. If model error is not normally distributed, but the model is free from autocorrelation, then it is possible to use asymptotic theory to assume that the significance test will be asymptotically valid (Brooks and Tsolacos, 2010). Alternatively, since the normality test has been found to be very sensitive to outlier observations, for a model influenced by outliers, it may be necessary to remove the outliers' influence by adding dummy variables representing the outlier observations (Brooks and Tsolacos, 2010).

The second test to ensure the consistency of the model estimation involves ensuring that the model residuals are free from autocorrelation. Specifically, we use the LM-test to determine whether the model residuals exhibit autocorrelation or not. This can be done as follows:

$$\hat{\varepsilon}_t = \beta_0 + \beta_1 \Delta X_{1t} + \ldots + \beta_k \Delta X_{kt} + \gamma u_{t-1} + \theta_1 \hat{\varepsilon}_{t-1} + \ldots + \theta_p \hat{\varepsilon}_{t-p} + e_t \qquad (12)$$

where e_t is the residual from the OLS regression and the rest of the variables are taken from the ECM (11). The null hypothesis assumes no autocorrelation. One can attempt to solve autocorrelation by adding the lagged dependent variable; however, this does not always work. Still, by testing for the existence of autocorrelation and the lag order, one can find the appropriate lag for the dependent variable, which may not always be the first lag. We chose the LM test because it is capable of running an autocorrelation test, including a lagged dependent variable. In contrast, the well-known Durbit-Watson test does not include the lag of the independent variable, as doing so would bias the normality of the results.

The third test, or the Autoregressive Conditional Heteroscedasticity (ARCH) test, takes the same approach as the second test, but performs the regression with squared residuals, as shown below.

$$\hat{\varepsilon}_t^2 = \beta_0 + \beta_1 \Delta X_{1t} + \ldots + \beta_k \Delta X_{kt} + \gamma u_{t-1} + \theta_1 \hat{\varepsilon}_{t-1}^2 + \ldots + \theta_p \hat{\varepsilon}_{t-p}^2 + e_t \qquad (13)$$

The test is run as an LM test, but significance indicates a model misspecification. This might indicate a need to add a relevant explanatory variable or remove insignificant lags for explanatory variables.

Last, we test model linearity in order to draw a valuable result from the OLS. We used Ramsey's RESET test, as shown below:

$$\Delta \hat{y}_t = \beta_0 + \beta_1 \Delta \hat{X}_{1t} + \ldots + \beta_k \Delta \hat{X}_{kt} + \gamma \hat{u}_{t-1} + \varepsilon_t \qquad (14)$$

Model (14) is the fitted model extracted from model (11), which will be added to the ECM to test whether the squared fitted value of the model is statistically significantly different from zero. The model to be run is as follows:

$$\Delta y_t = \beta_0 + \beta_1 \Delta X_{1t} + \ldots + \beta_k \Delta X_{kt} + \gamma u_{t-1} + \delta \Delta \hat{y}_t^2 + v_t \qquad (15)$$

The null hypothesis is that there is a linear relationship between the dependent variable and the explanatory variables. A significant parameter means that we must reject the assumption of a linear relationship; however, such a rejection might occur due to either non-linear relationship or the omission of important explanatory variable, and the test does not reveal which of these issues causes the null hypothesis of linearity to be rejected.

If the model under study passes all of the above tests, it is considered valid. However, if the model fails to pass any of the tests, then the model may not be reliable. In such a situation, the model may need to be redeveloped, or only some of the solutions may be used. Ways to improve model performance will be discussed in detail in the findings section.

5.3 Influence of events on the housing market

Testing the influence of an event on a housing market is as important as the economic and financial factors. In emerging markets, and in the case of Kuwait, political, legislative and stability-related events are very important to consider from commercial and residential real estate perspectives. Both local and regional events are important and could have a significant impact on the housing market.

We study the influence on the housing market of political, legislative and stability-related events at the local and regional level. The performance of the housing sector, like that of other real estate sectors, is not easy to measure, especially because of the heterogeneous nature, limited data and limited number of observations that characterise this market. Furthermore, it is critical not to ignore the influence of other variables on the dependent variable when trying to measure the impact of a specific event impact during a specific period of time.

A simple way to test for the impact of an event on the housing market is to use dummy variables. The concept of a dummy variable is very simple. Dummy variables are used to distinguish between different groups or periods of time. They simply take the value of 1 in targeted observations and take the value of 0 otherwise. In other words, this simple approach acts as a switch: it allows variables to turn on and off based on different tests. For example, as Brooks and Tsolacos (2010) explained, in the event of an outlier observation in a time series, a dummy variable can be added to the period in question to remove the impact of the outlier and prevent bias in the estimated model. This can be expressed as below:

$$y_t = \beta_0 + \beta_1 X_{1t} + \ldots + \beta_k X_{kt} + \gamma D87_t + u_t \qquad (16)$$

where βs are the explanatory variable and $\gamma D87_t$ is the dummy variable for the year 1987, which included an extreme (outlier) observation that could have affected the overall estimation (Brooks and Tsolacos, 2010). Dummy variables can also be used to control for continuous events, such as seasonality. For example, Brooks and Tsolacos (2010) studied performance across different quarters of the year as follows:

$$y_t = \beta_0 + \beta_1 X_{1t} + \ldots + \beta_k X_{kt} + \gamma D1_t + \gamma D2_t + \gamma D3_t + u_t \qquad (17)$$

where βs are the explanatory variables and $\gamma D1_t$ to $\gamma D3_t$ are the dummy variables for the first to third quarters of each year. Because the model includes a constant, it cannot include all four dummy variables; therefore, it removes the one that takes place when all three dummy variables take the value of 0. In their book on testing for quarterly dummy variables, Brook and Tsolacos (2010) identified two major findings: first, that not all dummy variables are significant (and, therefore, some can be removed), and second, that the inclusion of dummy variables that are statistically significant improves the model estimate and forecast.

Therefore, the use of dummy variables can take different forms depending on the needs of a given test; however, the number and frequency of observations can significantly affect the validity of this dummy variables-based approach (Brooks and Tsolacos, 2010).

To use dummy variables to test for event impact, we consider the following. We need to specify the length and start of the event dummy variable. However, since this is impossible to measure, especially since different events might have different impact lengths and impact lags, we develop eight dummy variables for each event. The first four dummy variables start during the same month as the event, and of these, one lasts for 3 months, one lasts for 6 months, one lasts for 12 months and one is assumed to have a permanent impact. The second four dummy variables start three months after the event, and they have the same impact period durations as the first four dummy variables. By using this approach, we increase the chances of finding significant proof of the impact of different events on the housing market. However, to implement this approach, we must consider the influence of other variables on HPI; therefore, we include our dummies in the ECM generated for the housing market, as follows:

$$\Delta y_t = \beta_0 + \beta_1 \Delta X_{1t} + \ldots + \beta_k \Delta X_{kt} + \gamma u_{t-1} + \gamma Dummy_t + \varepsilon_t \tag{18}$$

where the model is exactly the same as the ECM, but with the addition of the targeted event $\gamma \mathrm{Dummy}_{\mathrm{t}}$ dummy variable. Note that model (11) might include another dummy variable to control for outliers. Events are tested individually, and the individual models do not include many events. If the test for a given model is found to be statistically significant, we recheck the diagnostic test mentioned before to ensure the validity of the final model including the event. We also consider the sign of the impact and whether it is the expected sign or not.

In addition to using dummy variables in empirical tests, we also generate information about each event to lend additional support to our arguments. This information includes the HPI growth rate before and after each event, the standard deviation and the transaction volume. More details are provided in the findings section.

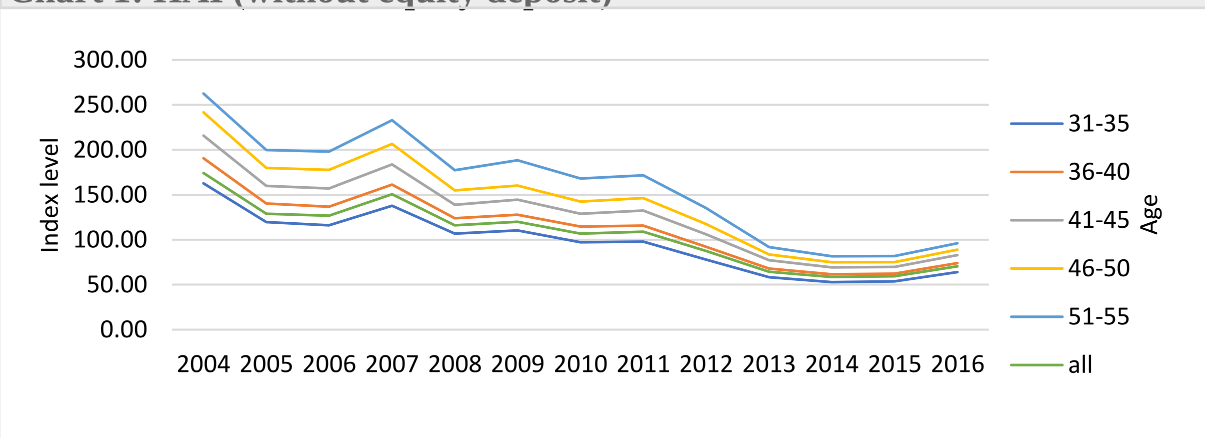
6.0 Findings

This section empirically studies the housing market in Kuwait. First, to construct housing affordability indices for the targeted markets. Next, to model the housing market using different methodologies to find what drives the housing market in Kuwait. Last, to test the reaction of the housing market to events happening in Kuwait and in the region.

6.1 Housing affordability indices

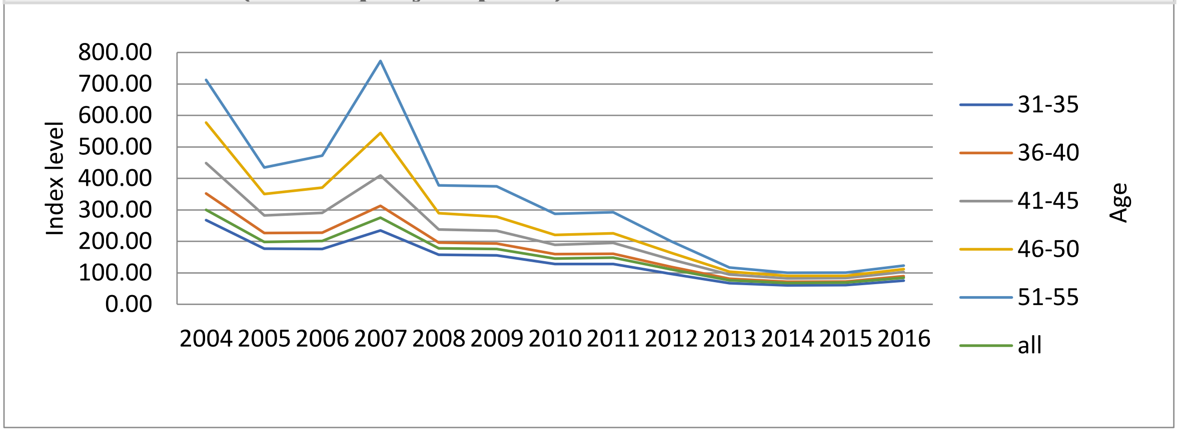
All three constructed indices indicate that housing affordability has worsened over the time. Chart 1 illustrates that, in 2004, all age categories qualified for mortgages. However, the percentage of qualifying categories dropped over time until 2013, when none qualified for mortgages. A similar finding is shown in Chart 2, in which we assume that families have down payments equivalent to one year of their family income. The only different between the two charts is that, in Chart 2, people aged 51 to 55 qualified for mortgage for the duration of the observation period, while people aged 46 to 50 and 41 to 45 qualified again in 2016 due to the drop in housing prices.

Chart 1: HAI (without equity deposit)



These first two charts clearly show that different categories have different sensitivities to housing price changes. This is particularly clear for the case of an assumed existing down payment in 2007 (Chart 2). This may be because older people, who tend to have higher incomes and higher down payment abilities, are likely to experience more rapid HAI increases when housing prices drop. We found no significant differences in income growth across the categories. Another finding is the reduction in gap between different age categories over time. This might be influenced by the sadden increase in required loan because of a jump in average house price in 2012 by around 20% followed by additional 40% the year after. This hugely affected required income which then causes different age categories to have close by readings.

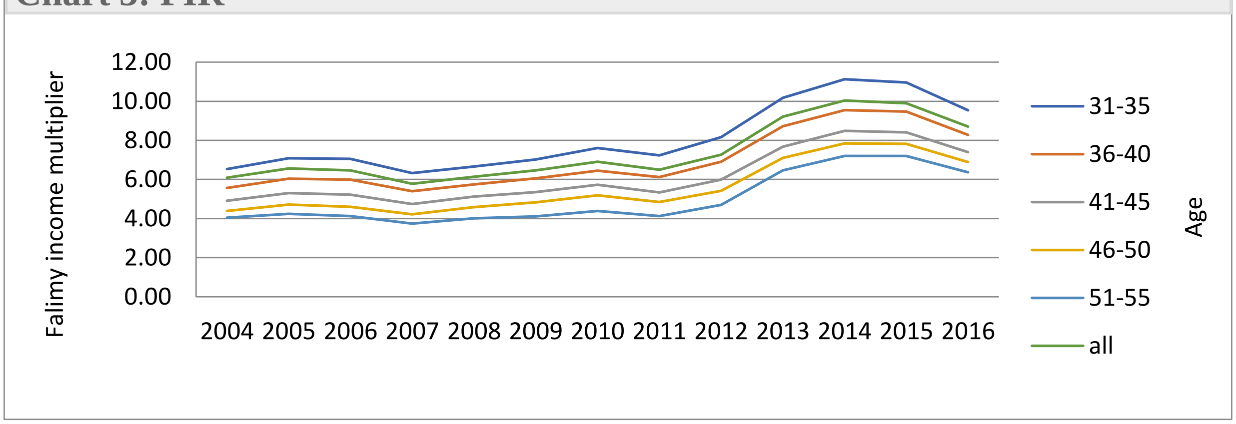
Chart 2: HAI (with equity deposit)



We also measure affordability using the PIR. Although the assumption that affordability can be measured using only income (per the PIR approach) is questionable, we consider this method for the sake of international comparison. Like the previous charts, Chart 3 clearly shows that affordability has been continuously worsening since 2004. The only correction occurred in 2016 following a drop in housing prices.

In comparison to international housing markets, Kuwait's housing market was rated "Severely Unaffordable" in the 13th Annual Demographic International Housing Affordability Survey: 2017 Standard (Hartwich, 2017). Since the main category affordability consider is young people, we consider families with adults aged 36 to 40. This category rated a PIR 6 in 2004, and then nearly reached PIR 10 in 2014, but ultimately dropped in 2016 to PIR 8. This places Kuwait in the same category as London in the UK, San Diego in US and Toronto in Canada in terms of housing affordability.

Chart 3: PIR



6.2 Modelling the housing market

As mentioned in the previous section, the methodology used to model the housing market in Kuwait is the ECM. Since Kuwait offers limited data over the short period of our observation, we found it interesting to develop the model using a monthly frequency. This approach gives us 158 observations: a sufficient amount to produce a good model. However, monthly frequency typically involves higher volatility, especially for real estate data and the HPI, which is constructed based on the median methodology. Therefore, we decided to run robustness tests by constructing a similar model based on a quarterly frequency and using rolling over periods and smoothing. Further details are provided below.

6.2.1 Error Correction Model (monthly frequency)

The first model was built using a monthly frequency. Tables 1 and 2 below provide a good overview of the data. Table 1 clearly shows that most of the variables have a unit root at level, but that all become stationary at their first difference. Table 2 also shows signs of non-normality in the variables from the skewness, kurtosis and Jarque-Bera tests for normality. These results are expected from real estate and financial data. They are the reason we use the ECM.

Table 1: Augmented Dickey Fuller test (monthly data)

	Full sample 2004M2 - 2017M3	
	In level	In difference
LHPI	-3.10208	-13.03015***
LHD	-6.36399***	-3.607144**
LHS	-16.94902***	-13.03817***
LCPI	-0.76420	-5.366153***
IR	-2.14181	-12.35266***
LOP	-2.33684	-8.696243***
LKSE	-2.87483	-7.923283***
LGP	-0.63150	-11.1115***

*MacKinnon (1996) one-sided p-values.
*** indicate significance at 1%

Table 2: Summary statistics of logged monthly data

	LHPI	LHD	LHS	LCPI	IR	LOP	LKSE	LGP
Mean	5.152	10.281	9.847	4.491	3.511	4.242	8.927	6.868
Median	5.064	10.628	10.123	4.522	2.500	4.273	8.847	7.031
Maximum	5.706	11.423	10.622	4.720	6.250	4.887	9.649	7.480
Minimum	4.605	5.624	5.497	4.202	2.000	3.399	8.527	5.950
Std. Dev.	0.324	1.097	0.821	0.163	1.632	0.371	0.285	0.445
Skewness	0.227	-1.478	-2.293	-0.363	0.701	-0.269	0.826	-0.661
Kurtosis	1.579	5.255	9.478	1.774	1.770	1.966	2.730	2.242
Jarque-Bera	14.648	90.975	414.707	13.353	22.917	8.942	18.436	15.281
Probability	0.001	0.000	0.000	0.001	0.000	0.011	0.000	0.000
Sum	813.976	1624.342	1555.902	709.580	554.750	670.300	1410.410	1085.151
Sum Sq. Dev.	16.477	189.091	105.706	4.196	418.418	21.597	12.791	31.108
Observations	158	158	158	158	158	158	158	158

One concern has to be considered to ensure the validity of the models constructed is multicollinearity. To test for multicollinearity, two tests were conducted: unconditional correlation test and variance inflation factor (VIF) test. The former considered the unconditional correlation between one independent variable to each of the other independent variables (bivariate), while the latter considered the correlation of one independent variable to all the other independent variables at the same time (multivariate). VIF test was conducted by regressing each independent variable on all the other independent variables and then seeing how much the group of the independent variables explained based on the R-squared of the model. Both tests were conducted on the first differences, not at level.

The results from both tests, as shown in Tables 27 in the appendices, showed signs of multicollinearity, except for the relationship between housing demand and housing start. Further detection of multicollinearity, therefore, was required for these variables, and if further signs of multicollinearity existed, then one variable had to be removed from the models. Given the dynamics and the underlying connections of the Kuwait market, it was unsurprising that we found a high correlation between housing demand (HD) and housing start (HS) is unsurprising. Looking at the underlying data, both increased every year, often at a similar magnitude. However, the increase in HD should exert the opposite effect on increased HS, which was consistent in all short- and long-term models. Several points, therefore, had be considered. First, the high R-squared in the short-term models, which could be a suspected sign of multicollinearity, was partly due to the inclusion of dummy variables, the HPI lags and the error correction term. To test this, we removed 5 dummy variables from the model in Table 6, and R square dropped from 65% to 23% (see the attached Excel file entitled R square). When also removing the lags of HPI, R square dropped from 23% to 5.5%. When removing the error correction term from the model, the R square dropped from 5.5% to 2.2%.

Second, as a sign of multicollinearity, we would expect an inflated standard error for suspected variables, which was not the case in HD and HS. When removing HD from the model in Table 6, the HS standard error fell from 0.44 to 0.10. We also returned HD to the model and removed HPI(-1) and HPI(-2) only, and HS fell 0.32 from 0.44. Based on these findings, it can be argued that the impact of HD on the HS standard error and vice versa was not that large when compared to the impact of HPI lags on HS standard error.

Third, after removing HD, one of the suspected variables, the long-term model residuals increased slightly, indicating that the inclusion of both did not cause distraction in the model but enabled better forecasting. Fourth, when we reran sub-sample VIF to housing start after removing the first 12 observations, the VIF dropped to less than the acceptable minimum (less than 5). A similar result was found for HD. Consequently, we compared the result of rolling over models as the only first contained the first 12 observations, while the remaining 3 models did not. Any major differences between the first model and other 3 models would indicate influence from multicollinearity in the first 12 observations. However, we found no differences in the standard error among all 4 models. Instead, the standard error increased slightly in the latter 3 models, indicating that the first model was not affected by multicollinearity.

Fifth, due to data limitations and low frequencies, high correlations among independent variables could be expected in real estate studies. Finally, all the short-term models used were error-correction models taking into account cointegration and thus long-term trends. We, therefore, were confident that no distractions affected the models constructed, and the inclusion of both HS and HD produced better-performing models then when excluding either one. None of the independent variables, therefore, needed to be removed from the models.

To construct the ECM, we developed a general long-run model for the housing market by regressing the HPI on selected variables, as follows:

$$LHPI_t = \beta_0 + \beta_1 LHD_t + \beta_2 LHS_t + \beta_3 LCPI_t + \beta_4 IR_t + \beta_5 LOP_t + \beta_6 LKSE_t + \beta_7 LGP_t + \beta_{i,k} Dummy_{i,k} + \varepsilon_t \quad (19)$$

where:

LHPI = (Log) Housing Price Index

LHD = (Log) Housing Demand (Accumulated)

LHS = (Log) Housing Start (Accumulated)

LCPI = (Log) Consumer Price Index

IR = Interest Rate

LOP = (Log) Oil Price

LKSE = (Log) Kuwait Stock Exchange

LGP = (Log) Gold Price

Dummy YY/MM = Dummy Variable at a Specific Point in Time

The results of this long-term model are shown in Table 3. Using this model, we generalise the long-term equilibrium relationships between the HPI and the explanatory variables. Wherever the tests prove the existence of integration, we can refer to the coefficient generated by the long-term model; however, the model is not very reliable, and we cannot refer to its standard error or s-statistics.

Table 3: Long term model (monthly data)

Dependent Variable: LOG(HPI)
Method: Least Squares
Sample: 2004M02 2017M03
Included observations: 158

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(HD)	**1.0268**	0.1900	5.4038	**0.0000**
LOG(HS)	**-1.0018**	0.1796	-5.5784	**0.0000**
LOG(CPI)	**1.3408**	0.4476	2.9955	**0.0032**
IR	**0.0353**	0.0142	2.4812	**0.0142**
LOG(OP)	**0.2996**	0.0445	6.7375	**0.0000**
LOG(KSE)	**-0.2261**	0.0622	-3.6334	**0.0004**
LOG(GP)	**-0.7019**	0.0679	-10.3432	**0.0000**
DUMMY06M1	**0.3327**	0.0891	3.7338	**0.0003**
DUMMY08M1	**0.6486**	0.0894	7.2566	**0.0000**
C	**3.8770**	1.7879	2.1685	**0.0317**

R-squared	0.9316	Mean dependent var	5.1517
Adjusted R-squared	0.9274	S.D. dependent var	0.3240
S.E. of regression	0.0873	Akaike info criterion	-1.9785
Sum squared resid	1.1271	Schwarz criterion	-1.7846
Log likelihood	166.2992	Hannan-Quinn criter.	-1.8998
F-statistic	223.9527	Durbin-Watson stat	0.7436
Prob(F-statistic)	0.0000		

Assuming the validity of the coefficients, the explanatory variables showed very interesting readings, and all of their signs were as anticipated (except in the case of the interest rate, for which there is a logical explanation discussed in the next paragraph). Housing demand and housing starts show similar elasticities, but in opposite directions. This makes sense because housing demand reflects the number of families that require houses, while housing starts reflects the number of families that have received houses. Inflation, as expressed by the CPI, also exhibits high elasticity, which is consistent with the literature.

Surprisingly, the sign for the interest rate was opposite from our expectations. In other words, when interest rates increased, housing prices increased. This contradicts the majority of findings in the literature, which generally shows that reducing the interest rate fuels housing demand and eventually drives housing prices upward. However, the case of housing in Kuwait is unique, and our results show how the housing market reacts differently in different circumstances. Specifically, the following factors must be considered in the case of Kuwait: First, the high pressure of the housing demand can reduce the influence of other variables or make them insignificant. Second, the housing supply shortage and complicated planning system can increase the demand pressure on housing. Third, mortgage constraints on individuals in Kuwait can significantly reduce the importance of interest rates. In other words, since the maximum loan any Kuwaiti can take is K.D. 70,000, if a family has a large enough down payment to buy a house, their decision to purchase may not be affected by interest rate changes, especially given the general belief that housing prices will always rise. On the other hand, if a family cannot afford to buy a house because of its price, then reducing the interest rates will not change the situation. Fourth, assuming that interest rates are less important on the demand side, it is possible that interest rates may actually affect the supply side due to the costs of construction. In simple terms, higher interest rates affects developers by increasing the premium on house prices.

Oil prices, as mentioned earlier, replace GDP in the higher frequency models because oil production represents 95% of the national income of Kuwait. Therefore, we use oil prices as a measure of overall national economic health and performance. The long-term model shows that a change in oil prices of 1% results in a change in housing prices of 0.3%. Although this influence may seem weaker than those of other variables, it worth noting that oil prices fluctuate dramatically, ranging in our sample from $110 in August 2014 to less than $30 by January 2016. Therefore, the price of oil is certainly among the important drivers of the Kuwait housing market.

We included our last two variables to measure the effect of investors on the housing market and to determine whether local investors consider the housing market in Kuwait to be an alternative investment opportunity. In other words, is the market influenced by investors? To answer this question, we included two alternative investments: the stock market, which is considered highly risky, and gold, which is considered relatively safe. The relationship between housing prices and the Kuwait Stock Market was found to be negative. This suggests that investors switch between investing in stocks and houses based on the relative performances of these markets. We observed a similar relationship between real estate and gold. Specifically, we found that the relationship between housing prices and gold is negative, indicating that investors move towards gold when housing prices drop and move towards real estate when housing prices rise.

As can be noted from the above model, we included dummy variables to control for two residual outliers that affected the model's normality. After controlling for these two observations, the model regained its normality. However, the model failed to pass the linearity, autocorrelation and heteroscedasticity tests. This should not affect the end results of the ECM, since we only extract the residuals from the long-term model, which remains valuable because it lacks a unit root.

In the next step, we generalise the residuals of the long-term model "U", which will be included in the ECM later. The residual can only be used if we can prove that the model lacks a unit root, which is also a sign of the existence of integration among the variables. The unit root test for "U" returned a value of -6.1074, which was significant at the 1% level using the Augmented Dickey Fuller test.

Table 4: VAR Lag structure (monthly data)

VAR Lag Order Selection Criteria
Endogenous variables: LHPI LHD LHS LCPI IR LOP LKSE LGP
Exogenous variables: C
Sample: 2004M02 2017M03
Included observations: 150

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1292.377	NA	5.05E-18	-17.12502	-16.96445	-17.05979
1	3287.408	3750.659	3.32E-29	-42.8721	**-41.42700***	**-42.28500***
2	3375.128	155.5564	2.44E-29	-43.18837	-40.45873	-42.0794
3	3479.62	174.1544	1.45e-29*	-43.72827	-39.71409	-42.09744
4	3528.865	76.82231	1.82E-29	-43.53154	-38.23282	-41.37884
5	3588.773	87.06607	2.03E-29	-43.47698	-36.89372	-40.80241
6	3651.583	84.58333	2.25E-29	-43.4611	-35.59331	-40.26467
7	3747.505	118.9439	1.66E-29	-43.88673	-34.7344	-40.16843
8	3824.832	87.63723*	1.65E-29	-44.06443*	-33.62756	-39.82426

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Next, we test whether the variables are co-integrated. To accomplish this, we begin by testing the lag order of the relationships among the variables, as shown in Table 4. Based on the Schwarz and Hannan-Quinn information criteria, we found that a lag order of 1 was the most appropriate for testing the co-integration of the variables.

The results of the Johansen co-integration test are shown below in Table 5. Both the trace and maximum Eigenvalue tests confirmed the existence of integration, finding eight and three signs of integration, respectively.

Table 5: Johansen cointegration test (monthly data)

Sample (adjusted): 2004M03 2017M03
Included observations: 157 after adjustments
Trend assumption: Linear deterministic trend
Series: LHPI LHD LHS LCPI IR LOP LKSE LGP
Lags interval (in first differences): No lags

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.917809	592.1505	159.5297	0.0000
At most 1 *	0.33128	199.8538	125.6154	0.0000
At most 2 *	0.298121	136.6787	95.75366	0.0000
At most 3 *	0.166073	81.10151	69.81889	0.0048
At most 4 *	0.125621	52.5888	47.85613	0.0168
At most 5 *	0.091607	31.51285	29.79707	0.0314
At most 6 *	0.076063	16.42865	15.49471	0.0361
At most 7 *	0.025207	4.008162	3.841466	0.0453

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.917809	392.2967	52.36261	0.0001
At most 1 *	0.33128	63.17514	46.23142	0.0004
At most 2 *	0.298121	55.5772	40.07757	0.0004
At most 3	0.166073	28.51271	33.87687	0.1908
At most 4	0.125621	21.07595	27.58434	0.2717
At most 5	0.091607	15.0842	21.13162	0.2831
At most 6	0.076063	12.42049	14.2646	0.0958
At most 7 *	0.025207	4.008162	3.841466	0.0453

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

At this stage, we can confidently build the error correction model using the variables we found to be integrated and the residual generated from the long-term model. The resulting ECM is as follows:

$$\Delta LHPI_t = \beta_0 + \beta_1 \Delta LHPI_{t-1} + \beta_2 \Delta LHPI_{t-2} + \beta_3 \Delta LHD_t + \beta_4 \Delta LHS_t + \beta_5 \Delta LCPI_t + \beta_6 \Delta IR_t + \beta_7 \Delta LOP_t + \beta_8 \Delta LKSE_t + \beta_9 \Delta LGP_t + \beta_{10} u_{t-1} + \beta_{i,k} Dummy_{i,k} + \varepsilon_t \quad (20)$$

where all variables are at their first difference and U is the residual from the long-term model. The results are as shown in Table 6 below.

Table 6: Error Correction Model (monthly data)

Dependent Variable: DLOG(HPI)
Method: Least Squares
Sample (adjusted): 2004M05 2017M03
Included observations: 155 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(HPI(-1))	**-0.3213**	0.0793	-4.0496	**0.0001**
DLOG(HPI(-2))	**-0.1057**	0.0635	-1.6631	**0.0985**
DLOG(HD)	0.6461	0.4630	1.3956	0.1651
DLOG(HS)	-0.5909	0.4438	-1.3314	0.1853
DLOG(CPI)	0.1563	0.8738	0.1788	0.8583
D(IR)	0.0237	0.0210	1.1291	0.2608
DLOG(OP)	-0.0008	0.0535	-0.0141	0.9887
DLOG(KSE)	0.0810	0.0850	0.9535	0.3420
DLOG(GP)	-0.1021	0.1130	-0.9033	0.3679
U(-1)	**-0.1500**	0.0586	-2.5596	**0.0115**
DUMMY06M1	**0.2007**	0.0546	3.6776	**0.0003**
DUMMY06M2	**-0.2076**	0.0551	-3.7665	**0.0002**
DUMMY08M1	**0.5960**	0.0571	10.4429	**0.0000**
DUMMY08M2	**-0.2456**	0.0695	-3.5360	**0.0006**
DUMMY08M3	**-0.1751**	0.0701	-2.4987	**0.0136**
C	0.0016	0.0066	0.2476	0.8048

R-squared	0.6518	Mean dependent var	0.0048
Adjusted R-squared	0.6143	S.D. dependent var	0.0845
S.E. of regression	0.0525	Akaike info criterion	-2.9592
Sum squared resid	0.3829	Schwarz criterion	-2.6450
Log likelihood	245.3381	Hannan-Quinn criter.	-2.8316
F-statistic	17.3484	Durbin-Watson stat	2.0452
Prob(F-statistic)	0.0000		

As illustrated, we included both the first and the second lag of the HPI in the model in order to remove the model's existing autocorrelation. We also included dummy variables to remove the influence of outliers that affected the model's normality. The above ECM passed all diagnostic tests, including normality, linearity, autocorrelation and heteroscedasticity tests. All tests results are presented in Appendices.

The model illustrates several things. First, none of the variables were significant, though most exhibited the anticipated sign. For example, housing demand and housing starts yielded similar coefficients but in opposite directions, as shown in the long-term model. The Kuwait Stock Exchange had a positive sign (opposite its sign in the long-term model), indicating that stock market performance has a positive impact on housing prices in the short term. The only unexpected result was that for oil price, which was found to have a negative sign. However, since the coefficient was extremely low (-0.0008) and the p-value was close to 1, this finding is not considered. Second, the correction term took the anticipated sign and exhibited a very fast correction (15% monthly) to the equilibrium, such that the model returned to equilibrium within seven months of disequilibrium. Last, the negative signs for the HPI at one and two lags were surprising, since previous periods led us to expect a positive sign. However, the market's lack of transparency and the strong influence of demand could cause a high level of continuous volatility, resulting in a continuous negative relationship from one period to the next. This issue will be resolved later in the smoothed HPI models.

6.2.2 Error Correction Model (quarterly frequency)

The quarterly ECM is developed following the exact same steps used to develop the monthly ECM, but with quarterly observations instead of monthly ones. Table 7 clearly shows that most of the variables have a unit root at level, but all become stationary at their first difference.

Table 7: Augmented Dicky Fuller test (quarterly data)

	Full sample 2004Q1 - 2017Q1	
	In level	In difference
LHPI	-2.18560	-8.401647***
LHD	-2.83350	-6.95641***
LHS	-20.94583***	-7.66917***
LCPI	-0.71140	-5.32433***
IR	-2.13947	-6.110436***
LOP	-2.17434	-6.559267***
LKSE	-2.69303	-5.343154***
LGP	-0.69734	-7.332592***

*MacKinnon (1996) one-sided p-values.

Table 8: Summary statistics of logged quarterly data

	LHPI	LHD	LHS	LCPI	IR	LOP	LKSE	LGP
Mean	5.1428	10.2921	9.8584	4.4944	3.519	4.2399	8.9242	6.8677
Median	5.0517	10.6341	10.1249	4.5294	2.500	4.2251	8.8167	7.0341
Maximum	5.6421	11.4229	10.6216	4.7203	6.250	4.8792	9.6161	7.4799
Minimum	4.6862	6.5862	6.6606	4.2017	2.000	3.5166	8.5536	5.9722
Std. Dev.	0.3181	1.0875	0.7983	0.1649	1.631	0.3716	0.2855	0.4479
Skewness	0.2285	(1.3673)	(2.0316)	(0.3702)	0.7067	(0.2233)	0.8663	(0.6478)
Kurtosis	1.5482	4.5625	7.3734	1.7898	1.7874	1.8903	2.7517	2.2057
Jarque-Bera	5.1162	21.9045	78.6955	4.4451	7.6591	3.1601	6.7658	5.0996
Probability	0.0775	0.0000	0.0000	0.1083	0.0217	0.2060	0.0339	0.0781
Sum	272.5691	545.4784	522.4954	238.2043	186.500	224.7131	472.9815	363.9890
Sum Sq. Dev.	5.2617	61.5008	33.1360	1.4135	138.356	7.1801	4.2384	10.4316
Observations	53	53	53	53	53	53	53	53

The results of the long-term model are presented in Table 9. From this model, we generalise the long-term equilibrium relationships between HPI and the explanatory variables. The model is as follows:

$$LHPI_t = \beta_0 + \beta_1 LHD_t + \beta_2 LHS_t + \beta_3 LCPI_t + \beta_4 IR_t + \beta_5 LOP_t + \beta_6 LKSE_t + \beta_7 LGP_t + \beta_{i,k} Dummy_{i,k} + \varepsilon_t \quad (21)$$

Table 9: Long term model (quarterly data)

Dependent Variable: Log(HPI)
Method: Least Squares
Sample: 3/01/2004 3/01/2017
Included observations: 53

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(HD)	**0.9388**	0.3394	2.7661	**0.0083**
LOG(HS)	**-0.9840**	0.3318	-2.9652	**0.0049**
LOG(CPI)	**1.6486**	0.7822	2.1077	**0.0408**
IR	0.0359	0.0002	1.4624	0.1508
LOG(OP)	**0.2900**	0.0792	3.6627	**0.0007**
LOG(KSE)	**-0.1881**	0.1105	-1.7021	**0.0958**
LOG(GP)	**-0.6432**	0.1183	-5.4389	**0.0000**
DUMMY17Q1	-0.1305	0.0925	-1.4112	0.1652
C	2.5138	3.0540	0.8231	0.4149

R-squared	0.9395	Mean dependent var	5.1428
Adjusted R-squared	0.9284	S.D. dependent var	0.3181
S.E. of regression	0.0851	Akaike info criterion	-1.9367
Sum squared resid	0.3186	Schwarz criterion	-1.6021
Log likelihood	60.3229	Hannan-Quinn criter.	-1.8081
F-statistic	85.3413	Durbin-Watson stat	1.1384
Prob(F-statistic)	0.0000		

The findings for the long-term model are similar to those for the monthly frequency model. The model shown in Table 9 passed the normality tests; however, it failed to pass the linearity, autocorrelation and heteroscedasticity tests.

Unlike the previous test based on monthly frequency, the model based on quarterly observations was found to have the best lag order at lag 4, as shown in Table 10 below.

Table 10: VAR Lag structure (quarterly data)

VAR Lag Order Selection
Criteria
Endogenous variables: LHPI LCPI LGP LHD LHS LKSE LOP IR
Exogenous variables: C
Sample: 3/01/2004 3/01/2017
Included observations: 49

Lag	LogL	LR	FPE	AIC	SC	HQ
0	472.0456	NA	8.21E-19	-18.94064	-18.63177	-18.82345
1	956.1747	790.4149	3.03E-26	-36.08876	-33.30894	-35.0341
2	1031.097	97.85806	2.39E-26	-36.53458	-31.28382	-34.54245
3	1137.061	103.8017	7.88E-27	-38.24741	-30.52569	-35.3178
4	**1353.261**	**141.1915***	**6.75e-29***	**-44.45963***	**-34.26697***	**-40.59255***

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The results of the Johansen co-integration test are shown below in Table 11. Both the trace and maximum Eigenvalue tests confirmed the existence of integration, and both found eight signs of integration among the variables.

Table 11: Johansen cointegration test (quarterly data)

Sample (adjusted): 3/01/2005 3/01/2017
Included observations: 49 after adjustments
Trend assumption: Linear deterministic trend
Series: LHPI LCPI LGP LHD LHS LKSE LOP IR
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.97843	600.2997	159.5297	0.0000
At most 1 *	0.88477	412.3185	125.6154	0.0000
At most 2 *	0.83207	306.4374	95.75366	0.0000
At most 3 *	0.78014	219.0106	69.81889	0.0000
At most 4 *	0.74101	144.7882	47.85613	0.0000
At most 5 *	0.60754	78.5907	29.79707	0.0000
At most 6 *	0.44558	32.76056	15.49471	0.0001
At most 7 *	0.07573	3.858603	3.841466	0.0495

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.97843	187.9812	52.36261	0.0001
At most 1 *	0.88477	105.881	46.23142	0.0000
At most 2 *	0.83207	87.4268	40.07757	0.0000
At most 3 *	0.78014	74.22245	33.87687	0.0000
At most 4 *	0.74101	66.19747	27.58434	0.0000
At most 5 *	0.60754	45.83014	21.13162	0.0000
At most 6 *	0.44558	28.90196	14.2646	0.0001
At most 7 *	0.07573	3.858603	3.841466	0.0495

Max-eigenvalue test indicates 8 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

At this stage, we can confidently built the ECM using the variables we found to be integrated and the residual generated from the long-term model. The resulting ECM is as follows:

$$\Delta LHPI_t = \beta_0 + \beta_2 \Delta LHD_t + \beta_3 LHS\Delta_t + \beta_4 \Delta LCPI_t + \beta_5 \Delta IR_t + \beta_6 \Delta LOP_t + \beta_7 \Delta LKSE_t + \beta_8 \Delta LGP_t + \beta_9 u_{t-1} + \beta_{i,k} Dummy_{i,k} + \varepsilon_t \quad (22)$$

where all variables are at their first difference and U is the residual from the long-term model. The results are shown in Table 12 below.

Table 12: Error Correction Model (quarterly data)

Dependent Variable: D(LHPI)
Method: Least Squares
Sample (adjusted): 6/01/2004 3/01/2017
Included observations: 52 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(HD)	0.0142	0.4907	0.0289	0.9771
DLOG(HS)	-0.0410	0.4861	-0.0843	0.9332
DLOG(CPI)	0.9940	1.3567	0.7326	0.4678
D(IR)	0.0237	0.0295	0.8058	0.4249
DLOG(OP)	**0.1350**	**0.0633**	**2.1321**	**0.0389**
DLOG(KSE)	-0.0203	0.0999	-0.2031	0.8401
DLOG(GP)	-0.1730	0.1552	-1.1149	0.2712
U(-1)	**-0.4041**	**0.1315**	**-3.0736**	**0.0037**
DUMMY17Q1	-0.1510	0.0774	-1.9525	0.0576
C	0.0122	0.0182	0.6697	0.5067

R-squared	0.3035	Mean dependent var	0.0144
Adjusted R-squared	0.1543	S.D. dependent var	0.0725
S.E. of regression	0.0667	Akaike info criterion	-2.4057
Sum squared resid	0.1869	Schwarz criterion	-2.0305
Log likelihood	72.5487	Hannan-Quinn criter.	-2.2619
F-statistic	2.0338	Durbin-Watson stat	2.1500
Prob(F-statistic)	0.0591		

From this ECM, we can extrapolate the following. Unlike the previous ECM, this one suggests that oil prices have a significant influence with the expected sign on housing prices in the short term. Housing demand and housing starts had similar coefficients, but in opposite directions, and the Kuwait Stock Exchange and gold had a negative sign, as in the long-term model. The correction term also took the anticipated sign and exhibited a very fast correction to equilibrium at 40%

correction quarterly, meaning that the model returned to equilibrium within three quarters of disequilibrium.

6.2.3 Error Correction Model (rolled over)

In this section, we rerun the error correction model on a monthly frequency, but roll over for different periods. This approach increases the robustness of our findings concerning relationship between housing prices and the other variables, specifically with regard to whether this relationship is consistent or changes over time. Rolling over the sample may also offer clearer findings than those for the whole period. The span of the period is 10 years (approximately 122 observations, beginning with the first observation in February 2004 and going until March 2014). The period then rolls one year forward. This results in four sub-samples, the last one of which starts in February 2007 and ends in March 2017, as shown in Tables 13 and 14 below.

Table 13, which presents the long-term model, shows that most of the variables have a consistent relationship with housing prices. Housing demand, housing starts, interest rates and gold prices all exhibit similar relationships with housing prices as those found for the ECM with the full sample. Inflation and oil prices also exhibit similar and consistent findings across all sub-samples except the last one, in which inflation and oil prices were found to have a negative relationship with housing prices. This last finding is not realistic and might be influenced by the volatility of oil prices and the drop in housing prices from 2014 until the end of the sample. Finally, the Kuwait Stock Exchange was found to have a negative relationship with housing price in the first sub-sample and a positive relationship in the remaining sub-samples.

The ECM in Table 14 below offers more reliable findings. Interestingly, unlike the ECM with the full sample, this sub-sample ECM illustrates the significant influence of the explanatory variables on housing prices. We considered only those variables that showed statistically significant findings and ignored the rest, some of which yielded signs opposite what was expected. The findings were similar to findings from the first ECM model at a statistically significant level in model (20). Housing demand, housing starts and interest rates all had a significant influence on housing prices in three out of the four sub-samples. Interestingly, even with period rollover, the coefficients of these three variables did not change significantly. Gold prices exhibited a continuous negative relationship with housing prices; however, this relationship was only significant in one of the four sub-samples. Like the full sample model, and contrary to expectations, the first two sub-samples showed that the HPI at lag one had a significant negative relationship with the HPI at level.

Table 13: Long term model (Rolling over)

Variables	2004M2-2014M3		2005M2-2015M3		2006M2-2016M3		2007M2-2017M3	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
LOG(HD)	**0.5207**	**0.0132**	**1.6812**	**0.0000**	**2.2255**	**0.0000**	**2.5144**	**0.0000**
LOG(HS)	**-0.5276**	**0.0074**	**-2.2583**	**0.0000**	**-3.0846**	**0.0000**	**-2.5790**	**0.0000**
LOG(CPI)	**2.2935**	**0.0002**	**1.5120**	**0.0068**	0.8995	0.1172	**-1.5381**	**0.0198**
IR	**0.0449**	**0.0003**	**0.0559**	**0.0000**	**0.0462**	**0.0000**	**0.04.65**	**0.0000**
LOG(OP)	**0.4194**	**0.0000**	0.0549	0.3372	0.0082	0.8850	-0.0318	0.5003
LOG(KSE)	**-0.3163**	**0.0000**	0.0322	0.6977	0.0480	0.5438	**0.1620**	**0.0257**
LOG(GP)	**-0.7076**	**0.0000**	**-0.2728**	**0.0050**	**-0.2040**	**0.0360**	-0.0980	0.2457
C	0.4166	0.8449	**4.5358**	**0.0314**	**9.4890**	**0.0000**	**10.7382**	**0.0000**
DUMMY06M1	**0.3047**	**0.0005**	**0.2861**	**0.0002**				
DUMMY08M1	**0.6287**	**0.0000**			**0.6717**	**0.0000**	**0.6926**	**0.0000**
DUMMY08M2			**0.6299**	**0.0000**	**0.2294**	**0.0008**	**0.2433**	**0.0001**
Observations	122		122		122		122	
R-squared	0.9018		0.9432		0.9603		0.9643	
Durbin-Watson stat	0.8037		0.7253		0.9124		1.1448	
Normality test	Yes*		Yes		Yes		Yes	
Linearity test	No		No		No		No	
Autocorrelation test	No		No		No		No	
Heteroscedasticity test	No		No		No		Yes	

* Yes indicated model passed the test.

The long-term models above, like the previous long-term models, passed only the normality tests and failed the rest. This model also shows a very high R-squared value, which might indicate that the model has the power to explain most of the movement in the dependent variable. The ECMs below are highly reliable and passed all four diagnostic tests. All exhibit a modest R-squared value, which is considered very good for models at their difference level.

Table 14: Error Correction Model (Rolling over)

Variables	2004M2-2014M3		2005M2-2015M3		2006M2-2016M3		2007M2-2017M3	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
DLOG(HPI(-1))	**-0.235**	**0.0066**	**-0.1883**	**0.0284**	0.0168	0.8258		
DLOG(HD)	0.5766	0.19	**1.3341**	**0.0331**	**1.7207**	**0.0179**	**1.7766**	**0.0277**
DLOG(HS)	-0.5689	0.1855	**-1.5397**	**0.0058**	**-1.8906**	**0.0167**	**-1.6001**	**0.0258**
DLOG(CPI)	0.1728	0.8432	-0.0631	0.9416	-0.7443	0.4686	-1.6079	0.1309
D(IR)	0.0235	0.0024	**0.0522**	**0.0002**	**0.0511**	**0.0004**	**0.0435**	**0.0007**
DLOG(OP)	0.0502	0.4359	0.0064	0.9132	-0.0049	0.9421	-0.0093	0.8836
DLOG(KSE)	0.0763	0.3741	0.1168	0.1704	0.0453	0.6619	0.0545	0.5891
DLOG(GP)	-0.1454	0.2206	-0.0544	0.6293	-0.1735	0.1804	**-0.2158**	**0.0925**
U(-1)	**-0.1465**	**0.0322**	**-0.2801**	**0.0004**	**-0.4346**	**0.0000**	**-0.549**	**0.0000**
C	0.0048	0.4998	0.0032	0.7199	-0.0003	0.9718	-0.0001	0.9951
DUMMY06M1	**0.1949**	**0.0002**	**0.1987**	**0.0001**				
DUMMY06M2	**-0.22**	**0.0000**	**-0.239**	**0.0000**				
DUMMY08M1	**0.585**	**0.0000**	**0.5965**	**0.0000**	**0.6386**	**0.0000**	**0.6653**	**0.0000**
DUMMY08M2	**-0.3016**	**0.0000**	**-0.3381**	**0.0000**	**-0.441**	**0.0000**	**-0.4291**	**0.0000**
DUMMY08M3	**-0.2052**	**0.0027**	**-0.1744**	**0.0084**				
Observations	121		121		121		121	
R-squared	0.7257		0.7469		0.6487		0.6748	
Durbin-Watson stat	2.0429		1.9478		2.0663		2.1521	
Normality test	Yes*		Yes		Yes		Yes	
Linearity test	Yes		Yes		Yes		Yes	
Autocorrelation test	Yes		Yes		Yes		Yes	
Heteroscedasticity test	Yes		Yes		Yes		Yes	

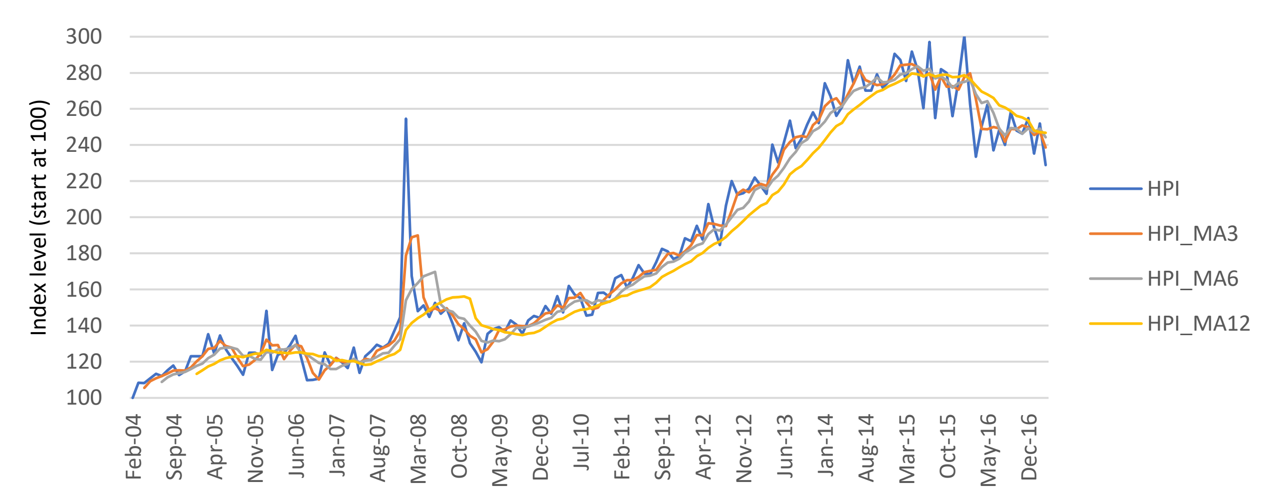
* Yes indicated model passed the test.

Interestingly, the correction speed differs from sub-sample to another, indicating a difference in the market's speed in returning to equilibrium. For example, sub-sample one contains only one major event (around 2008) and exhibits a relatively slower correction speed (15% monthly), while the last sub-sample, which contains two major events (around 2008 and 2014) exhibits an extremely fast correction (55% monthly). These findings may be due to the period of volatility.

6.2.4 Error Correction Model (smoothed HPI)

In this section, we try to control for short-term volatility. We assume that such volatility caused noise in the previous models, resulting in less accurate findings. Smoothing the HPI, therefore, might result in clearer findings and additional robustness. We smoothed the HPI across three moving average durations of 3, 6 and 12 months, as shown in Chart 3 below. The 3-month moving average (3MA) HPI starts in April 2004 and has 156 observations, the 6-month moving average (6MA) HPI starts in July 2004 and has 153 observations and the 12-month moving average (12MA) HPI starts in January 2005 and has 147 observations, as shown in Tables 15 and 16 below.

Chart 4: HPI smothened



The long-term model below shows findings consistent with those of previous models. The only unexpected finding is the negative relationship between oil prices and housing prices in the 12MA model. This model had a very high R-squared value and only passed the normality test.

Table 15: Long-term model (Smoothed HPI)

Variables	3 months moving average		6 months moving average		12 months moving average	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
LOG(HD)	**1.2791**	**0.0000**	**1.0299**	**0.0000**	**1.3313**	**0.0000**
LOG(HS)	**-1.3291**	**0.0000**	**-1.2077**	**0.0000**	**-1.8518**	**0.0000**
LOG(CPI)	**0.9045**	**0.0096**	**1.7253**	**0.0000**	**1.8236**	**0.0000**
IR	**0.0448**	**0.0000**	**0.0480**	**0.0000**	**0.0428**	**0.0000**
LOG(OP)	**0.1843**	**0.0000**	**0.1244**	**0.0015**	**-0.0675**	**0.0253**
LOG(KSE)	-0.0365	0.4961	**0.1102**	**0.0523**	**0.2479**	**0.0000**
LOG(GP)	**-0.4941**	**0.0000**	**-0.3594**	**0.0000**	**-0.1478**	**0.0036**
C	**3.8104**	**0.0076**	-0.4989	0.7166	0.4849	0.6314
DUMMY05M1					**-0.2448**	**0.0000**
DUMMY05M2					**-0.1862**	**0.0003**
DUMMY08M1	**0.2912**	**0.0000**				
DUMMY08M2	**0.3276**	**0.0000**				
DUMMY08M3	**0.2772**	**0.0001**				
DUMMY17M2					**-0.1219**	**0.0066**
DUMMY17M3	**-0.1686**	**0.0133**			**-0.1364**	**0.0025**
Observations	156		153		147	
R-squared	0.95889		0.956568		0.981213	
Durbin-Watson stat	0.306293		0.206889		0.360256	
Normality test	Yes*		Yes		Yes	
Linearity test	No		No		No	
Autocorrelation test	No		No		No	
Heteroscedasticity test	No		No		No	

* Yes indicated model passed the test.

The findings from all of the ECMs (shown in Table 16) support the previous findings. Focusing only on significant coefficients, housing demand, housing starts and interest rates exhibit relationships with housing prices similar to those found in previous ECMs. Since the main concern in the previous models is the influence of volatility, which produces a negative relationship between HPI at level and at lag one, it is interesting to see that smoothing the HPI across three moving average durations results in a significant positive sign between HPI at level and at lag one. Gold prices exhibit a continuous negative relationship with housing price; however, this relationships is only statistically significant in the 12MA HPI. The correction speed was very slow compared to those found in previous ECMs. Specifically, in the 3MA and 6MA HPIs, the correction speed is 5% monthly, while in the 12MA HPI, it is only 2% monthly. Both this finding and the small coefficient numbers are affected by the smoothing process. Finally, the high R-squared value is also a result of the HPI smoothing.

Table 16: Error Correction Model (Smoothed HPI)

Variables	3 months moving average		6 months moving average		12 months moving average	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
DLOG(HPI(-1))	**0.2879**	**0.0000**	**0.4946**	**0.0000**	**0.6978**	**0.0000**
DLOG(HD)	0.1198	0.4684	0.1308	0.2386	**0.1704**	**0.0075**
DLOG(HS)	-0.1419	0.3863	-0.1355	0.1763	**-0.1852**	**0.0021**
DLOG(CPI)	-0.0900	0.7820	0.0231	0.8986	0.1201	0.2147
D(IR)	**0.0130**	**0.0009**	0.0070	0.0014	**0.0057**	**0.0002**
DLOG(OP)	-0.0061	0.7496	0.0152	0.1767	0.0021	0.7173
DLOG(KSE)	**0.0615**	**0.0420**	0.0157	0.3716	-0.0006	0.9500
DLOG(GP)	-0.0365	0.3615	**-0.0432**	**0.0638**	**-0.0210**	**0.0832**
U(-1)	**-0.0493**	**0.0539**	**-0.0466**	**0.0032**	**-0.0228**	**0.0611**
C	0.0036	0.1373	0.0024	0.1173	0.0004	0.6233
DUMMY07M12	**0.0795**	**0.0001**	**0.0803**	**0.0000**		
DUMMY08M1	**0.1579**	**0.0000**			**0.0372**	**0.0000**
DUMMY08M4	**-0.1571**	**0.0000**				
DUMMY08M7			**-0.0857**	**0.0000**		
DUMMY09M1					**-0.0348**	**0.0000**
DUMMY17M3	**-0.0918**	**0.0000**	**-0.0498**	**0.0000**		
Observations	154		151		145	
R-squared	0.6235		0.6615		0.8037	
Durbin-Watson stat	2.0410		2.1106		2.0515	
Normality test	No		Yes		Yes	
Linearity test	Yes*		Yes		Yes	
Autocorrelation test	No		Yes		Yes	
Heteroscedasticity test	Yes		Yes		Yes	

* Yes indicated model passed the test.

6.3 Event influence on the housing market

To test for influence of events on the housing market, we use two parametrical and non-parametrical methods. The parametrical method uses dummy variables for event time, as explained in methodology section. We have two main assumptions. The first assumption is that the event impact will either last for 3, 6 or 12 months or become permanent. The second assumption is that the event impact will start either in the same month as the event or three months after the event. Thus, we have eight scenarios per event. These events cannot be regressed only on the HPI, since such an approach would ignore the influence of other variables (those used as explanatory variables in previous points) over time. Therefore, we add the dummy variables generated in model (20) to the ECM. Events are added to the ECM one by one rather than altogether. After the dummy variables are added, we determine the model's validity, conduct the four tests we use for the ECM, determine whether the dummy variable has a statistically significant coefficient and calculate the sign of this coefficient.

The second method, the non-parametrical one, compares the HPI's standard deviation, the HPI's growth and the transaction volume for exactly the same period after the event (three or six months) and before the event. For example, if an event started in March and we wish to examine its six-month impact, we compare the performance six months from March and the performance six months from the previous March. This approach reduces the influence of seasonality. Furthermore, as noted in the discussion on transaction volume, we further reduce the influence of seasonality by only using the 12MA HPI for non-parametrical tests.

6.3.1 Regional events

We selected three events that happened in the surrounding region that we believed were most likely to impact the Kuwait housing market, the Kuwait economy and the confidence of Kuwaiti citizens. Details and findings concerning these events are presented in Table 17 below.

The first event is the death of King Fahad Alsaoud, who was the king of Saudi Arabia until August 2005. This event was considered because of the close relationship between Kuwait and Saudi Arabia and because Saudi Arabia is among the most important, wealthiest and strongest countries in the region. Therefore, changes in the Saudi Arabian presidency are likely to influence a small market like Kuwait. We anticipated that the corresponding rise of King Fahad's successor, King Abdullah (King Fahad's brother), may have had positive or negative impacts on the market, depending on people's expectations.

Table 17: Regional event impact on housing in Kuwait

	Event period			After the event			Similar period last year		
	Start (from event date)	End (after start)	Significance	HPI SD	HPI Growth	Transaction Volume	HPI SD	HPI Growth	Transaction Volume
Death of King Fahad August-2005	Same day	3 months	-0.023383	N/A	N/A	N/A	N/A	N/A	N/A
	Same day	6 months	-0.009427	N/A	N/A	N/A	N/A	N/A	N/A
	Same day	12 months	0.007989	N/A	N/A	N/A	N/A	N/A	N/A
	Same day	Permanent	-0.018136	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	3 months	0.012522	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	6 months	0.01668	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	12 months	-0.01401	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	Permanent	-0.004252	N/A	N/A	N/A	N/A	N/A	N/A
Saddam Husain execution January-2007	Same day	3 months	-0.01372	N/A	0.74%	871	N/A	-0.14%	640
	Same day	6 months	-0.017822	N/A	2.68%	1,892	N/A	0.03%	1,310
	Same day	12 months	-0.003469	7.1304	17.72%	4,508	0.3774	-0.62%	2,696
	Same day	Permanent	-0.00188	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	3 months	-0.021156	N/A	1.14%	1,021	N/A	-0.06%	669
	After 3 months	6 months	-0.00204	N/A	7.29%	2,272	N/A	-0.12%	1,330
	After 3 months	12 months	0.008853	12.8234	29.09%	4,952	0.4138	0.05%	2,926
	After 3 months	Permanent	0.001328	N/A	N/A	N/A	N/A	N/A	N/A
Arab Spring December-2010	Same day	3 months	0.014675	N/A	2.24%	839	N/A	2.04%	716
	Same day	6 months	0.006749	N/A	3.72%	1,706	N/A	6.68%	1,512
	Same day	12 months	0.004742	5.1443	10.18%	3,575	5.8244	11.79%	3,208
	Same day	Permanent	0.016213	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	3 months	-0.002177	N/A	1.00%	867	N/A	3.06%	796
	After 3 months	6 months	-0.00602	N/A	4.24%	1,789	N/A	5.84%	1,635
	After 3 months	12 months	0.005679	5.5116	9.40%	3,718	5.1490	11.75%	3,331
	After 3 months	Permanent	0.014791	N/A	N/A	N/A	N/A	N/A	N/A

N/A: Not applicable

We found no evidence that the market reacted to the change in the Saudi Arabian presidency. Furthermore, even without considering the significance level of the results, the signs were inconsistent, confirming that what happened in Saudi Arabia has no influence on the Kuwait housing market. No non-parametrical test is available for this event because it occurred so close to the beginning of the sample.

The next event was the execution of Saddam Hosain, the former president of Iraq, in January 2007. This event is important to consider because Saddam was the president of Iraq when Iraq invaded Kuwait in 1990. Even after freeing Kuwait in 1991, Saddam continued to threaten further invasions and chemical bombs. Therefore, his death may have increased Kuwaitis' confidence in the beginning of a new era of peace with Iraq. We found no evidence that the execution of Saddam Hosain impacted the Kuwait housing market; however, non-parametrical tests showed huge differences in HPI SD, HPI growth and transaction volume over the 12 months before and after the event. Therefore, the event can be said with a low level of confidence to have had a positive impact on the Kuwait housing market.

The last regional event considered was the Arab Spring. The Arab Spring started in Tunisia in December 2010 and spread across several countries in the region, producing different levels of activism, demonstrations and consequences in each one. Kuwait was one of the few countries in the region that did not participate in the Arab Spring. This is because, unlike the other participating countries, Kuwait has followed a democratic system for very long time. In Kuwait, demonstrations are allowed and can be organised for any reason. Kuwait even provides a place for such events. Kuwait's other issues, including the continuous conflict between the cabinet and the Parliament, did not stem from the Arab Spring; rather, such practices have been ingrained for more than 70 years. To test whether the Kuwait housing market was affected by Arab Spring, we ran the two tests, paprametrical and non-parametrical. We found no evidence that the Arab Spring affected the housing market in Kuwait, and even the non-parametrical tests suggest that the performance of the housing market was similar before and after the start of this event.

6.3.2 Local events

We selected four main local events that we believed were most likely to impact the Kuwait housing market, the Kuwait economy and the confidence of Kuwaiti citizens. The details and findings concerning these events are presented in Table 18 below.

The first local event we considered was the death of the former Kuwait president Shaikh Jaber Alsabah in January 2006. As in the case of the death of King Fahad, we expected that the market may have positive or negative reactions to this event, depending on people's expectations concerning the new president. We found that this event had two significant but temporary positive impacts on the housing market: one that started the month of the event and lasted for six months and one that started three months after the event and lasted for three months. These impacts likely reflect the market regaining its confidence due to the smooth transition to the new president and the unanimous support of the Kuwait parliament. Since the former president was one of the most loved presidents of Kuwait, the housing market's positive reaction to his death can only be read as the market regaining its confidence based on high expectations of the new president. The non-parametrical tests showed that housing prices dropped slightly after the event, compared to a slight growth around the same time the year before. The transaction volume was similar before and after the event.

The second local event we considered was the introduction of two new laws related to the housing sector. Law 8-2008 forbids companies from buying any houses or residential lands, while law 9-2008 requires any individual who owns more than 5,000 square meters of undeveloped lands to pay a tax of K.D. 1 per each additional square meter per annum. These laws took effect in February 2008. The introduction of the new laws was the event with the clearest impacts on the housing market. We found that the housing market exhibited a significant negative reaction during the first 3 months and the first 12 months after the event. When we assumed that the impact of the event did not start until three months after the introduction of the laws, we found that the event negatively affected the housing market for the 6-month and 12-month periods, but did not have a permanent impact. We also noted that the transaction volume decreased by half during the 12 months after the event, compared with the same period of time the previous year. Furthermore, for 12 months after the event, the HPI exhibited a small negative growth, compared to a 25% growth during the same period the year before. Although the negative impact of the introduced laws is clear, it is difficult to tell which of the two laws (if either) had the most influence on the shift in the market.

The third, in December 2011, Kuwait experienced the first replacement of a prime minister. The replacement occurred in response to a number of demonstrations requesting that the president of Kuwait replace the prime minister, Shaikh Naser Alsabah. Although all coefficients for these event had positive signs, none were statistically significant. Furthermore, the performance of the HPI in term of growth and transaction volume was similar before and after the event. Therefore, it appears that the market had no reaction to this event. This may indicate that the market had a high level of confidence in the system.

Table 18: Local event impact on housing in Kuwait

	Event period			After the event			Similar period last year		
	Start (from event date)	End (after start)	Significance	HPI SD	HPI Growth	Transaction Volume	HPI SD	HPI Growth	Transaction Volume
Death of President Jaber Alsabah January-2006	Same day	3 months	0.009991	N/A	-0.14%	640	N/A	2.94%	668
	Same day	**6 months**	**0.05746*****	N/A	0.03%	1,310	N/A	6.19%	1,297
	Same day	12 months	-0.00625	0.3774	-0.62%	2,696	2.8030	7.71%	2,531
	Same day	Permanent	-0.007102	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	**3 months**	**0.070518*****	N/A	-0.06%	669	N/A	2.29%	628
	After 3 months	6 months	-0.021264	N/A	-0.12%	1,330	N/A	2.24%	1,237
	After 3 months	12 months	-0.010139	0.4138	0.05%	2,926	1.6618	4.56%	2,503
	After 3 months	Permanent	-0.007713	N/A	N/A	N/A	N/A	N/A	N/A
Introducing new housing law February-2008	**Same day**	**3 months**	**-0.118076*****	N/A	2.75%	1,268	N/A	1.32%	908
	Same day	6 months	-0.043597	N/A	5.77%	2,276	N/A	4.07%	2,014
	Same day	**12 months**	**-0.063062*****	4.2526	-1.53%	3,577	9.4140	24.93%	4,677
	Same day	Permanent	-0.003175	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	3 months	-0.023826	N/A	1.50%	1,008	N/A	2.32%	1,106
	After 3 months	**6 months**	**-0.05077*****	N/A	2.07%	1,768	N/A	9.38%	2,411
	After 3 months	**12 months**	**-0.035966*****	8.3337	-11.11%	2,750	13.7134	30.11%	5,037
	After 3 months	Permanent	0.000604	N/A	N/A	N/A	N/A	N/A	N/A
Prime Minister replacement December-2011	Same day	3 months	0.018334	N/A	0.93%	982	N/A	2.24%	839
	Same day	6 months	0.027278	N/A	4.23%	2,021	N/A	3.72%	1,706
	Same day	12 months	0.024675	6.6923	11.46%	3,985	5.1443	10.18%	3,575
	Same day	Permanent	0.01579	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	3 months	0.034658	N/A	2.06%	1,039	N/A	1.00%	867
	After 3 months	6 months	0.016882	N/A	4.97%	2,034	N/A	4.24%	1,789
	After 3 months	12 months	0.026426	8.2288	14.00%	3,926	5.5116	9.40%	3,718
	After 3 months	Permanent	0.013361	N/A	N/A	N/A	N/A	N/A	N/A
Alsaddeq Terrorist attack July -2015	Same day	3 months	0.012477	N/A	-0.45%	682	N/A	1.70%	754
	Same day	6 months	0.003787	N/A	-1.45%	1,320	N/A	3.49%	1,475
	Same day	12 months	-0.01149	3.9398	-4.33%	2,487	4.2518	3.96%	2,902
	Same day	Permanent	-0.019312	N/A	N/A	N/A	N/A	N/A	N/A
	After 3 months	3 months	-0.004999	N/A	-0.85%	638	N/A	1.12%	721
	After 3 months	6 months	-0.024623	N/A	-1.68%	1,237	N/A	2.01%	1,447
	After 3 months	12 months	-0.012989	6.2941	-6.71%	2,398	2.0472	1.53%	2,830
	After 3 months	**Permanent**	**-0.024275*****	N/A	N/A	N/A	N/A	N/A	N/A

N/A: Not applicable

The last local event we studied was the July 2015 terrorist attack on a mosque. The terrorist was a suicide bomber who entered Kuwait from another country and blew himself up in a mosque during the Joma'a prayer. This event was the first such attack to happen since the 1980s, so it had a huge impact on Kuwaiti society. Although most of the coefficients showed that this event had a negative impact on the housing market, the impact was only statistically significant for the scenario in which the event impact started three months after the event and lasted permanently. It should be noted that 'permanent' for this event means from October 2015 until March 2017. There is no evidence that the terrorist attack reduced the housing transaction volume; however, though the HPI growth for the same period the year before was positive, the HPI growth after the event was negative.

Overall, the Kuwait housing market seems to be largely insensitive to local and regional political events. This could be due to the constraints on housing demand or a high level of confidence in the country's system. However, changes in housing legislations clearly affected the Kuwait housing market across four different periods. The market also exhibited a negative response to a terrorist attack within the country, perhaps due to a loss of confidence in the market. All of the results (positive/negative and significant/non-significant) showed the expected signs and strengths, indicating that the methodology used was highly effective.

7.0 Conclusion

Studying housing sectors in emerging markets is challenging, especially in cases with limited data and short periods of study. To address these issues, we decided to use monthly data for housing and other related variables. When variables were available at monthly frequencies, we used these variable; when they were not, we replaced them with suitable proxies.

Housing prices in Kuwait, as most other countries, have rapidly increased. This has significantly affected housing affordability, resulting in an HAI of less than 100 for most age categories. This HAI suggests that most individuals in Kuwait are unable to afford a home mortgage. Furthermore, the income multiplier jumped from PIR 6 in 2004 to PIR 10 in 2016 for families with adults aged 31 to 35. This shift is a clear result of a housing supply shortage and a high accumulated housing demand.

We modelled the housing market in Kuwait using an ECM because of the need to examine non-stationary data, including the HPI, housing demand, housing starts. When using monthly data for the full sample, all variables in the long-term model exhibited the expected relationship with the housing market; however, in the short-term ECM, these variable coefficients were not significant (with the exception of the error correction term, which indicated that the market returned to equilibrium at a rate of 15% monthly). When we reran the same model with a quarterly frequency, we found evidence that oil prices positively influence the housing market even in the short-term. The short-term model yielded a correction term of 40% per quarter (relatively close to the monthly speed of adjustment of the first model).

We found further improvements in the results when we reran the model using rolling over and smoothing approaches. In the rolling over model, we found consistent and significant results for housing demand, housing starts, interest rates and gold prices. Specifically, housing demand was found to have a positive relationship with housing prices, while housing starts were found to have a negative relationship with housing prices. Interestingly, in most of the findings, housing demand and housing starts were found to have relatively similar influences on housing prices, but in opposite directions. This make sense, since housing demand and housing starts can both be considered ways to compare the number of families desiring houses to the number of existing houses. The interest rate was found to have a positive relationship with housing prices in both the long- and short-term models. This finding contradicts general expectations regarding the influence of interest rates on housing. However, the results were likely influenced by the unique characteristics of the Kuwait market, including the strict limitations on mortgages and the blanket mortgage cap. The findings may also reflect the impact of interest rates on construction costs. Gold prices were found to have a negative relationship with housing prices in both the short term and the long term. This may be because investors switch from houses to gold (and vice versa) based on the performance of each market. Finally, in three improved models with smoothed HPIs, all significant findings confirmed the findings of previous models.

In a closed market like Kuwait, in which only Kuwaiti citizens can purchase real estate, we found that testing the relationships between the housing market and the Kuwait stock market, gold prices and the HPI at one lag yields a good understanding of whether and how the market is influenced by investors and speculation. We found that the Kuwait stock exchange has a positive impact on the housing market in the short term, but a negative impact in the long term. This suggests that investors switch from housing to the stock market depending on the markets' respective performance. We found similar results for gold prices, which have a negative relationship with the housing market in both the short term and the long term. Last, smoothed HPI models were constructed to reduce the influence of short-term volatility in the housing market. These models showed that HPI at one lag has a positive impact on housing prices, indicating the existence of housing market speculation. Such speculation may explain why HPI at one lag positively influences housing prices.

When testing for the impacts of regional and local events, we did not find any influence of regional events on the Kuwait housing market. On the local level, however, we found that the housing market was influenced by changes in legislation and terrorist attacks. Other political events in Kuwait had no impact on housing. This could be because of Kuwait is politically mature, with a trusted system of government.

Overall, this paper contributes to the body of research on the real estate market in Kuwait and the surrounding region. It is the first study on the Kuwait housing market and offers important findings that should be considered by decision makers. To resolve the difficulties in the housing market, it is necessary to meet the nation's current housing demand. However, any drop in oil prices is likely to have a significant and lasting impact on both the housing market and housing prices. Such changes will certainly impact Kuwait's major housing development plan, which requires significant funding.

Kuwait, as well as many other emerging countries, is considered a young country. A majority of its residents are young, so is the country is expected to face a strong and fast-growing demand for housing. This fact cannot be changed; however, as noted in this paper, the supply of houses is critical for solving housing-related problems and the rapid increase in prices.

The government in Kuwait, as in many other emerging-market countries, relies on itself to provide or control the housing supply. This has been clear in the Kuwaiti market and emphatically proven to be among the main drivers of housing prices. However, the market has no capability of keeping up with demand and providing the required supply. As a result, governments must adopt models used in developed markets that rely on the private sector to serve as the main player in housing supply.

Further, signs from existing investors and speculation in the housing market need to be treated as they have been in Singapore, which has noted the influence of investors on housing. Singaporean officials worked to provide alternative investments to reduce investors impact on housing. Singapore developed the REIT market to provide alternative real estate investment opportunities to investors who trade in housing; this approach should be considered in Kuwait and other emerging markets.

Finally, the impact of oil prices must be taken into consideration in those countries that rely on oil production, such as GCC states. As this has shown a direct impact on housing prices in Kuwait, it must also be considered among the main sources of income for those countries and the main source for their development plans. A drop in oil prices means that those countries might not have enough funding to provide housing as called for in their major development plans. If this were to happen, housing problems could not be resolved unless the funding shortage was solved; this could require those countries to consider alternative sources of funding to develop more houses. Based on this, the third paper will address funding issues and discuss alternative sources of funding that could solve the funding limitations in Kuwait and other emerging-market countries.

8.0 Limitations

The main limitation of this paper is a shortage of data. Given the short period of time covered, we were forced to consider monthly observations, which are more likely than quarterly or annual observations to suffer from high levels of volatility that could impact findings. We also used the HPI, which follows the median method. Although we improved the performance of the index using a technical adjustment (explained in first paper), we found that the index still suffered from volatility. However, with respect to this limitation, it is important to note that the nature of the real estate and housing market would cause any index to suffer from volatility.

End of
The Second Paper

Fourth chapter-Third Paper

The Portfolio Advantages of Sukuk:

Dynamic Correlations between Bonds and Sukuk

Abstract:

The issue of whether sukuk are different from bonds is an ongoing debate. Many previous studies have found sukuk to be different from bonds as they provide the advantage of diversification, which could be the reason for high demand for sukuk from global market that is not limited to Muslim countries.

This advantage is critical for countries with a large development plan, such as the Kuwait Vision 2035, especially after the oil price crisis which affected the main source of income for Kuwait. Therefore, identifying an alternative source of funding for the development plan is important, not only for Kuwait but for most emerging countries, which have funding limitations and require another source of funding, such as issuing bonds and financial certificates (sukuk).

This study considers the relationship between bonds and sukuk, which is critical to the attractiveness of sukuk for investors who might buy sukuk. The relationship is tested by using Generalised Autoregressive Conditional Heteroscedasticity–Dynamic Conditional Correlation (GARCH-DCC) in an additional to unconditional correlation framework. Additionally, this paper tests the relationship between individual bonds and sukuk, which are highly comparable, which is advantageous over studies that instead use indices or portfolios in running tests. By constructing 21 pairs over various lengths of time, we found that sukuk highly correlates to bonds and falls within bonds correlation. Also, we found no evidence of different performance between different types of sukuk, as they all show significant relationships to bonds. This finding is important to consider from an investment perspective, as it seems sukuk significantly similar to bonds and do not provide diversification advantages as were found in earlier studies.

1.0 Introduction

Sukuk are considered new financial instrument which dragged the investor's interest all over the globe, from the Far East, Middle East, to Europe and North America. Although these financial products have to be in complaint with Islamic law "share'ah", non-Muslim investors and corporate showed positive interest in sukuk. Watkins (2011) found that 80% of sukuk were held by non-Muslim parties as of 2011. The main reason for such interest, especially from non-Muslim investors, is purely from risk diversification perspectives. Since Sukuk early years and they proved to provide diversification advantage and showed in some studies weak relationship to bonds. However, this relationship is still in debate among researchers, financial markets and share'ah scholars. From one side, sukuk structure, risk and return ended up having almost bonds like products, while the other side showed empirically finding that they are not the same in term of correlation, market reaction and yield to maturity (YTM) differences. However, because sukuk are new instrument and could still be in early stage, comparison studies have to be made to explore these instrument in more details before running tests. Many academic researchers and industry reports found that the main challenge for sukuk are tradability and liquidity levels which causes the price gap between sukuk and bonds (Thomson Reuters Zawya, 2014). Thomson Reuters Zawya (2014) report found in their survey that 70% of lead arrangers, major investment banks, assume that sukuk tradability highly influenced their return and relationship with bonds. This is because of sukuk holder to hold sukuk till maturity and because of unbalanced relationship between sukuk supply and demand. As of Thomson Reuters Zawya report (2014), they found supply of sukuk is in short by $230 billion as of first half on 2014, which give an indication about the level of relationship between supply and demand. These issues, in addition to other issues such as differences among sukuk, sample period, data used and methodology all of which could be the influence for having doubtful relationship between sukuk and bonds in previous studies.

What is interesting about sukuk from the perspective of real estate development is the possibility to finance real estate and infrastructure development in Kuwait and emerging markets. Sukuk is in its early stage and has huge demand from local, regional and international investors. With short supply, there are many possibilities to issue sukuk to fund major development plans, such as Kuwait Vision 2035. In particular, dropping oil prices, which account for 95% of Kuwait's income, have created an annual $15 billion deficit in Kuwait's budget for the past three years, making it impossible to make the annual required funding of roughly $100 billion for Kuwait Vision 2035. As an alternative funding source, sukuk could solve the funding shortage for governments and investors to achieve development plans. This could help solve real estate issues in housing and other sub-sectors. Other countries, such as Qatar, Saudi Arabia and Bahrain, have issued sukuk to fund real estate development (examples are following). However, the development funding provided by sukuk is very small compared to the overall required funding. It, therefore, is important to consider sukuk as an alternative funding source and to study its relationship to bonds. This is critical from an investment perspective: if sukuk issuers, governments and investors seek to issue sukuk to develop the real estate sector, then they need to understand the attractiveness of sukuk to investors. Earlier studies showed advantages from adding sukuk to investment portfolios, but this finding needs to be reassessed, which is the focus of this paper. If sukuk still shows a different relationship to bonds, then this will be a main point of attraction to local and international investors. If sukuk shows similarities to bonds, then parties planning to issue sukuk should carefully consider the expected future demand for sukuk.

The aim of this paper is to explore the relationship between these two instruments. To reach more accurate result, this paper have tested the relationship between sukuk and bonds in a sensitive matters. Targeted market, data frequency, type of sukuk and bonds, type of issuers and rating, sample period, methodology etc., all of which have been carefully selected for the purpose of having comparable products and right approach to test their relationship. Further details on this will be explained in.

1.1 Islamic Finance

To understand Sukuk, it is best to start by having general idea on the concept of Islamic Finance. For simplicity, it is adopting traditional finance but without breaking any of the Islamic law "Share'ah". As Nienhaus (2014) explained that to be in complaint with share'ah, trading contracts should be free of the main three restrictions in share'ah. First, contracts must be free of "Gharar" uncertainty or ambiguity. For example, anything could cause dispute between parties in future such as terms of payments, quality of products or date of delivery. Second, contract must be free of "Maysir" gambling where winning of one party is losses for another party which do not have any added value to the economy or community and create bad habits. Third, contract must be free of "Riba" interest on loans or usury. This last restriction is the most challenging one for all the Islamic products and it is the reason for the creation of complicated structures for Sukuk and other products. Although most share'ah scholars, experts in share'ah law, agreed on the definition of Riba, it is still a main point of debate because in the Holly Qur'ah it is clearly mentioned that Riba is forbidden, however, it is not explained what exactly is Riba. In addition to these three issues, Nienhaus (2014) explained that all transactions should be free of general restrictions of Islamic law such as trading of weapons, alcohol or other products that harm human.

It is interestingly to note that although Islam religion returns to the fifth century, the creation of Islamic commercial code, which explains commercial rules under Islamic law "Share'ah", was in the nineteen century (Nienhaus, 2014). Yet, Islamic banking first started in the 1970s for the purpose of creating alternative products to those provided by traditional banks. This can explain the dramatically growth in finance products in complaint with share'ah. However, such fast growth and creation of products equivalent to traditional products causes some confusion where few of those innovative products considered by some share'ah scholars a break of share'ah law (Archer, 2015).

Islamic finance sector has clearly started growing dramatically since the early 2000s, not only Malaysia but GCC, Turkey and other Islamic countries in Africa and Asia mainly followed lately by acceptance in many other countries such as The UK, Germany. This market assets size grow from about $400 billion in 2006 to around $2 trillion in 2014 (Husain, el at., 2015) most of which is from Islamic banking followed by the issuance of sukuk. Yet, based on Malaysia's Islamic Finance Marketplace (MIFC), expectation to continue growing and reach $4 trillion by 2018, mainly influenced by Malaysia, and Saudi Arabia (MIFC, 2014). Interestingly to note that most of the recent driver for Islamic finance is the influence form sukuk issuance which mostly used for real estate, infrastructure and development purposes.

1.1.1 Sukuk

As Islamic finance grows, people from this industry tried to have an equivalent to bonds but in complaint to share'ah law which causes the foundation of such products called Sukuk. Sukuk is an Arabic word meaning financial certificates. Those certificates in contrast to bonds must represent undivided shares in ownership of tangible assets, usufruct and services (Vishwanath and Azmi, 2009). Sukuk as new financing instrument have been growing very fast since the early 2000s (Rasameel, 2014). Although sukuk first founded in Malaysia in 1990, it was limited to Malaysia and not being accepted by other countries till 2002 (Rasameel, 2014). Afterward, sukuk have been accepted internationally and growth not only in Malaysia, but in Middle East and some European countries to reach from $5 billion in 2002 to $286 billion in first half of 2014 (Rasameel, 2014). Sukuk as financing instrument formed in compliance to share'ah, however; sukuk have never been limited to institutions work under share'ah, but demand for sukuk is from all over the globe (Rasameel, 2014).

Interestingly, sovereign and quasi-sovereign represent 80% of sukuk issuance as of 2013 and expected to continue at that level because of infrastructure and pipeline projects for governments in Middle East and Asian, which expected to push sukuk market further up and increase confident and stability of this market (Standard & Poor, 2013). As a result of such performance in sukuk market, many independent rating agents started rating and evaluation sukuk instruments which has improved sukuk competitiveness and transparency (Standard & Poor, 2013)

1.1.2 Sukuk issued in GCC to finance major real estate and development projects

Since sukuk were introduced in 2003 to GCC markets, many GCC governments and corporations started issuing them. Focusing on sukuk issued to finance major developments either with sovereign/quasi-sovereign sukuk or corporate, literature reports such sukuk issued for different purposes in Saudi Arabia, United Arab Emirates, Qatar and Bahrain.

Starting in Qatar, where the first sukuk in the GCC were issued in 2003 with a government issue of sukuk for $700 million to finance the development of Hamad Medical City (MEED, 2003). The same year, Emaar Properties, a United Arab Emirates (UAE) real estate development company (government company), issued sukuk worth $50 million to finance real estate development projects (MEED, 2003). The next year, in 2004, another real estate project in Bahrain issued $120 million sukuk to finance Durrat al-Bahrain resort; this was issued by Durrat al-Khaleej al-Bahrain company (MEED, 2004). Since then, sukuk have become a major source of financing in the GCC. In the UAE, the government of Dubai issued $1 billion sukuk as part of their $4.1 billion plan to finance Dubai International Airport (Euroweek, 2004). At the end of 2006, Nakheel (a UAE government-related company) issued the largest sukuk at that time, $3.5 billion to finance landmark developments in Dubai such as the Palm, Jumeirah, and the World (Euroweek, 2006). In 2007, Saudi Arabia started issuing sukuk; Dar Alarkan (a non-government company) closed $950 million in sukuk financing to finance their real estate developments (MEED, 2007). In the oil sector, Saudi Aramco Total Refining and Petrochemical Company (SATORP) issued $995 million sukuk in 2011 for its Jubail refinery, which is considered the first Greenfield projects that used sukuk (O'Neill, 2011). Dana Gas, a UAE oil company, issued sukuk worth $1 billion to finance acquisitions and new projects in the oil and gas sector (MEED, 2007). The last example is Saudi Electricity Company (SEC), which became the first entity to issue 30-year USD sukuk for value of $1 billion. In addition, SEC issued another $1 billion sukuk, but for 10 years, for a total of $2 billion sukuk in 2013. The purpose of issuing these sukuk was to finance new developments in the electricity sector in Saudi Arabia (Euroweek, 2013).

1.1.3 Type of Sukuk

When considering Sukuk it is important to note how they differ from bonds and more importantly how they differ from each other. Such differences have huge impact in pricing and risk associated to each of those Sukuk. As Sukuk are considered the alternative to conventional bonds, is it necessarily to start with basic definition of bonds then compare to each of the Sukuk types. Bonds, are financial certificates issued by corporate and government promising to pay bonds holders fixed or floating interest in return to their money and promise to pay back the principle on agreed time or before that if they agreed to give bonds issuers the right for early termination. Bonds rating, return and risk all associated to the issuance financial strength. On the other hand, Sukuk must represent an ownership of an assets, usufruct and services to Sukuk holders (Nienhaus, 2014). In addition, because Sukuk are based on one of the nominal share'ah commercial contracts, it is expected to have some differences in expected risk and return to Sukuk holders as well as differences in Sukuk issuance rights and responsibilities. Yet, for return smoothing purposes, Sukuk structure have to be more complicated than bonds for the sake of fixing returns and face value till maturity, if possible, without violating share'ah complaint.

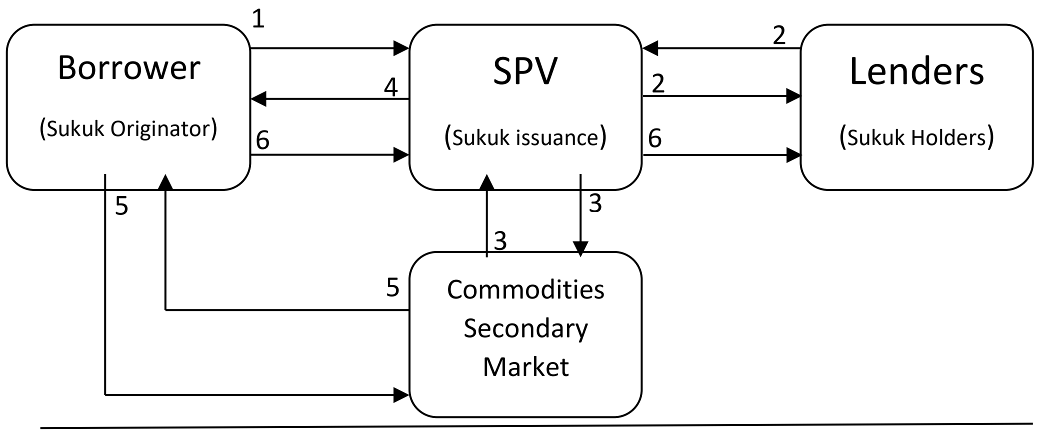
To clarify all that, it is important to consider the main four types of Sukuk and how they differ from each other and why each of these Sukuk is used. It is important to note that even though examples below reflect four different kind of contract, within the same contract originators can change some terms or has different structure which might cause huge different in Sukuk pricing and risk calculation. Further explanation is below. (Cited from Usmani, (1998); Vishwanath and Azmi, (2009); Nienhaus, (2014); and Archer, (2015)).

1.1.3.1 Murabaha Sukuk (mark-up sale)

Murabaha (mark-up sale) is a straightforward contract where seller sell an asset (commodity, goods or property) to buyer at present with deferred payments. Because the repayments delayed for a period of time, it is expected from the seller to have a mark-up premium calculated in equivalent to traditional loan on fixed interest rate. Under Murabaha contract, delivery of assets has to be at present, however, payments can be delayed for whatever period both parties agreed on in advance. In contrast to most of the share'ah contracts, Murabaha must have fixed profit (highly like fixed interest in conventional loan) and it cannot be extended for additional period with extra charge, at the same time it cannot have a discount for early repayments. For example, if party A sold to party B goods worth today 100 for 120 (+20 is mark up for delayed payments) and agreed to have equal monthly repayments for 60 months, then party B cannot extent the period of the repayment for extra interest to party A, also, party B is committed to pay back 120 even if decided to close the debt the next day of signing the contract, unless party A agreed to give discount to party B with no enforcement on party A.

When considering this contract for sukuk, it is important to note that sukuk holders (lenders) are not expected to be owning assets that will be used to complete this transaction, at the same time sukuk originator (borrower) is not interested to hold assets he/she bought in this transaction but they required cash instead. Therefore, Murabaha sukuk have the following steps.

Chart 1: Example of Murabaha structure



1- Sukuk originator (borrower) promise to buy from the Special Purpose Vehicle (SPV) commodity at agreed price (market price + premium) and to repay on agreed schedule (monthly for 60 months).
2- Lenders (Sukuk holders) inject their funds in the SPV for the purpose of buying commodity and sell it to borrower, so their funds become sukuk issued by the SPV.
3- The SPV buys commodity from the market that borrower agreed to buy.
4- The SPV sells commodity to borrower at agreed price in step 1.
5- Borrower sells back commodity in secondary market and receive cash.
6- Borrower pays the SPV based on agreed schedule.

Note: step 1 to 5 is expected to take one day or few days maximum, while last step might continue for years.

This kind of sukuk is attractive to investors who want straightforward borrowing without long term commitment to involve assets like other kind of sukuk. It is also attractive to short term investors who have cash which do not intend to use in the short term so they participate in short term Murabaha financing through banks and other financial institutions. Although Murabaha sukuk is one of the most common used sukuk because of its simple structure and fixed rate, it does have some disadvantages made other kind of sukuk become more popular. On one hand, sukuk originator has no flexibility in financing term or cost. So, to extend the financing they need to take again all the 6 steps in chart 1, which incur high transaction cost. Yet, if sukuk originator could not roll over Murabaha sukuk (issue new Murabaha sukuk) and missed payment, then it is considered a default. On the other hand, sukuk holders under Murabaha contract are considered holders of debt sukuk. After step 5 in chart 1, the relationship between sukuk holders and sukuk originator is purely debt repayment. Therefore, it is prohibited under share'ah to sell debt, making sukuk holders hold their sukuk till receiving the last payment which raises the issue of illiquidity for this kind of sukuk. Although most of share'ah scholars agreed on the prohibition of selling debt, some scholars found it permissible with some conditions.

Interestingly, this king of sukuk considered the most favourable kind for real estate and infrastructure development. The reason behind it is the flexibility for sukuk issuer to manage liquidity generated from issuing sukuk. Also, this kind of sukuk do not require the existing of assets to be used, except for the day of transaction, then after than it is a loan relationship. This might be the reason for having Murabaha sukuk the most issued among all types.

Murabaha sukuk are considered riskier than other sukuk as sukuk originator is responsible for the repayment and if defaulted to meet sukuk liability this could risk their other assets. Therefore, in Murabaha sukuk, lenders and rating agent consider sukuk originator financial strength and assets they have in their balance sheet which will be reflected on the cost of lending, based in the borrower financial position.

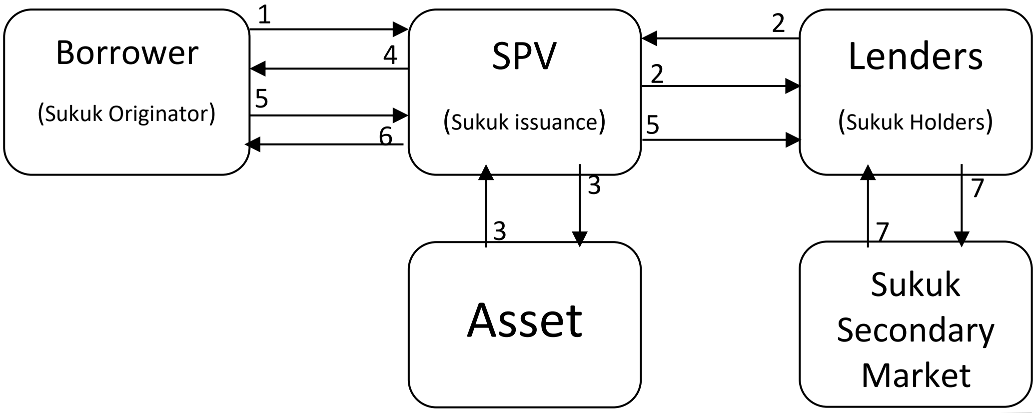
1.1.3.2 Ijara Sukuk (leasing)

Ijara contract is a leasing contract where one part who owns a specific asset leases it to another party for the agreed terms. Lessee receive the rights of using asset leased either for themselves or to lease it to third party, all of which is subject to the agreement between the lessee and the asset owner (lessor). Under this contract, lessor charge rent on the leased asset equivalent to market financing rate. For example, if conventional financing rate in that specific market is 5%, then under Ijara financing the rent charged by the lessor is expected to be equivalent to market financing rate. Interestingly, this contract in contrast to Murabaha has high flexibility for both parties. First, rental rate can be fix or variable. In other words, rate charged can be fixed for example at 5% or it can be floating, for example based on London Interbank Offered Rate (LIBOR) plus 200 basis points over LIBOR and reviewed annually. Second, contract term (leasing period) can be shortened or extended without breaking share'ah, however, it should be agreed between parties. For example, if the lease contract for 10 years, the lessee, not the lessor, can terminate the contract any time before maturity. Also the lessee can ask for the contact to be extended without incurring additional cost of rolling over, but it is subject to lessor approval. Third, under Ijara contract the lessee will be charged "profit" only for the period they leased the asset (Note: Profit is the term used in Islamic finance which is equivalent to interest). So, if the contract last for 10 years, but the lessee terminate after 18 months, then the lessee should pay profit for only the 18 months and not like Murabaha for the entire period.

Another important advantage in Ijara contract is the right to promise to purchase the asset from the asset owner. In most of Ijara contract, the lessee intention is to acquire the asset leased and agreed on advance on payment schedule which is normally either by down payment plus continued instalments or by down payment plus balloon payment end of the term. Yet, in most of Ijara contract the lessee have the right to pay additional amount of the remaining principle at specific time like every April or at the end of each quarter. Interestingly, in all of these scenarios, the lessee profit charged will be calculated based on the remaining of the principle which is considered another advantage when comparing with other type of contracts. In addition, as the lessee agreed in advance to buy the asset, the lessor (lenders) will be less worrying about the underlying asset value as it will not affect them in case of value appreciation or depreciation.

To issue sukuk under Ijara contract, it is important to have asset to lease which can be asset already owned by sukuk originator (sale-lease back) or asset to be bought and held for the whole period of financing. Chart 2 illustrate the structure of Ijara sukuk.

Chart 2: Example of Ijara structure



1- Sukuk originator (borrower) promise to lease from the Special Purpose Vehicle (SPV) the asset (property, airplane etc.) at agreed price (equivalent to market cost of financing) and to repay on agreed schedule (monthly for 60 months). Originator also promises to buy the assets at agreed price (normally original price).
2- Lenders buy Sukuk issued by the SPV for the purpose of buying targeted asset and lease it to the borrower. Note: targeted asset can be asset owned by sukuk originator so they sell it and lease it back, or the asset can be as asset the originators want to acquire.
3- The SPV buys the asset that borrower agreed to lease.
4- The SPV leases the asset to the borrower at agreed price in step 1.
5- Borrower pays sukuk holders through the SPV based on agreed schedule. Payments can take different shapes, either to pay the profit only (equivalent to market interest rate) and pay balloon at the end as the principle, or payment can be mix of profit and part of the principle (amortisation).
6- The SPV transfer the ownership of the asset to the originator after paying the entire principle.
7- Sukuk holders can sell their sukuk in secondary markets after step 4.

Note: step 1 to 4 is expected to take one day or few days maximum, while the last three step might continue for years.

This kind of sukuk is useful for investors who want to acquire an asset or to investors looking for liquidity and willing to sell their asset and least it back, then eventually buy it back. The main issue of this kind of sukuk is the requirement of having an underlying asset which will be leased from one part to another. However, flexibility under this kind of sukuk is very high and sukuk holders can sell their sukuk in secondary markets. Sukuk holders under Ijara contract are not exposed to credit risk of the originator but if the profit is at fixed rate then they are also exposed to interest rate risk.

On the other hand, originator has financial commitment to meet payments to the SPV or they are in position to take over the underlying asset, unless the sukuk are asset-based which will be explained in point 1.1.4. Also, as originator mostly promise to buy the asset at agreed value in advance, therefore, risk of depreciation of the asset is beared by the originator, and asset value appreciation is for originator benefit.

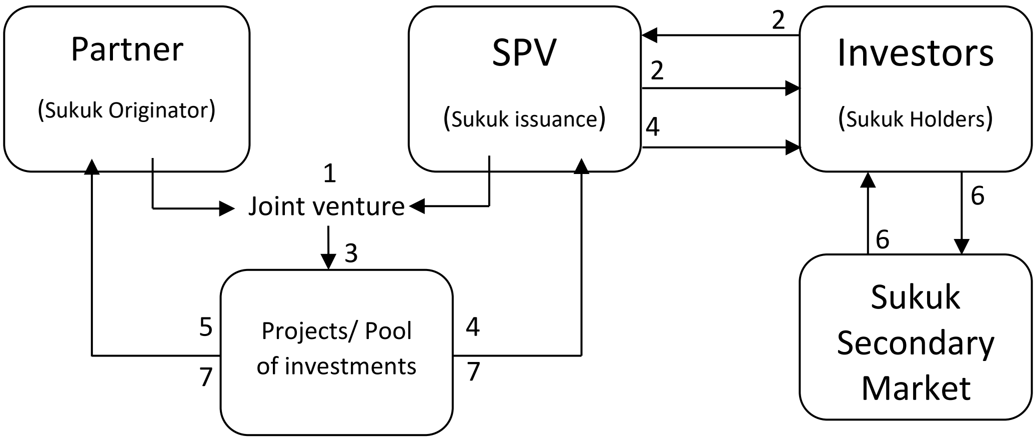
1.1.3.3 Musharaka Sukuk (Joint Venture)

Musharaka contract is a partnership contract where two or more parties participate in capital and assets for the purpose of making profit, while some or all of them participate in the management. Under such kind of contracts, partners can agree in advance about profit shares which can be different from their ownership ratios. Partner contributes more and participates in the management on daily basis are expected to have more profit. However, in losses under share'ah, each party should bear losses equal to its share. Also it is prohibited for parties in musharaka to guarantee each other capital.

This kind of contract is more like equity instead of Sukuk and bonds, so it requires additional terms to make Sukuk under musharaka contract become more like other kind of Sukuk and bonds. To do so, Sukuk under musharaka contract can have the following terms. To reduce the risk of not receiving distributions (coupon in conventional bonds) Sukuk originator for example agreed to give Sukuk holders 99% of the profit while taking only 1%. In return, whatever profit achieved exceed expected profit, for example 5%, is considered incentive fee to Sukuk originator. In this case, Sukuk holders chances to get returns more than expected, for example 5% is impossible, at the same time expectation to receive less than expected profit is very limited as they will first get 99% of the profit without taking in consideration Sukuk originator share of the partnership which might be 30% or more. Yet, in some musharaka contract, Sukuk originator is willing to inject extra capital in case of profit shortfall. Also, in some musharaka contract when the profit excees expectation they keep excess fund in escrow account just to cover unexpected future shortfall and at the end of the investment term the access fund goes to Sukuk originator as incentive. In addition, to fix the value of Sukuk, Sukuk originator cannot guarantee the value of the Sukuk, however, they promise in advance to purchase Sukuk at face value, making changes in underlying investment value has no impact on Sukuk value.

Musharaka sukuk has simpler structure when compared to Ijara as it do not required assets to be leased but a pool of investments. For illustration chart 3 explains a simple musharaka structure.

Chart 3: Example of Musharaka structure



1- Sukuk originator (Investor/bank/government) sign a joint venture agreement with the Special Purpose Vehicle (SPV) to invest their capital in a specific project or in any investment opportunities, all subject to partners interests. Parties agreed to give the management to sukuk originators and agreed in advance about profit sharing scheme.
2- Investors (sukuk holders) buy Sukuk issued by the SPV for the purpose of investing their capital with sukuk originator capital.
3- Sukuk originator invests joint capital in targeted investment and hold the management of it.
4- Sukuk originator distribute expected profit to sukuk holders through SPV and keep excess profit in escrow account to cover future shortfall.
5- Sukuk originator receive their profit 1% as it was in the example above.
6- Sukuk holders can sell their sukuk in secondary markets at any time.
7- At the end of the investment period sukuk originator receive all profit exceeded expected profit as an incentive after paying back sukuk holders face value of their sukuk.

This kind of sukuk is very attractive to Islamic financial institutions who are looking for liquidity with high flexibility and less financial constrain. Under this contract, sukuk originator is not liable to distribute profit, if not making profit, and consequences will not cause bankruptcy of sukuk originator or considered defaulted. Interestingly to note, this kind of sukuk can be considered under Basel III Capital Adequacy Standard as Addition Tier 1 which made it very attractive to Islamic Banks. In addition to distribution flexibility condition, other Basel criteria can be met by sukuk under musharaka contract which are loss absorption for sukuk holders and perpetuity of sukuk. So, this kind of sukuk provide high flexibility and no risk of financial commitment on sukuk originator so in case of stumble for some time this partnership will continue operation like normal.

1.1.3.4 Mudaraba Sukuk (Silence partner)

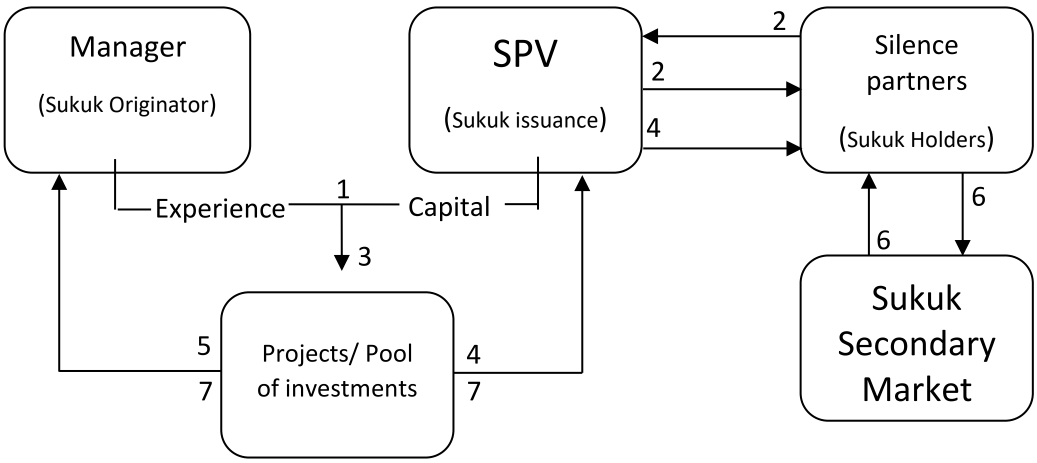
Mudaraba contract is considered a special case of Musharaka contract, where under Mudaraba one party provide capital (called rab almal) while the other party (called mudarb) which provide labour, experience and manage the investment alone without first party intervention (Archer, 2015). This kind of contract last for agreed duration, however it can be extended or early terminated without breaking share'ah law. Under this contract mudareb is not allowed to have fixed fee, however, like Musharaka parties can agree on profit sharing scheme. Although parties share profit under mudaraba, only Rab almal absorb losses unless in case of negligence, misconduct and breach of the terms of the contract.

Sukuk under Mudaraba contract is like under musharaka where they look more like equity instead of bonds. Therefore, sukuk mudaraba will have additional terms (like musharaka sukuk above) such as profit ratios, incentive after certain profit for the purpose of reducing risk of distribution fluctuation. Also, like musharaka sukuk, sukuk originator (mudareb) can pre-purchase sukuk at par for the sake of waving risk of sukuk value fluctuation over the investment period.

Mudharaba sukuk are like Musharaka sukuk very attractive to Islamic financial institutions because of their high flexibility, less financial risk to originator and can meet Basel III Capital Adequacy Standard as Addition Tier 1. What really make this kind of sukuk differ from Musharaka is that originator do not invest in capital and do not bare losses, however they get profit sharing and incentives. This is a major issue to be considered as originator might invest in high risk investment or have some kind of conflict of interest with rab almal. Under this kind of sukuk, important corporate governance issues have to be taking in consideration especially in emerging markets where corporate governance in general is not developed.

Mudaraba structure is highly like musharaka which is illustrated in chart 4 below.

Chart 4: Example of Mudaraba structure



1- Sukuk originator (Investor/bank/government) sign a management agreement with the Special Purpose Vehicle (SPV) to invest their capital in a specific project or in any investment opportunities, all subject to partners interests. Parties agreed that management to be with sukuk originator only, and agreed in advance about profit sharing scheme.
2- Investors (silence investors) buy Sukuk issued by the SPV for the purpose of investing their capital under sukuk originator management.
3- Sukuk originator invests capital in targeted investment and manage the investment.
4- Sukuk originator distribute expected profit to sukuk holders through the SPV and keep excess profit in escrow account to cover future shortfall.
5- Sukuk originator receives their profit 1% as it was in Musharaka example.
6- Sukuk holders can sell their sukuk in secondary markets at any time.
7- At the end of the investment period sukuk originator receive all profit exceeded expected profit as an incentive after paying back sukuk holders face value of their sukuk.

1.1.4 Concepts of assets-backed/based-Sukuk

Although Sukuk had witness rapid growth, they had some issues hamper that growth at first, which later had been solved by the creation of the concept of Asset-based Sukuk. To understand this new concept it is important to explain the original concept of Sukuk which is Asset-backed. Sukuk are asset-backed when sukuk holders have full rights on underlying assets, which they become the owners through true purchase of the assets and true transfer to them from the originator or third party to the SPV. Under this concept, the SPV (Sukuk holders) can take recourse on those assets in the case of originator/obligator default to meet their financial commitments to the SPV or become bankrupt (Archer, 2015). In this scenario, return to Sukuk holders is highly depending on the underlying asset performance and default of originator should not affect return flow and Sukuk value if the underlying asset is operating normally.

Such a concept has few issues have to be taken in consideration. First, asset-backed has major constrain on sovereign to issue Sukuk. Many sovereign are not willing to alienate sovereign assets to investors or it is impossible by their local law to sell their assets for the purpose of issuing Sukuk. Second, many countries do not allow foreigners to own assets in their country, so ownership of Sukuk, which is ownership of the underlying assets, will not be permissible to foreigners but to be limited to locals only. Third, true sell of the assets incur high transaction cost which might include stamp duty, tax and agent fees. Last, true sell normal takes long process to transfer the asset ownership which is some countries might take months (Archer, 2015).

As a result of these constrains, the concept of asset-based Sukuk has been created which has some important differences to asset-backed. First, it is a sell of usufruct but not a true sell that include a transfer of asset ownership. Such sell of usufruct give Sukuk holders contractual rights on the cash flow from the asset (beneficial ownership), but not the rights of the assets. Second, in the case of originator/obligator default to meet their financial commitments to the SPV or become bankrupt, Sukuk holders do not have recourse of the asset, but a claim against the originator/obligator which might rank pari passu with other creditors or junior in the existence of senior creditors (Archer, 2015). Under this concept performance of the underlying asset might not be an issue as originator will provide credit enhancement to Sukuk holders in the case of asset under performed.

Therefore, rating of Sukuk which reflect the risk level and pricing will differ from asset-backed to asset-based Sukuk. For asset-backed Sukuk rating is totally based on the underlying asset, unless there is additional enhancement or guarantee from the originator or a third party. However, under asset-based Sukuk rating is purely based on the originator/obligator credit rating (Nienhaus, 2014).

Although asset-based solved major issues for Sukuk, it does create additional major issue with share'ah scholars. Large number of share'ah scholars consider asset-based Sukuk as not true sell and Sukuk holders did not actually own the underlying asset which made them conclud that this kind of Sukuk is not share'ah complaint and they are more like bonds instead of true Sukuk, therefore distributions are considered interest on loan (usury) which preach one of the main share'ah restrictions. Such issue can lead to major risk for Sukuk not to be purchased nor traded in the markets where share'ah scholars consider asset-based Sukuk non-share'ah complain (Archer, 2015).

Table 1: Summary of the comparison between four types of financial certificates (sukuk).				
	Sukuk Murabaha	Sukuk Ijara	Sukuk Musharaka	Sukuk Mudharaba
Rate / period	Fixed/Fixed	Fixed or floating/Flexible	Floating/Flexible	Floating/Flexible
Uses (mostly)	Buying goods or assets/ Way of borrowing	Buying goods or assets/ Way of borrowing	Investment/ Way of borrowing	Investment/ Way of borrowing
Tradability	Not tradable (with exceptions)	Tradable (no restrictions)	Tradable (no restrictions)	Tradable (no restrictions)
Roles of the underlying assets	- To be used by the borrower (machines, cars) - To be used as intermediate assets; a one party sell to another at a higher price and with a different payment, and then the buyer sells it immediately for cash at the current price (cash raising-way of borrowing).	- To be used by the borrower (machines, property). - To be rented from one party to another. This could be buying an asset wanted by the lessee, or a sale-lease back with a promise to buy it back after the agreed upon period for the sake of raising funds.	- In this type of investment, the parties agree to share the profits. This could be real estate, shares, commodities or other investments.	- In this type of investment, the parties agree to share the profit. This could be real estate, shares, commodities or other investments.
Length of the uses of underlying assets	Could be very short (a few minutes)	Until liquidation	Until liquidation (note: there should be assets associated with the investment, but these can change over time).	Until liquidation (note: there should be assets associated with the investment, but these can change over time).
Associated risks	- Interest rate risk (fixed rate) - Illiquid in most of the markets (with exceptions) - Risk of rolling over (difficulties and cost) - Borrower (sukuk issuer) default risk	- Underlying assets risks (unless promise to buy back) - Borrower (sukuk issuer) default risk (if promise to buy back the underlying asset)	- Investment risk - The investment might be unknown to the sukuk holders.	- Investment risk - The investment might be unknown to the sukuk holders. - The sukuk issuer does not contribute to equity, so the investment might be risky.
Similarity to bonds	This is the most likely to behave like bonds as the relationship is as a loan with clear repayment schedule. Also, the collateral and rating of sukuk is based on the issuer.	This kind of sukuk might be considered the least similar to bonds. As it requires asset to be lease and hold till maturity, this would make it different than bonds. In default event, liability might be limited to the asset not the sukuk issuer.	After controlling for profit distribution, this kind is highly similar to bonds but not as murabaha. In default event, liability might be limited to the asset not the sukuk issuer.	After controlling for profit distribution, this kind is highly similar to bonds but not as murabaha. In default event, liability might be limited to the asset not the sukuk issuer.

*Note: the way a sukuk are structured can manipulate some of the restrictions/limitations associated with each type of sukuk. This means that the points mentioned in this schedule can be solved in some cases; for example, a sukuk musharaka has to have floating rates, but as explained in Chart 3 (page 184) that rate can be fixed.

2.0 Literature review

To consider newly growing instruments like sukuk and compare it to mature instrument like bonds, few things have to be considered from previous literature. In addition to studies considered the relationship between sukuk and bonds, it is important to consider literature that cover other instrument in early stages and how their correlation to other assets changes over time. Also, it is important to consider literature that cover similar illiquidity issues in sukuk and how such issue might bias outcomes and how it can be adjusted. Last, an overview on relationship among bonds have to consider just to know how to place sukuk among them.

2.1 Relationship between Sukuk and Bonds

Since the creation of sukuk instrument and they have been questioned whether they are a reflection of conventional bonds but in compliant to Islamic law; or they are new independent instrument have some similarity with bonds, but have their major differences. Many studies tried to explore the relationship between these two instruments and uses different approaches.

2.1.1 Correlation between bonds and sukuk

Some studies used Value at Risk (VAR) to evaluate the maximum losses might occur to portfolio in future downturns. Such approach is consider useful to measure whether adding new asset can reduce overall portfolio risk (hypothetical portfolio) which imply that the new asset has low correlation with other assets in the portfolio and create additional diversification. Cakir and Raei (2007) used this approach on their sample from Malaysia, Qatar, Bahrain and Pakistan for the period from 2000 to 2007. By running two portfolios, one with bonds and sukuk and one with only bonds they found over all the four countries, the inclusion of sukuk reduced portfolio risk. However, few things need to be considered in this paper. First, they used one sukuk (the sample contains only one sukuk) in their study for each country and two or three bonds which made the result exposed to the sukuk type they used. Second, all sukuk used were on floating rates while all bonds were on fixed rates which should has impact on result. Last, sukuk and bonds in sample have different maturities range from 5 years to 30 years. All these issues could have major impact on outcomes, which could be the result for having very low or negative correlation between bonds and sukuk, and having very low correlation among Pakistani bonds.

The recent study tested the relationship between bonds and sukuk by Mosaid and Boutti (2014) tried to test whether bonds portfolio and sukuk portfolio have significant differences in their means and what is the correlation between them. Using sample from Malaysian market for the period from 2007 to 2012. To run their tests they used market indices for all bonds and sukuk. From those indices they constructed five sukuk portfolios and five bonds portfolios, each sukuk portfolio will have a comparable bonds portfolio in term of maturity. In contrast to previous studies, they found in four out of the five tests they had showed no statistical differences between sukuk portfolio and bonds portfolio means. Also they found that in all five tests correlation between sukuk portfolios and bonds portfolios is highly positive with significant level of 1%. Although the result from Mosaid and Boutti (2014) study is one of the points this paper trying to prove, two issues have to be considered. First, the sample period which is in financial crisis time could bias the outcomes. In their study they clearly noted the almost perfect movement of both instrument in more than the first half of the sample, which is as expected in crisis timing where correlation between different assets increases. Running sub-sample would solve this issue and prove if there is a serious impact or not. Second concern is the use of all sukuk indices without considering the differences between sukuk. Mixing different kind of sukuk smoothen the overall fluctuating for sukuk portfolios, also it ignored some of the important characteristics such as issuer, sukuk type, maturity and capital size, all of which are important and could show bias outcomes.

2.1.2 Differences in Yield to Maturity (YTM)

The second approach some studies used is a comparison between Yield to maturity for bonds and sukuk. Basically, the conventional theory explain the bond value to be the expected future payment discount at current cost of borrowing (Williams, 1938). Ariff and Safari (2012) used this approach on a sample from Malaysian market from 2005 to 2011, using monthly observation. They were carefully testing the relationship between bonds and sukuk by running paired-samples each with same duration and same category of issuer (note: they used indices not individual sukuk). Sample include sovereign, quasi-sovereign, AAA rated financial institutions and AAA rated corporate for various maturities range from 3 months to 20 years. Among their total sample of 64 paired-samples they found 46 cases showed statistically differences in the yield to maturities between bonds and sukuk. In most of the cases they found the differences in means positive figure which indicate that sukuk have higher yields than bonds. They also tested the influence of one instrument on the other by using granger causality test (Granger, 1969) between sukuk and bonds yield but found limited evident in both directions. In other words, they found among the 64 pairs only 13 pairs showed changes in sukuk yield caused by changes in bonds yields; and only 10 pairs showed changes in bonds yield caused by changes in sukuk yields. Interestingly, they tested the impact of Ijara sukuk on 16 corporate issuers' betas and found them significant from zero when compared to their own betas before issuing sukuk. What the authors comment on this issue is one of the main purposes for this paper which is how some sukuk are different than others, and that is why authors assumed that it might be the reason for having differences in yield to maturities is Ijara sukuk in the sample used. Another concern about this paper is the sample timing. Although they have decent sample, the period used is within the global financial crisis. They could have done sup-sample tests to robust their findings. Also, they used Bonds and sukuk indices but not individual bonds and sukuk which question the influence of instrument within each index and question the influence of using index and how indices smoothen movements.

Recent study by Ariff el at. (2013) also used Malaysian market but with shorter sample and one year longer period to be from 2005 to 2012. In total they have 34 paired-sample (bonds and sukuk) of sovereign, quasi-sovereign, AAA rated financial institutions and AAA rated corporate for various maturities range from 3 months to 20 years. Overall result are the same as Ariff and Safari (2012), where most of the paired-sample showed significant differences in YTM between bonds and sukuk, also Granger causality test have not showed major impact from sukuk to bonds and vice versa. Both studies, Ariff and Safari (2012) and Ariff el at. (2013) suggested to run Granger test on both bonds and sukuk by a third variable to see if this variable has the same impact on any or both of them. Some issues to consider in this study. First, monthly data do not capture large changes of instrument movements. Second, monthly data made the study uses short number of observation which is more likely to show less accurate findings.

Another study by Fathurahman and Fitriati (2013) used the same approach YTM to compare bonds and sukuk but in Indonesian market. They have not mentioned the starting period of the sample but they only mentioned the end of the sample period which is October 2011. The sample contains on one hand 31 sukuk (mix of Ijara and Mudaraba) on the other hand 234 bonds with fixed and floating rates. The way they run the comparison is by having 10 randomly selected groups of bonds that are equivalent to the weight of the 31 sukuk, then run t-test between sukuk and each of the bonds groups. What they found is similar to Ariff and Safari (2012) that sukuk YTM is different than bonds YTM in 3 out of 10 tests. In other words, only 3 bonds groups out of ten showed significant differences in yield to maturities when compared with sukuk. Also they found that sukuk have higher yield to maturity, at the same time higher standard deviation. However, this study raises few concerns have to be considered. First, the mix of Ijara and Musharaka sukuk might bias the outcomes because of the major differences in their nature. Second, mixing in random bonds with fixed and floating rates might not provide accurate comparison to sukuk. Third, as in Ariff and Safari (2012) the sample period in crisis timing might not provide normal outcomes and give wrong indications because of crisis shocks. Last, when running test of ten bonds groups compared to one sukuk group and found some results are significant while other are not, this imply that there is something wrong or not accurate in bonds groups, most probably the mixed between fixed and floating with different maturities could bias the outcomes.

2.1.3 Abnormal Return

Another approach to study the relationship between bonds and sukuk is to test for abnormal returns for bonds and sukuk announcement. In other word is to test whether the market have positive, negative or no reaction for corporate announcement of issuing bonds or sukuk. The aim of this test is to see if these two instrument have different market reaction. Ashhari et al. (2009), Godlewski et al. (2013) and Alam et al (2013), all used this approach and found similar finding that market do not have same reaction to sukuk and bonds in most of the cases.

Ashhari et al. (2009) limited their sample to Malaysian market from 2001 to 2006 and found that stock return for companies announced issuing sukuk have positive significant abnormal return day before announcement while bonds announcement showed no significant reaction from the market to companies issued bonds. Interesting finding they found is that large stable companies were the companies issuing bonds, while companies issuing sukuk were small less stable companies.

Godlewskiet al. (2013) also used Malaysian market from 2002 to 2009 with sample size of 170 issues, 77 sukuk and 93 bonds. Like previous study by Ashhari et al. (2009) they found no reaction from the market for bonds announcement, however they found market react negatively to sukuk announcement and showed significant abnormal return. They also found that companies issuing sukuk are smaller than companies issuing bonds, and have higher debt and exposure to financial risk. Because of this finding, they test market reaction to health companies issuing sukuk but they still found same negative market reaction which they referred to as reaction to sukuk issuance not company financial strength.

Alam et al (2013) extended same test on six countries, Malaysia, Indonesia, Singapore, Pakistan, UAE, Bahrain and Qatar. Their sample contain 79 sukuk and 87 bonds over the period from 2004 to 2012. Interestingly, none of the companies in their sample issued sukuk and bonds, so it is either issuing sukuk or bonds. To insure not having biased result because of financial crisis they divided their period into three periods to capture such impact from global financial crisis. What they found is that sukuk announcement have negative market reaction in pre-crisis and in crisis period, however, they have positive reaction post-crisis. While bonds announcement have no market reaction except in crisis period which is sub-period 2007 to 2009. Last finding they have, which is similar to previous studies, is that companies issuing sukuk tend to be smaller and riskier.

This approach of testing abnormal return to compare bonds and sukuk do not seems to have high accuracy. Results can be considered exposed to unsystematic risk related to specific corporate issuing sukuk. Those companies might have different leverage ratios, risk exposure and balance sheet size than the other companies issuing bonds which make the comparison less accurate. Also, those studies used this approach ignored the impact of different kind of sukuk and how they differ from each other. In other words, issuing sukuk Ijara might have negative impact while issuing sukuk Musharaka or Mudaraba might have the opposite reaction from the market. Worth noticing that Godlewski et al. (2014) found that type of sukuk influenced market reaction to sukuk announcement. All previous studies have not clarified which kind of sukuk they have in their sample, so it is assumed that their sample contain mix of different kind of sukuk.

2.2 Changes in relationship between different type of assets

Another important issue has to be considered in literature is the nature of relationship between different assets. Longin and Solnik, (1993) highlighted an important points that in some papers they assume the consistency in relationship between assets under their studies. Before testing the relationship between bonds and sukuk, it is important to review findings from previous studies regarding the nature of correlation between different assets and how and why they might change over time. Many studies have confirmed that correlation changes over time, however; it changes because of different reasons which some of them might have influence on previous finding about bonds and sukuk relationship.

Erb et al. (1994) tested equity correlation between G-7 countries, United State, United Kingdom, Canada, France, Germany, Italy and Japan. They found that business cycle affect correlation between equities in different countries. Also they found that correlation increases positively during recession, however; the correlation is not symmetric in up and down markets. Not only correlation of international equity changes over time, but correlation changes between assets and between assets classes within the same market (Spurgin et al., 2000). They studied US market and also found that correlation changes between equity and bonds more positively in declining market while their correlation changes negatively in rallies market. Furthermore, Silvennoinena and Thorp (2007) included commodities future to equity and bonds when testing changes in correlation. Interestingly, although all 24 commodities types showed significant changes in correlation with S&P500, from almost zero in 1900 to around 0.5 in 2000, 11 of them have shown dramatically high correlation with equities when stock market volatility expected to be high. In consistency, Liow (2012) found that real estate stocks in eight Asian market showed a positive increase in correlation on local, regional and global level influenced significantly by relative real estate or stock volatilities. So, not only market performance can influence relationship between assets, but also volatility in other assets which need to be carefully considered in bonds and sukuk relationship.

Changes in relationship between assets is not limited to market influence, but also the nature of the assets themselves. Taking Real Estate Investment Trust (REIT) as an example (equity REITs) can give an idea about how relationship between assets change because of the assets themselves. Since the beginning of REIT in the 1960s till early years of 1990s and REITs were considered segmented from broader equity market (Glascock et al., 2000), however, this changed dramatically as REIT grown. Many studies such as (Clayton and Mackinnon 2001, Cotter and Stevenson 2006, and Chong et al., 2012) and others found that REITs have a turning points in the early years of 1990s and increasing trend with equity to reach high positive relationship. Investors awareness and interest in this instrument played significant role in REITs sector and made them became eventually part on mainstream equity (Chong et al., 2009). Interestingly, this causes REITs to grow from around $5billion in early nineties to reach in twenty years more than $300billion (Chong et al., 2012).Yet, Wang et al., (1995) explain that this growth made more analysts following REITs which provide more information to investors that resulted in increasing in trading volume and reduction in the bid-ask spread. All of these made market consider REITs as highly integrated to broaden equity which is in contrast to early year's findings.

2.3 Trading volume impact

Another important issue not to be ignored is the impact of trading volume on return volatility of an asset and subsequently its relationship with other assets. Although sukuk have been growing very fast, the majority of sukuk holders tend to hold till maturity (Thomson Reuters Zawya, 2014). Such issue could heavily affect trading volume, which reflect on sukuk volatility and consequently could bias the result of the tests taken on them. Many studies tested the relationship between trading volume and volatility on different kinds of assets and large number of those studied found that volume influence volatility. Karpoff (1987), Schwert (1989), Pyun Lee and Nam (2000) and Cotter and Stevenson (2008), are among researches made on relationship between volume and volatility and found it positively significant. For example, Cotter and Stevenson (2008) found trading volume is an important explanatory variable to explain REIT volatility with strong statistical significance. They found changes in REIT volume of 1% is related to a 0.01% change in their volatility.

2.4 Relationship among bonds

The last thing to be considered is the relationship among bonds. As the argument is whether sukuk and bonds are alike should be based on understanding bonds relationship themselves before applying any tests on sukuk. For example, Reilly et al., (2009) studied the relationship of bonds and equity within the same market but with different issuer, different bonds rating. Their sample contains equity, investment grade and high yields bonds in the US market over the period 1985-2009. Interestingly, they found not only relationship among bonds changes over time, but also they found that correlation among bonds is high between some bonds, low with others and negative sometimes. The lower the bonds rating, the higher volatile they are compared to grade bonds. Another example by Hunter and Simon (2005) which focused in sovereign bonds of the US, UK, Germany and Japan found that correlation between international bonds not only changes over time but sometimes remains close to zero, which was the case between US and Japan bonds. Such result found to be influence significantly by local macroeconomic and market conditions. Similar study by Bunda et al. (2009) but on emerging market bonds. Among the 18 countries, they found them having different correlation, at the same time the impact of crisis differ from country to another.

This findings are very important when considering the relationship between sukuk and bonds. If the relationship is not stable among different bonds issuer and different counties, then it is obvious that not considering these factors when selecting sukuk or bonds sample might provide biased result, which questioned some of the previous studies.

2.5 What influence bonds

To understand sukuk and their similarity to bonds it is essential to understand what influence bonds. Starting with Lin et, al. (2007) to tested bonds in emerging markets. They tried to understand what influence bonds in those market, specifically South Korea, Malaysia, Thailand, Argentina, Chili, Mexico, Venezuela and Poland. Interestingly, they not only considered local factors but also international factors which showed important result. On the local level, they divided factors to macroeconomic which include consumer price index and employment growth and financial factors which include market equity excess returns and bonds market excess return. On international level, they used international bonds from developed markets. Obviously they found local macroeconomic and local financial factors significantly influence bonds in emerging markets. This findings is in consistent with previous finding by Clare et al., 1996; Kavussanos et al., 2002; Li, 2002; Ang and Piazzesi, 2003; Wu, 2003. In addition, they found international bonds also significantly influence local bonds in emerging market which indicate the integration of those markets. Interestingly, Thailand found more influenced by international factors than locals.

In addition to factors mentioned above, it is important to consider bond specific factors, factors that differ from bond to another. Heinke (2006) tested the influence of bonds rating on their prices and found lower rating bonds showed higher credit spread volatility that higher rated once. While Fridson and Garman (1997) and Altman and Eberhart (1994) bonds seniority is also important factors where senior bond of lower credit has higher expected default than junior bond of strong credit, even if they both have the same credit rating. Bond maturity is also essential to consider. Bali and Skinner (2006) noted that bonds with lower credit rating might have difficulties redeeming or roll over the debt. Another point she mentioned needed to be consider in bonds is either it is straight forward bond or bond with call options or convertible bonds. Many research including Bali and Skinner (2006) mentioned the importance of having comparable bonds to run more accurate tests. As a result of these findings, it is important to try to reach the most closely bonds and sukuk in term of rating, type, seniority and maturity.

3.0 Research questions

The aim of this paper is to understand sukuk and where they stand among assets. All previous research about sukuk confirmed the existing similarities between bonds and sukuk; however, most assumed sukuk to be different from bonds as a stand-alone instrument having major differences from bonds, one of the main differences being the fact that each type of sukuk has different ownership structure and rights and risks. Indeed, sukuk has a complicated structure and sometimes they have to involve underlying assets; yet, going into the details of a sukuk prospectus would question the existing differences of sukuk compared to bonds. The best approach to understand sukuk is to monitor market reaction to them in comparison to bonds. Carefully selecting the right data and running appropriate tests places sukuk in the market of assets. This paper clarifies some important points about sukuk. The four main research questions are as follows:

What is the relationship between bonds and Sukuk?

Sukuk movement is dynamic in relation to bonds. Having high correlation and similar volatility means markets react similarly to sukuk and bonds, and it also means that the factors influencing the bonds have similar influence on sukuk. This finding not only places sukuk within the category of bonds, but it gives important indications about sukuk volatility in comparison to bonds, which is a key issue from finance and investment perspective.

Is there a significant difference in performance among different types of sukuk?

When considering the types of sukuk and the level of risk exposure sukuk holders are exposed to in each of the sukuk types, we would expect to have different performances between types of sukuk against their comparable bonds. To answer this question accurately, we monitor not the relationship between different types of sukuk, but the relationship between each type of sukuk to their comparable bonds, then compare the results. Not finding notable differences would question the need for all these different types of sukuk and might question their compliance to Share’ah roles. Also, we give additional support to the argument that sukuk is a type of bond.

Has the relationship between bonds and sukuk changed over time?

Like any new product in the market, sukuk might have shown a heterogeneous behaviour in early days, but sukuk have gradually integrated to the correct category of assets. Answering ‘yes’ to this question will explain earlier studies’ findings on sukuk differences in comparison to bonds and how these differences have changed over time. This could alert to future demand for sukuk if they become more integrated into the bonds sector, possibly losing the advantage of diversification.

This question is challenged by the sample period length, as the samples used a shorter time period than what researchers used in the past to test changes in relationship. If the findings do not show changes in the relationship between bonds and sukuk but showed stable high correlation, then this could be the result of a short sample period.

How is the relationship between bonds and sukuk in high volatility periods?

This is a critical point to consider and will give good indication about sukuk in comparison to bonds. If sukuk is truly influenced by its underlying assets rather than the issuers, then in high volatile periods, sukuk are expected to show lower correlation to bonds, especially in the Ijara and Musharaka types of sukuk. If results show stable or higher correlation in high volatile periods, then this will be additional support for the argument in support of sukuk as a type of bond.

4.0 Data

It can be noted that data is one of the most important factors in influencing any study. Inappropriate data consideration can lead to weak or bias findings. Not only the length or type of data is important, but also how the data is used to reach the best findings. We attempt to understand sukuk, the new product, to see how they behaves in relationship to bonds. We use specific criteria to understand how sukuk match bonds by constructing pairs (one bond against one sukuk) to be tested. Those criteria were selected carefully to reach the most comparable products. First, each pair should be issued by the same issuer. This factor is important in this kind of test. Having the same issuer waives the uncertainty of risks associated to parties within one pair test. In other words, if the same party issues bonds and sukuk, this creates a risk related to the party having the same influence on both bonds and sukuk, while if the comparison is between separately issued bonds and sukuk, then risks associated to one of those parties could influence the performance of its bond/sukuk, and consequently the comparison test could result in bias.

Second, the capital size of bonds and sukuk within the same must be comparable, for example both of them have capital size more than 100 million. This is to reduce the influence of small capital bonds and sukuk, which might be affected by traders who trade frequently or investors who hold for a long time or until maturity. Only one exception is pair 10 which has been monitored carefully not to be influenced by this factor.

Third, bonds and sukuk in a pair should have close maturity dates. Although we ignored the issuance date, we believe maturity date is an important factor that must be considered. This is due to the repayment of principle and the risks associated to it, as well as long term commitment to fix rates exposed to interest rate risk. The only exception is pair 12, which was monitored carefully and was not influenced by this factor.

Lastly, the number of daily observations should not be less than 250 for an entire year in order to have a decent number of observations. Other factors we took into consideration include: all bonds and sukuk must be categorised in plain vanilla, have fixed rates and be straightforward instruments with semi-annual coupon payments without complications, such as call or put options. Having those restrictions are very important to have a comparable bonds to sukuk. Risk associated to floating bond and its movement will produce different reaction to event in comparison to sukuk with fixed rate. Similar influence would occur in the existing of call or put options. Also, none of all the bonds and sukuk can be guaranteed by a third party (this is mostly for financial and corporate institutions).

It is also important to highlight other criteria that have been ignored from selected bonds and sukuk, including bonds and sukuk price, coupon rate and date of issuance. Those factors are not expected to influence bonds and sukuk performance as far as each pair is issued by the same issuer. For example, if one party issued a bond in 2010 and issued a sukuk in 2012 and both will mature in 2020, then observations from 2012 onward are valid. Also, if the bond was issued at 5% in 2010 while sukuk was issued at 7% in 2012, this will not influence the performance of the pair as the market drives the pair prices to the appropriate level. Eventually, both will have the same performance, as far as all criteria above are met.

By far, the Malaysian market is the only market that can provide such a large number of bonds and sukuk; therefore, this market will be the focus of this research. Kuwait is the focus of this paper, there is no data for sukuk in this market. Although thousands of bonds and sukuk were found in Malaysian market, it was challenging to come up with large number of pairs that were highly comparable, so we ended up with only 21 pairs. Another issue related to finding a large number of pairs stemmed from corporate workers under Islamic law being restricted from issuing bonds, while traditional corporate workers found it less attractive to issue sukuk.

The data used is from daily bond and sukuk prices collected from Thomson Reuters, while the Thomson Reuter Government 5-year Bond Index was collected from DataStream. The length of data difference from pair to pair and can be found in table 2. Table 2 also shows the issuer name and category for every bond and sukuk, type of sukuk, capital size, maturity size and sample size. All of these are considered in the tests below. Software packages used are EViews, R and Microsoft Excel.

Two issues have to be cleared about pair 1 and pair 21. Both instruments within pair 1 matured while doing this research, so this could influence the performance of those instruments in their sample period. Clearly, the volatility of both instruments within pair 1 are smaller than the volatility of all the other instruments, and the prices for both instruments in pair 1 were heading toward price 100, which is the redemption price. This actually might be the reason for not having acceptable results for some of the tests run for pair 1; therefore, those results will not be shown. In pair 21, the bond series showed single extreme shock on the 10^{th} of April 2014 where the price increased by about 10%. Neither the performance of bond nor the market reaction was affected, and this shock was not followed by any further volatility. We contacted the issuer to understand what happened, but did not receive a reply. Therefore, we believe such an observation should not be included in the tests, so we removed that day of return observation for both instruments, which gave stable results and passed diagnostic tests. Note: without removing this single observation, we could not pass diagnostic tests.

Table 2: Detailed information about selected bonds and sukuk

Pairs	Category	Issuers	Type	Size	Maturity	Sample size		Number of observations
Pair 1	Government	Central Bank of Malaysia	Bond	100,000,000	18-Mar-16	03-Apr-15	17-Mar-16	250*
			Sukuk (Bai'Inah)**	100,000,000	01-Apr-16			
Pair 2	Government	Central Bank of Malaysia	Bond	13,500,000,000	31-Oct-17	01-Jun-12	05-Aug-16	991
			Sukuk (Bai Bithaman Ajil)***	9,000,000,000	30-Aug-17			
Pair 3	Government	Central Bank of Malaysia	Bond	8,786,560,000	01-Mar-18	04-Jun-13	05-Aug-16	726
			Sukuk (Bai Bithaman Ajil)	4,000,000,000	30-Nov-18			
Pair 4	Government	Central Bank of Malaysia	Bond	7,973,060,000	31-Jul-20	24-Sep-13	05-Aug-16	645
			Sukuk (Murabaha)	9,500,000,000	23-Mar-21			
Pair 5	Government	Central Bank of Malaysia	Bond	8,750,000,000	15-Feb-17	19-Oct-11	05-Aug-16	1093
			Sukuk (Bai Bithaman Ajil)	3,000,000,000	15-Jun-17			
Pair 6	Government	Central Bank of Malaysia	Bond	17,119,000,000	29-Nov-19	19-Oct-11	05-Aug-16	1140
			Sukuk (Bai Bithaman Ajil)	6,000,000,000	13-Aug-19			
Pair 7	Quasi-Government	Bank Pembangunan	Bond	400,000,000	23-Apr-21	10-Sep-14	05-Aug-16	468
			Sukuk (Murabaha)	700,000,000	10-Sep-21			
Pair 8	Quasi-Government	Bank Pembangunan	Bond	500,000,000	30-Oct-25	10-Sep-14	05-Aug-16	469
			Sukuk (Murabahah)	500,000,000	12-Sep-24			
Pair 9	Quasi-Government	Cagamas	Bond	65,000,000	03-Sep-21	02-Jun-11	05-Aug-16	1266
			Sukuk (not spisified)	60,000,000	19-Jul-21			
Pair 10	Quasi-Government	Cagamas	Bond	410,000,000	18-Nov-25	19-Nov-13	05-Aug-16	665
			Sukuk (not spisified)	10,000,000	07-Apr-26			
Pair 11	Quasi-Government	Cagamas	Bond	310,000,000	18-Nov-20	22-Apr-14	05-Aug-16	563
			Sukuk (not specified)	390,000,000	28-Oct-20			
Pair 12	Quasi-Government	syarikat prasarana negara	Bond	1,914,000,000	30-Nov-16	13-Jan-10	05-Aug-16	1579
			Sukuk (Ijara)	1,200,000,000	30-May-18			
Pair 13	Financial Institution	AMBANK	Bond	225,000,000	28-Apr-17	05-Oct-10	05-Aug-16	1402
			Sukuk (Musharaka)	550,000,000	20-Sep-17			
Pair 14	Financial Institution	CIMB Bank	Bond	1,350,000,000	08-Aug-16	15-Aug-11	05-Aug-16	1178
			Sukuk (Musharaka)	250,000,000	21-Apr-16			
Pair 15	Financial Institution	CIMB Bank	Bond	1,500,000,000	30-Nov-22	30-Nov-12	05-Aug-16	892
			Sukuk (Musharaka)	300,000,000	15-Sep-22			
Pair 16	Financial Institution	HSBC	Bond	500,000,000	28-Jun-22	31-Mar-15	05-Aug-16	335
			Sukuk (Wakala bil-Istithmar)	750,000,000	27-Mar-20			
Pair 17	Financial Institution	My Bank	Bond	2,000,000,000	15-Aug-16	17-Aug-11	05-Aug-16	1177
			Sukuk (Musharaka)	1,000,000,000	30-Sep-16			
Pair 18	Financial Institution	My Bank	Bond	1,600,000,000	29-Jan-19	04-Apr-14	05-Aug-16	572
			Sukuk (Musharaka)	1,500,000,000	05-Apr-19			
Pair 19	Financial Institution	Public Bank	Bond	450,000,000	29-Oct-18	06-Jun-14	05-Aug-16	525
			Sukuk (Murabaha)	500,000,000	10-Jun-19			
Pair 20	Financial Institution	RHB Bank	Bond	1,000,000,000	08-Jul-24	08-Jul-14	05-Aug-16	507
			Sukuk (Murabaha)	500,000,000	15-May-24			
Pair 21	Corporate	ANIH	Bond	350,000,000	29-Nov-30	08-Dec-11	05-Aug-16	1136
			Sukuk (Musharaka)	230,000,000	29-Nov-29			

Notes: * Bond and Sukuk in pair 1 matured while conducting this research. ** and *** both type of sukuk falls under sukuk murabaha type.

5.0 Methodology

5.1 Unconditional correlation

Studying the relationship between two instruments is important in the finance sector, especially from portfolio management perspectives. This section will study the unconditional correlation between bonds and sukuk in the 21 pairs. The correlation coefficient test is a measure of linear association between random variables (draper and Smith, 1998).

$$\rho_{x,y} = \frac{\mathrm{Cov(X,Y)}}{\sqrt{Var(X)Var(Y)}} = \frac{\mathrm{E}[(\mathrm{X}-\mu_x)\,(\mathrm{Y}-\mu_y)]}{\sqrt{\mathrm{E}[(\mathrm{X}-\mu_x)^2\,(\mathrm{Y}-\mu_y)^2]}} \qquad (1)$$

where μ_x and μ_y are the mean on X and Y. Results for this test must lie between 1 and -1, indicating the level of association between selected time series instruments, for example X and Y, where 1 indicates perfect positive correlation, -1 indicates perfect negative correlation and 0 indicates no correlation between the variables. This is important in testing the relationship between bonds and sukuk for two main reasons. First, it will show an agreement or disagreement to the argument that sukuk provide diversification advantages when added to a bond portfolio or a mixed portfolio of different kinds of assets. Second, if it showed high correlation between bonds and sukuk, this will defeat the argument that sukuk are independent instruments that do not belong to fixed income sector.

To apply unconditional correlation tests, we took a few points in consideration. Many previous studies ignored the fact that some changes in relationship or some shocks might happen in the tested sample, whether through a single event or a major shift over a long time period. Therefore, in addition to running full sample correlation tests, we also ran two sub-sample correlation tests by dividing each pair period into half, then testing them independently. Sub-sample tests can prove the consistency of relationships between bonds and sukuk in each pair; they can also give an indication of improvement in relationships over time; for example, whether the correlation increased in sub-sample 2 compared to sub-sample 1. In addition, we worked on testing correlation between all the pairs over the same time periods. We took the shortest pair period (after ignoring pair1 we choose pair16, which has 335 observations) and then matched all the other pairs to that sample period, producing correlation tests for the last 335 observations (to be called later L-335) on each of the pairs. This test can give an indication as to whether the correlation for L-335 has a different reading which might be influenced by major events, and it also can indicate whether there is a relationship among pairs in that specific period, not like in sub-sample tests where each pair has a different start, half and end point, but in this test the period for all of the pairs is fixed.

5.2 Testing dynamic correlation between bonds and sukuk

As the goal of this paper is to investigate the correlation between bonds and sukuk through time series data sets using their return, it is important to first consider the features of asset returns. Engle (2004) described asset returns to be mostly unpredictable, extreme returns are possible and volatile assets that vary with time and tend to cluster. Therefore, modelling the dynamic correlation requires considering the most appropriate methods among the many that have been used. Some research used simple methods, such as rolling correlation and exponential weighted moving average methods, which are less preferable. As noted by Forbes and Rigobon (2002), rolling correlation has specified a moving window where all observations have the same weight, while outside the window observations receive no weight. Forbes and Rigobon also noted that heteroskedasticity causes rolling correlation coefficients to be biased upward in periods where one of the assets increased in terms of volatility. In addition, the rolling correlation method has no theoretical or empirical basis for selecting the size of the window or the number of observations to be included in the window. The other simple method, exponential weighted moving average, avoided the issues in rolling correlation methods, such as all observations within a window having the same weight and outside the window observations having no weight, but it is still not based on theoretical or empirical information in terms of choosing the value of the smoothing parameter λ (case et al. 2010).

Alternatively, some researchers used more complicated methods, such as multivariate GARCH models. In this research, we carefully considered the drawbacks of simple methods as well as the multivariate GARCH method. We chose Generalised Autoregressive Conditional Heteroscedasticity-Dynamic Conditional Correlation (GARCH-DCC), a multivariate GARCH model to tests the correlation between bonds and sukuk. To best describe this model and why it has been selected, we will first explain the origin of this model and how it is developed from Autoregressive Conditional Heteroscedasticity (ARCH) model.

5.2.1 Autoregressive Conditional Heteroscedasticity (ARCH)

Engle (1982) introduced the ARCH model, a new approach for modelling volatility which can provide volatility measurements like a standard deviation, something that is useful in the finance industry to consider risk, portfolio assets allocation and derivative pricing (Engle, 2004). Such issue is critical in the finance industry, especially when considering time series data such as stocks or bonds. Before the introduction of ARCH, the basic assumption for least square model is that the expected value for all squared error terms are equal at any time in the sample period (Engle, 2004). However, this is not the case for the ARCH model, which takes into consideration that variances are expected to vary over time, high at some points and low at others, meaning data suffers from heteroscedasticity. Before introducing the ARCH model, in ordinary least square regressions, existing heteroscedasticity could affect the precision of regression parameters, but ARCH model deals with heteroscedasticity as a variance to be modelled. This allows ARCH models to capture volatility clustering of tested time series as well as changes over time which will produce more accurate time dependent findings, especially for high frequency data, such as daily observations (Engle, 2004). The ARCH model specifications are below.

$$x_{i,t} = \mu_{i,t} + \varepsilon_{i,t} \tag{2}$$

$$h_{ii,t} = \gamma_i + \alpha_i \varepsilon^2_{i,t-1} \tag{3}$$

Where $x_{i,t}$ denotes daily return, μ is a conditional mean which is typically estimated to be close or equal to zero, and $\varepsilon_{i,t}$ is the error term of information set available at time t-1, which is assumed to be independently identically distributed (iid) with mean equal to zero and variance $h_{ii,t}$. Equation (3) is the simplest form of ARCH models. The ARCH (p) model, where p = 1, can be extended up to p-lags variables as in equation (4).

$$h_{ii,t} = \gamma_i + \alpha_1 \varepsilon^2_{t-1} + \alpha_2 \varepsilon^2_{t-2} + \cdots + \alpha_p \varepsilon^2_{t-p} \tag{4}$$

Where γ_i denotes long term mean variance, $\alpha_i \varepsilon^2_{i,t-1}$ is the squared error terms generated from set available at time t-1. The ARCH model describes the forecast variance in terms of current observation. It does not use standard deviation of long or short selected samples, but it weights averages of past squared forecast errors as a method of weighted variance. Interestingly, this approach can give more influence to recent information and less to old information (Engle, 2004). Engle (2004) noted that a major advantage in the ARCH model is that weight can be estimated from historical data by calculating forecasts for selected periods, such as daily observation, and examining them for different weights until reaching the closest forecast set to the variance of the next period/observation. This can be achieved by the maximum likelihood method. Once the optimal weights are found, a dynamic model of time-varying volatility is ready and can be used to measure volatility or running forecasts. This means the ARCH model can deal with issues mentioned earlier about the features of assets return, such as unpredictability, fat tail and volatility clustering (Engle, 2004). The ARCH model has a major drawback as it often requires many parameters to best describe the volatility in assets return (Tsay, 2010). For example, Tsay (2010) found the best model to explain S&P 500 monthly return is ARCH (9). This issue led to the introduction of many ARCH model extensions, mainly Generalised ARCH (GARCH) which solved this issue.

5.2.2 Generalised Autoregressive Conditional Heteroscedasticity (GARCH)

Generalised Autoregressive Conditional Heteroscedasticity (GARCH) is an extension of the ARCH model suggested by Bollerslev (1986) which only added the conditional variance $\beta_i h_{ii,t-\mathrm{p}}$ to the ARCH model as in equation (5) below. As in ARCH models, GARCH models can be extended to GARCH (p,q), where (p) relates the number of ARCH term lags imposed on the model, and (q) relates to the number of GARCH term lags specified.

$$h_{ii,t} = \gamma_i + \alpha_i \varepsilon_{i,t-1}^2 + \beta_i h_{ii,t-1} \qquad (5)$$

Where γ_i denotes long term mean variance, $\alpha_i \varepsilon_{i,t-1}^2$ is the squared error terms generated from set available at time t-1, and $\beta_i h_{ii,t-1}$ is the conditional variance generated from time t-1. GARCH specifications are subject to $\gamma_i > 0, \alpha_i, \beta_i \geq 0, \alpha_i + \beta_i < 1$, otherwise the model is considered non-stationary and subject to biasness. This model, GARCH (1,1), is referred by Engle (2004) as the most widely used model among all ARCH extensions. Basically, GARCH forecast variance is a weight average of three different variance forecasts, long term mean variance and forecasts made in the previous period, and the additional information was not available when the previous forecast was made (Engle, 2004). The weights on those three forecasts show how quickly the variance reacts to new information or how quickly it reverts to its long-term mean. The α and β coefficients determine volatility of short term movement in a time series. While large α indicates that volatility responds intensely to recent movements in the market, a large β indicates that shocks to conditional variance lasts for a long time and volatility is persistent (Chong, et al., 2012).

Interestingly, among all ARCH/GARCH models and their different orders (p,q), GARCH (1,1) was superior in describing volatility (Engle, 2004). Engle explains this by referring to the importance of new information and how it influences the level of uncertainty of expected future returns. Engle also noted that new information influences the volatility and creates clustering over time. This theory is applicable to different financial markets, developed and emerging, as well as to different assets, such as stock, bonds and exchange rate (Engle, 2004).

Although ARCH/GARCH models are considered to be relatively new models, they have been used extensively and many extensions are generated from it. Once researchers found the most appropriate model among all ARCH/GARCH models, they were able to understand over time dynamics of studied instruments, as well as note changes in volatility and reaction to market movement or shocks. Such reading is very important from investment perspectives, yet, it is very useful to compare instrument reaction to market or news and movement over time. Therefore, GARCH models have been extended to multivariate GARCH models which can test the correlation between instruments.

5.2.3 Multivariate - Generalised Autoregressive Conditional Heteroscedasticity (Multivariate -GARCH)

Multivariate GARCH models are a major extension for GARCH models for multivariate volatility. Those models focus on volatility and correlation of more than one asset return and study the relationship between asset returns by using the conditional covariance matrix of multiple assets return (Tsay, 2010). This approach provides useful information for investors in asset allocation and risk computing. Many models exist for modelling multivariate volatility; however, we will briefly discuss the most useful models among them such as DVEC, BEKK and CCC, while discussing in more detail DCC, the model used for this research.

DVEC is a restrictive form of VEC model introduced by Bollerslev, et al. (1988) which suffers from a dramatic increase in parameters when a number of assets increase, creating restrictions which reduce the number of parameters. For example, in VEC the number of parameters is $N(N+1)(N(N+1)+1)/2$, while in DVEC the number of parameters is $N(N+5)/2$, meaning for N=3, the number of parameters would be 78 for VEC and 12 for DVEC (Bauwens et al., 2006). Although DVEC follows GARCH (1,1) type model and is considered a simple model, it does not guarantee a positive-definite covariance matrix. Also, this model does not allow for dynamic dependence between volatility series (Tsay, 2010).

In order to avoid the uncertainty of producing a positive-definite covariance matrix, Engle and Kroner (1995) introduced the Baba-Engle-Kraft-Kroner (BEKK) model. Although this model, unlike DVEC, allows for dynamic dependence between the volatility series, it has its disadvantages. First, the parameters in A_i and B_j do not have direct interpretation to lagged values of volatilities or shocks. Second, this model, like DVEC, can increase rapidly in the number of parameters affecting the outcome parameters and their significance readings (Tsay, 2010). Even with the restrictions imposed on DVEC and BEKK, they still produce a high number of parameters which can be considered the reason that research rarely uses those models for number series larger than 3 or 4 (Bauwens et al., 2006). DVEC and BEKK are among the models considered appropriate to study the dynamic correlation between instruments, while other multivariable models will not be appropriate as they do not allow for time dependence, which is critical when considering time series instruments such as bonds and sukuk.

Different classes of Multivariate GARCH models were proposed by Bollerslev (1990) which take two steps to form, including: 1) estimating the univariate GARCH model of each asset separately to find its conditional variance and 2) finding the conditional correlation from models generated from the first step (Bauwens et al., 2006). Bollerslev’s model (1990) showed that constant conditional correlation (CCC) assumed correlations are constant, so the conditional covariances are proportional to the product of the corresponding conditional standard deviation

(Bauwens et al., 2006). This restriction significantly reduces the number of parameters to $N(N+5)/2$. Although CCC is considered to be the simplest of its class and has been used widely, the assumption that conditional correlation is constant is considered unrealistic by many authors, including Bauwens et al. (2006), Minovic (2007) and Engle (2002). Franke et al. (2005) explained that in financial markets, the correlation among assets in a crisis period tend to increase, which questions the validity of considering the conditional correlation as a constant over time. This drawback of CCC leads to further extension which only allows conditional correlations to be time varying.

5.2.4 Generalised Autoregressive Conditional Heteroscedasticity- Dynamic Conditional Correlation (GARCH-DCC)

Engle (2002) introduced a GARCH-DCC model which can be viewed as the generalization of Generalised Autoregressive Conditional Heteroscedasticity-constant conditional correlation (GARCH-CCC) model introduced by Bollerslev (1990). GARCH-DCC has the same specification as GARCH-CCC with only one major difference, which is allowing conditional correlation matrices to be time varying, which is explained below. The variance of each return series is modelled using the univariate GARCH process, and the conditional correlation between the return series is directly parameterised. The model will follow the same steps as in the univariate GARCH and initially estimating GARCH (1,1) by using the resulting standardised residuals to estimate the varying correlation matrix. This requires transforming residuals by their estimated standard deviations as below:

$$h_{ii,t} = \gamma_i + \alpha_i \varepsilon_{i,t-1}^2 + \beta_i h_{ii,t-1} \quad (6)$$

$$\mathrm{z_t} = \varepsilon_t / \sqrt{h_t} \quad (7)$$

$$\varepsilon_{i,t} = \sqrt{h_{ii,t}}\,\mathrm{z_t} \quad and \quad \varepsilon_{i,t} \sim N\left(0, h_{ii,t}\right) \quad (8)$$

$$q_{ij,t} = \bar{\rho}_{ij} + \alpha(\mathrm{z_{i,t-1}}\,\mathrm{z_{j,t-1}} - \bar{\rho}_{ij}) + \beta(q_{ij,t-1} - \bar{\rho}_{ij}) \quad (9)$$

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t}\,q_{jj,t}}} \quad (10)$$

$\bar{\rho}_{ij}$ is the unconditional correlation between $\mathrm{z_{i,t}}$ and $\mathrm{z_{j,t}}$. $\mathrm{z_t}$ represents the standardised residuals. The covariance matrix is $H_t \equiv D_t R_t D_t$, where D_t is a diagonal matrix of univariate GARCH volatilities. $R_t = \mathrm{Q}_t^{*-1}\,\mathrm{Q}_t\,\mathrm{Q}_t^{*-1}$ is the time varying correlation matrix, and Q_t as below:

$$\mathrm{Q}_t = (1-a-b)\overline{\mathrm{Q}} + a(\mathrm{z_{t-1}}\mathrm{z}'_{\mathrm{t-1}}) + b\mathrm{Q}_{t-1} \quad (11)$$

Where $\overline{\mathrm{Q}}$ is the unconditional covariance of standardised residuals, Q^* is a diagonal matrix composed of the square root of the diagonal elements of Q_t. To generate the coefficients of

Univariate GARCH as well as GARCH-DCC, the models are estimated by the maximum likelihood procedure using the algorithm of Broyden-Fletcher Goldfarb-Shanno (BFGS).

GARCH-DCC was ultimately the chosen model, as we found it met our aim and criteria. It is simple to estimate like univariate GARCH models, but with the two steps likelihood function method, we obtained clear computation advantage over other multivariate GARCH models. Additionally, GARCH-DCC is time varying, allowing tests to witness the dynamic of the time series and run more accurate correlation tests. While restrictions in GARCH-DCC produce positive-definite covariance matrix, conditions in DVEC did not. Lastly, the number of parameters to be estimated in the correlation process is independent from the number of assets to be tested for correlation, making this model useful to studies with high numbers of assets. Also, GARCH-DCC will reduce the risk of misspecification of the parameters coefficient.
GARCH-DCC is widely used, and while some researchers have used it to test validity, others have used it to test correlations between assets. Engle (2002) compared GARCH-DCC to BEKK, Moving average (MA), Exponential smoothing (EX) and Orthogonal GARCH models to test correlation among stocks, between stocks and bonds and between exchange rates of different currencies. Engle (2002) found that the bivariate version of GARCH-DCC provided very approximation to a variety of time-varying correlation processes, but outperformed simple models and multivariate GARCH models. Engle concluded that GARCH-DCC performed well in different situations and high dimensional data sets.

Chong et al. (2009) applied GARCH-DCC to test the relationship between Real Estate Investment Trusts (REITs) and equity over the period from 1990 till 2005 of a daily observation, observing the dynamic changes in REITs behaviour over time. Also, Chong et al. (2009) noted the changes in correlation over time between REITs and equity and how they become more integrated. Additionally, Chong et al. (2009) noted how the correlation between REITs and equity rose in period with high volatility. A similar study by Chong et al. (2012) also on REITs, but focusing on the dynamic correlation among REITs sub-sectors, used GARCH-DCC to study relationships and noted the upward trend between sub-sectors. Also, Chong et al. (2012) noted that in high volatility periods correlation rises between sub-sectors. These findings in Chong et al. (2009) and Chong et al. (2012) are very important from investment perspectives. GARCH-DCC allows investors to accurately observe the dynamic of asset co-movements over time and making investment decisions accordingly.

6.0 Findings

Before running tests on selected data, it is important to satisfy stationarity assumptions on time series data to ensure that mean, variance and covariance are constant over time (Brooks and Tsolacos, 2010). Ignorance of this condition might lead to continued growth in series mean and variance with sample size increase over time, which would underestimate mean and variable, resulting in biased findings, such as the correlation among time series instruments. As all tests in this paper are based on time series data, it is important to take necessary action to have unbiased readings. To remove non-stationarity from the series, we converted all time series prices to log returns.

Table 3 shows descriptive statistics for all the series after converging them to log return. A few things can be noted from Table 3. First, all the series are stationary at a 1% significance level. Second, the majority of pairs have sukuk standard deviation that is higher than bonds. This can initially mean that sukuk are more volatile than a bond. The market might not have the same level of confidence in sukuk as it does in bonds, or it could mean that the high demand for sukuk could be the driver for high volatility. However, overall, the standard deviation for both sukuk and bonds are very low in comparison to other assets, such as stocks. Third, although all series have some degree of skewness and kurtosis, it is not essential to consider this because we tested them and found that a few outliers are the reason for the presence of some degree of skewness and kurtosis.

6.1 Graphics initial reading

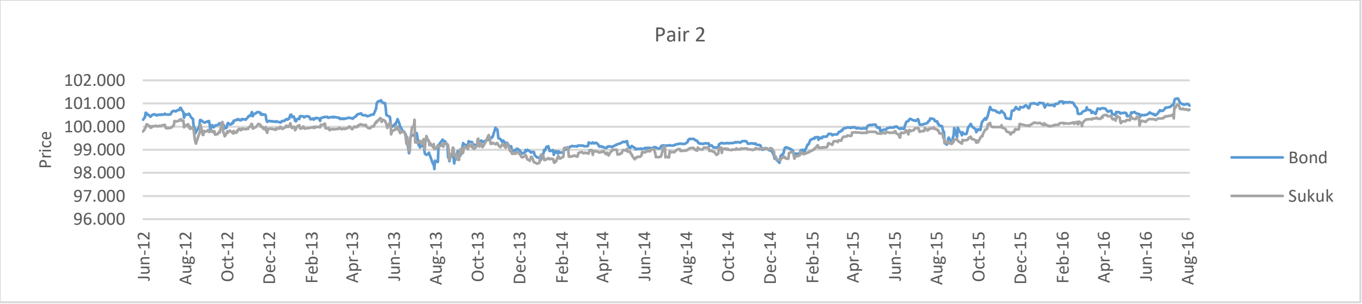
The first step to read the relationship between any two instruments is to plot their prices and return on graphs and notice how they move in relation to each other. This is important in discovering overall performance, reaction to shocks and long term relationship. graph 1 showed examples of the price and return movement for pairs 2 and 3, the rest in the appendices section. Interestingly, all of the 21 pairs included prices showing almost perfect movement between each pair instruments (bond and sukuk), taking into consideration that a comparison is run as one instrument against another and not one portfolio against another or one index against another. This is critical as it reflects a clear, straightforward relationship between two instruments, which is beneficial for explaining the actual dynamic between them. When using a group of bonds against a group of sukuk, like in portfolios or indices, the result will be smooth, but there is potential for the result to be influenced by some of the instruments within the portfolio or the index. Ro and Ziobrowksi (2011) and Chong et al. (2012) both noted that indices can be influenced by one or some of the instruments within a portfolio or index which can significantly influence the tests result.

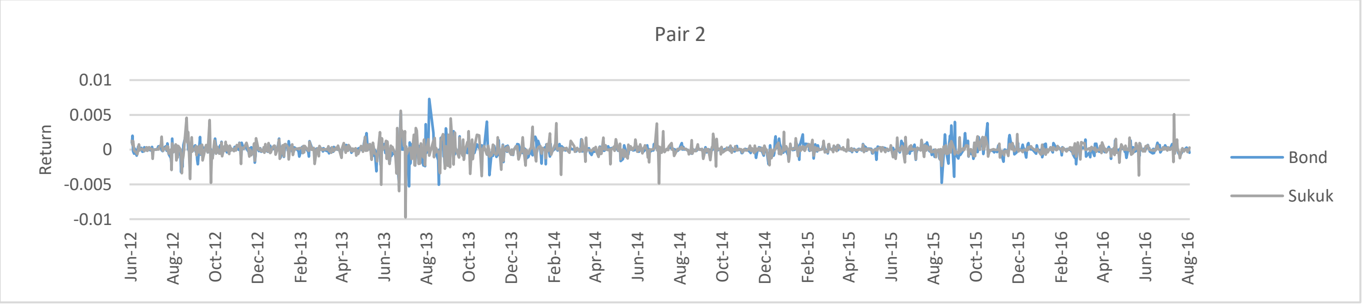
Table 3: Descriptive statistics of daily returns series

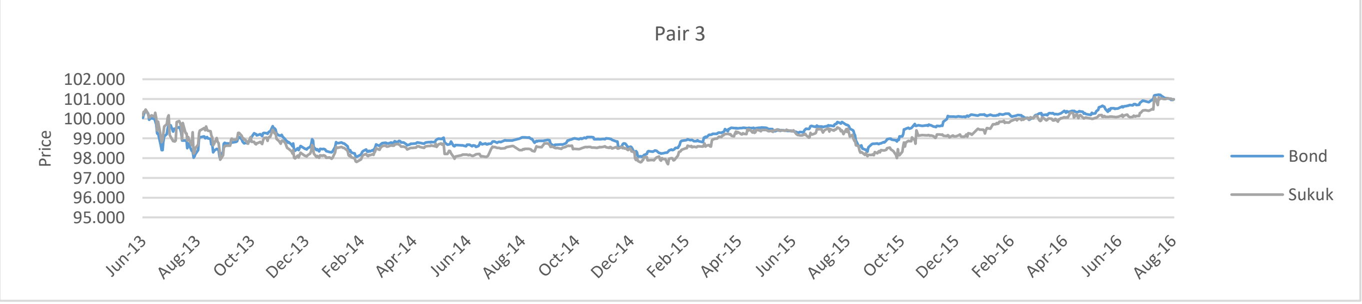
Pairs	Type	Average daily return	Standard Deviation	Skewness	Kurtosis	Minimum	Maximum	Stationarity
Pair 1	Bond	0.0119%	0.0108%	0.7681	9.9449	-0.0449%	0.0726%	***
	Sukuk (Bai'Inah)	0.0125%	0.0106%	0.9049	7.8919	-0.0346%	0.0707%	***
Pair 2	Bond	0.0006%	0.0872%	0.1703	16.0480	-0.5297%	0.7285%	***
	Sukuk (Bai Bithaman Ajil)	0.0007%	0.1030%	- 1.0380	16.9448	-0.9749%	0.5585%	***
Pair 3	Bond	0.0013%	0.0950%	- 0.4868	11.5791	-0.5810%	0.6332%	***
	Sukuk (Bai Bithaman Ajil)	0.0011%	0.1484%	- 0.4024	16.3117	-1.1045%	0.9430%	***
Pair 4	Bond	0.0020%	0.1218%	- 0.8242	10.3041	-0.7056%	0.5186%	***
	Sukuk (Murabahah)	0.0023%	0.1767%	- 0.5259	13.1059	-1.3753%	1.0492%	***
Pair 5	Bond	-0.0005%	0.1161%	0.0817	35.1105	-1.1510%	1.1266%	***
	Sukuk (Bai Bithaman Ajil)	-0.0006%	0.1212%	0.1311	14.5405	-0.8037%	0.8682%	***
Pair 6	Bond	-0.0005%	0.1180%	- 1.3080	21.9767	-1.2621%	0.7053%	***
	Sukuk (Bai Bithaman Ajil)	0.0011%	0.1344%	- 0.5255	12.0489	-1.1372%	0.6901%	***
Pair 7	Bond	-0.0029%	0.1208%	- 0.1432	10.0174	-0.8032%	0.5534%	***
	Sukuk (Murabahah)	0.0061%	0.1974%	0.2139	9.9213	-0.9297%	1.2562%	***
Pair 8	Bond	-0.0046%	0.1563%	- 0.0085	8.1159	-0.7880%	0.7060%	***
	Sukuk (Murabahah)	0.0075%	0.2858%	0.1431	7.1149	-1.2625%	1.2880%	***
Pair 9	Bond	0.0005%	0.1978%	- 0.4118	14.7251	-1.5704%	1.4349%	***
	Sukuk (not specified)	-0.0003%	0.1967%	- 0.1097	16.5343	-1.5412%	1.5677%	***
Pair 10	Bond	0.0059%	0.2793%	- 0.7160	9.5435	-1.7808%	1.1673%	***
	Sukuk (not specified)	0.0033%	0.3197%	- 0.3854	8.8472	-1.8262%	1.4362%	***
Pair 11	Bond	0.0051%	0.1336%	- 0.0789	9.6932	-0.7401%	0.6237%	***
	Sukuk (not specified)	0.0049%	0.1455%	- 0.2304	13.9923	-0.9826%	0.9577%	***
Pair 12	Bond	0.0002%	0.1345%	- 0.4298	49.7863	-1.7945%	1.7527%	***
	Sukuk (Ijara)	0.0011%	0.1609%	- 0.4448	18.4480	-1.1861%	1.4131%	***
Pair 13	Bond	-0.0019%	0.1392%	1.3624	22.2587	-0.8443%	1.6372%	***
	Sukuk (Musharakah)	0.0003%	0.1727%	0.8837	40.5167	-1.9050%	2.2617%	***
Pair 14	Bond	-0.0001%	0.1453%	- 0.3365	39.4812	-1.4713%	1.6026%	***
	Sukuk (Musharakah)	-0.0003%	0.0907%	0.1575	16.5691	-0.7205%	0.6563%	***
Pair 15	Bond	0.0006%	0.1055%	- 0.1997	11.7488	-0.6854%	0.6181%	***
	Sukuk (Musharakah)	0.0000%	0.2469%	0.1105	6.5735	-0.9221%	1.2330%	***
Pair 16	Bond	-0.0018%	0.0441%	0.2209	10.3465	-0.2252%	0.2399%	***
	Sukuk (Wakala bil-Istithmar)	0.0003%	0.0880%	- 0.1388	7.2339	-0.4403%	0.3727%	***
Pair 17	Bond	-0.0004%	0.2057%	- 0.3554	14.1315	-1.6066%	1.2870%	***
	Sukuk (Musharakah)	-0.0003%	0.1921%	- 0.5320	18.9398	-1.7391%	1.2845%	***
Pair 18	Bond	0.0002%	0.2270%	- 0.4014	9.1723	-1.3290%	1.1291%	***
	Sukuk (Musharakah)	0.0017%	0.2145%	- 0.0082	8.2989	-1.2827%	1.1678%	***
Pair 19	Bond	0.0021%	0.1126%	- 0.2164	12.5894	-0.6456%	0.7332%	***
	Sukuk (Murabahah)	0.0021%	0.2287%	- 0.3193	8.5417	-1.3786%	1.1984%	***
Pair 20	Bond	0.0023%	0.2131%	- 0.0739	11.7858	-1.3723%	1.1996%	***
	Sukuk (Murabahah)	0.0020%	0.2286%	- 0.0772	7.9481	-1.2846%	1.1777%	***
Pair 21	Bond	0.0105%	0.4842%	1.0996	15.7491	-2.1268%	4.7591%	***
	Sukuk (Musharakah)	0.0079%	0.4658%	- 0.0011	7.3018	-2.4446%	2.8723%	***

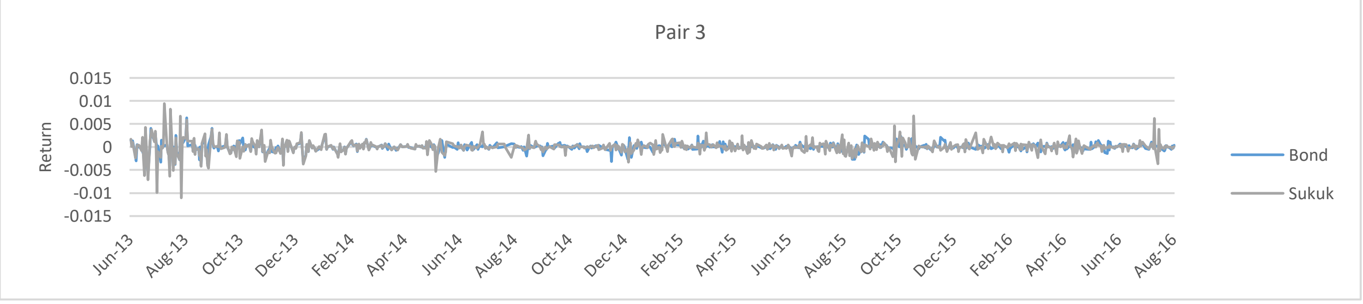
Notes: This table presents descriptive statistics for each of the pairs for the entire sample period. The first two moments are expressed in percentage form. *** indicate statistically significant at 1%

Graph 1: Pairs observations over time (Price & Return)









Another initial reading from the graphs shows how relatively stable both instruments within each pair were over the observed periods. For example, looking at any instrument price at the beginning of the period and comparing it to all the observations afterward can show how instrument prices moved within the boundaries; most of them stayed around the price of 100. This is important when considering sukuk and questioning the argument that sukuk are different from bonds. Such noted movement clearly proves the nature of sukuk and how they belong to the fixed income sector.

Interestingly, all different types of sukuk showed similar performance despite the major differences in their rights and ownership structure. For example, pair 8 and pair 12 are both issued by Quasi-Government, but pair 8 is Murabaha sukuk, and pair 12 is Ijara sukuk. Both pairs showed similar movements between their bonds and sukuk. Similar findings occurred between pair 4 and pair 19, and while both are Murabaha sukuk, one is issued by government with the other is issued by a financial institution respectively. These findings give signs of how sukuk place in the fixed income market and question the existing idea of real differences existing between types of sukuk.

Another interesting initial reading is from pairs return. First, periods with high volatility in one of the instruments within a pair also showed high volatility in the other instrument, and pairs showed similar performances in low volatility periods; these findings are true for almost all of the 21 pairs. Second, a decent number of sukuk showed clear reduction in volatility overtime, which might be a sign of maturing or being accepted by the market as a fixed income instrument.

6.2 Unconditional correlation

Table 4 shows the results of unconditional correlation tests for all 21 pairs. First, we found sukuk are highly correlated to bonds with most of the pairs have correlation above 0.5000, while the average for all pairs, full sample test correlation, is 0.6118 with no major differences in the result for sub-sample1, sub-sample2 and L-335. This is despite the existence of noises in daily observations which can be influenced by many factors, such as short term traders (high frequency traders) or long term investors. None of the pairs showed negative correlation, and only two pairs, pair 5 and pair 7, showed positive low correlation in the full sample test; however these two pairs also showed improvement in correlation in their sub-sample2 and L-335 tests.

Table 4: Unconditional correlation of daily return

Pairs	Full period	first half sub-period 1	Second half sub-period 2	Last 335 observations
Pair 1	0.8673	0.7671	0.9591	NA
Pair 2	0.3193	0.3085	0.3483	0.3652
Pair 3	0.5591	0.6604	0.2282	0.2201
Pair 4	0.5359	0.6175	0.4024	0.3940
Pair 5	0.0665	0.0440	0.2198	0.2233
Pair 6	0.3905	0.4077	0.3492	0.3289
Pair 7	0.0996	0.0378	0.2297	0.1312
Pair 8	0.7377	0.7133	0.7835	0.7599
Pair 9	0.9522	0.9509	0.9552	0.9767
Pair 10	0.3389	0.2668	0.4944	0.4940
Pair 11	0.8924	0.9762	0.7914	0.8134
Pair 12	0.7345	0.8262	0.5699	0.2165
Pair 13	0.7935	0.8088	0.6545	0.8419
Pair 14	0.6314	0.6131	0.9157	0.9088
Pair 15	0.5827	0.5323	0.6701	0.7338
Pair 16	0.5310	0.4903	0.6743	0.5310
Pair 17	0.9511	0.9545	0.7599	0.7429
Pair 18	0.8693	0.8507	0.9599	0.9530
Pair 19	0.6125	0.4398	0.9059	0.7886
Pair 20	0.8131	0.9218	0.6252	0.6288
Pair 21	0.5697	0.6838	0.3007	0.6101
Average	0.6118	0.6129	0.6094	0.5831
SD	0.2581	0.2829	0.2620	0.2647
Range	0.8857	0.9384	0.7401	0.8455

Notes: This table reports the unconditional correlation coefficients reported across the entire sample period of each pair, and three sub-periods, including first half, second half and the last 335 observations for each pair. The final row in the table reports the average correlation coefficient reported across each pairing for each period.

Second, we tried to prove the improvement of correlation over time by comparing the correlation in sub-sample1 to sub-sample2, However, not all the observations support this argument. For example, Pairs 3, 4, 12, 13, 17, 20 and 21 showed reductions in correlation over time, while pairs 1, 5, 7, 10, 14, 15 and 19 showed improvements in correlation, and the remaining pairs showed minor changes in both directions. This indicates that the type of issuer or type of sukuk does not influence the relationship between bonds and sukuk to one direction, but there is some kind of independence. For example, pair 4 and pair 5 are both issued by the government, but they showed opposite changes in correlation over time. Another example is pair 14 and pair 17, which are both issued by financial institutions and have Musharaka sukuk but still showed opposite changes in correlation over time. This could be associated with issues related to the issuers rather than the market, in general, and this could be the reason for changes in the correlation in some of the pairs, such as pair 3 or pair 12.

Third, we found evidence of high correlation between bonds and Murabaha sukuk, Musharaka sukuk, Bai'Inah sukuk, Bai Bithaman Ajil sukuk and Ijara Sukuk. All of them showed high correlation with bonds and all of them showed consistence in relationship over time, except Ijara sukuk which showed very high correlation then dropped.

Fourth, it was a bit surprising to see the differences in findings between pair 7 and pair 8, as both are issued by Bank Pembangunan, Quasi-Government, and both have murabaha sukuk, which is the closest type of sukuk to bonds, theoretically.

These correlation results between bond and sukuk are actually within the boundaries of relationships within bonds themselves. Indeed, adding sukuk to a bond portfolio might improve its performance; however, the improvement is not the same as adding an independent instrument, as sukuk was assumed in earlier studies, but most probably like adding another bond to a bond portfolio with a different issuer or a different rating. Although using unconditional correlation can give an indication about the relationship between bonds and sukuk, it is considered less reliable as it ignores the correlation dynamic and how changes occur over time. How the relationship changes over time and how it reacts to shocks in the market or upward and downward trends is one of the most important findings investors take into consideration. Therefore, in the next section, we will use highly useful tests to capture the dynamic correlation and give more accurate findings about the relationship between bonds and sukuk.

6.3 GARCH-DCC

The first step in building a GARCH-DCC model is specifying the mean equation for each of the instruments to test for serial dependence in its data. Equation (2) above is the simplest form of mean equation; however, sometimes it requires further extension to best describe the mean model and remove its serial correlation if found. Therefore, we used Box-Jenkins approach in using Autoregressive Moving-Average (ARMA) to try to find the best model to explain the dynamic of each of the time series data. Equation (12) below is the general equation for ARMA (p,q) model used to describe mean model, where (p) represents the order of Autoregressive (AR) in the model, and (q) represents the order of Moving-Average (MA)

$$x_t = \phi_0 + \sum_{i=1}^{p} \phi_i x_{t-i} + a_t \sum_{i=1}^{q} \theta_i a_{t-i} \qquad (12)$$

Determining the order of each model is important in capturing the dynamic of each time series (Brooks and Tsolacos, 2010). This requires using Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) tests to observe the relationship overtime within the time series. As ACF can show the relationship between each time series' current and past observations, PARF's further readings show the correlation between the time series and each of the intermediate lagged values (Tsay, 2010). Plotting ACF and PACF graphically can show the dynamic of each time series under test. The second step includes estimating the model parameters specified in the previous step by using the least square test. The last step includes model checking by residual diagnostics. Models are inadequate if evidence of linear dependence is found in the residuals; if this occurs, then there is a need to reconstruct until the model becomes acceptable. All test results are in appendices.

After finding the best mean model for each time series, we ran a univariate GARCH test for each of the pairs, as explained above. Autoregressive Conditional Heteroscedastic (ARCH) models assume that the volatility of time series data is deterministic of its past observations, so it is conditioned on its previous error terms. This assumption has been tested, and the results confirmed the assumption of having ARCH affect. All tests results are in appendix. At this stage, models are adequate and ready to complete GARCH-DCC tests, which are repetitive tests for GARCH.

Table 5: Dynamic Conditional Correlation

Pairs	γ_1	γ_2	α_1	α_2	β_1	β_2	a	b
Pair 1	NA	NA	NA	NA	NA	NA	NA	NA
Pair 2	0.00000	0.00000	0.06406***	0.20619**	0.90840***	0.78593***	0.00321	0.97600***
Pair 3	0.00000	0.00000	0.07240*	0.17392***	0.91067***	0.77132***	0.03435***	0.96255***
Pair 4	0.00000	0.00000	0.20793**	0.21491***	0.78822***	0.70262***	0.00661*	0.98744***
Pair 5	0.00000	0.00000	0.19512***	0.02800**	0.79921***	0.95766***	0.02420*	0.94101***
Pair 6	0.00000	0.00000	0.13658***	0.11210	0.85827***	0.87383***	0.00708*	0.98884***
Pair 7	0.00000	0.00000	0.10530	0.37728**	0.89217***	0.55593***	0.06264	0.00000
Pair 8	0.00000	0.00000	0.28668***	0.35367***	0.59431***	0.54730***	0.09956***	0.77844***
Pair 9	0.00000	0.00000	0.16857*	0.18266*	0.81880***	0.81164***	0.09767*	0.82475***
Pair 10	0.00000	0.00000	0.09030***	0.01126	0.79412***	0.98288***	0.01296**	0.98477***
Pair 11	0.00000	0.00000	0.03169	0.14956***	0.95965***	0.64890***	0.04967***	0.94268***
Pair 12	0.00000	0.00000	0.05787*	0.21940***	0.93700***	0.77943***	0.07249*	0.79844***
Pair 13	0.00000	0.00000	0.06362	0.05583	0.92044***	0.93498***	0.01820*	0.91122***
Pair 14	0.00000	0.00000	0.06743*	0.05960	0.90806***	0.91507***	0.00856***	0.99144***
Pair 15	0.00000	0.00000	0.03215	0.15541*	0.95352***	0.83832***	0.02950**	0.94958***
Pair 16	0.00000	0.00000	0.05823*	0.05134	0.90356***	0.92779***	0.06507	0.16848
Pair 17	0.00000	0.00000	0.07601*	0.05777	0.91077***	0.90613***	0.05680***	0.91321***
Pair 18	0.00000	0.00000	0.05938	0.31877**	0.93256***	0.65400***	0.01591***	0.98381***
Pair 19	0.00000	0.00000	0.01002	0.14116	0.97404***	0.82941***	0.02234***	0.97759***
Pair 20	0.00000	0.00000	0.07946	0.19446**	0.90072***	0.72070***	0.03656***	0.94728***
Pair 21	0.00000	0.00000	0.04306	0.06241	0.94977***	0.93459***	0.04744***	0.93583***

Notes: This table reports the coefficients from the GARCH-DCC estimations. The γ, α and β coefficients refer to the respective GARCH (1,1) model, with a subscript of 1 refer to the bond and a subscript of 2 referring to the sukuk of each pair. The a and b coefficients refer to the GARCH-DCC (1,1) estimates.
*, ** and *** indicate significance at the 10, 5 and 1% levels, respectively.

Table 5 shows the estimated time varying conditional coefficients for each pair for GARCH-DCC models. The table contains GARCH (1,1) estimation for each instrument within each pair separately, and it also it contains the GARCH-DCC (1,1) estimation for each pair. Overall, the GARCH-DCC seems to provide a good representation of the conditional variance of the data. In the GARCH model for individual instruments, most of the instruments showed very high β_i, very low α_i and close to unified $\alpha_i + \beta_i$, indicating a strong persistence in volatility. In the GARCH-DCC model, the parameters a + b, which represent the conditional covariance, showed positive and significant findings for almost all of the pairs, except pair 7 and pair 16. This indicates a strong interaction between bonds and sukuk within each pair. Another interesting finding is related to the assumption that type of sukuk are different from each other because of the nature of their structure and underlying assets, if any. In GARCH-DCC, we found positive and significant parameters, a + b, close to unity for pairs containing Murabaha sukuk, Musharaka sukuk, Bai'Inah sukuk, Bai Bithaman Ajil sukuk and Ijara sukuk. This questions the existence of differences among sukuk types; even if they take different approaches or have different structures, they might end up with the same result, in which case the market would treat them the same.

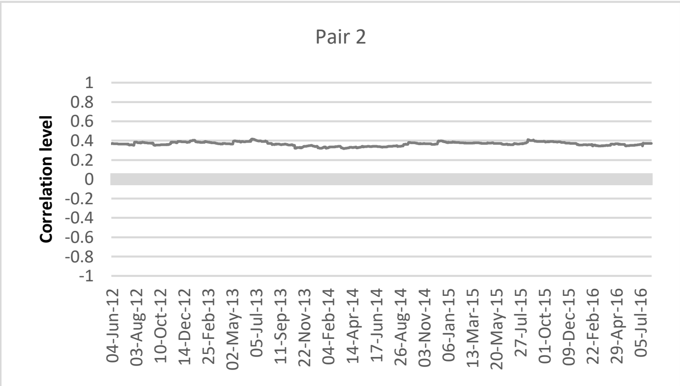
Interestingly, when comparing unconditional correlation findings in table 4 to the average conditional correlation finding in table 6 below, we noted worthwhile improvements in later tests. For those pairs without similar findings in the two tests, in most of the cases they showed lower correlation in conditional correlation test, with the exception to pair 5 and pair 7 which showed the opposite due to being influenced by the major changes in their correlation over time. Also, when comparing the mean of all pairs' correlations, after excluding pair 1, results showed 0.5991 in an unconditional test and 0.5883 in a conditional test. This could be due to the unconditional correlation limitation for capturing the volatility and upward/downward trends over the sample period.

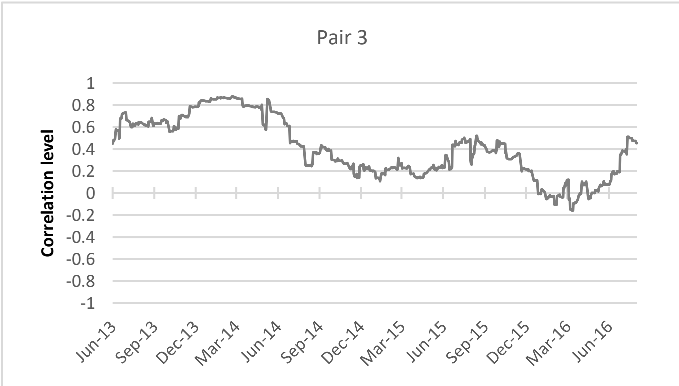
Graph 2 shows a graphical display of the conditional correlation over time for each of the pairs. Overall, it was hard to prove the upward trend of the relationship between bonds and sukuk because of data availability and limited time to test them. Chong et al. (2012) included 18 years of daily observations to test Real Estate Investment Trust "REIT" behaviour. Another interesting finding shows that the majority of the pairs showed stable levels of correlation over the time. Also, it has been noted that correlation levels recover quickly to the same level after shocks, which is clear in pairs 9, 11, 13, 17 and 18, while most of the rest were not exposed to major shocks. In addition, almost none of the pairs have a negative conditional correlation over an observed period, except pairs 3, 12 and 21, which showed few negative observations although pair 7 showed a continuous one. Pair 7 is the only pair that showed signs of serious fluctuation in correlation and a better diversification advantage compared to the rest of the pairs.

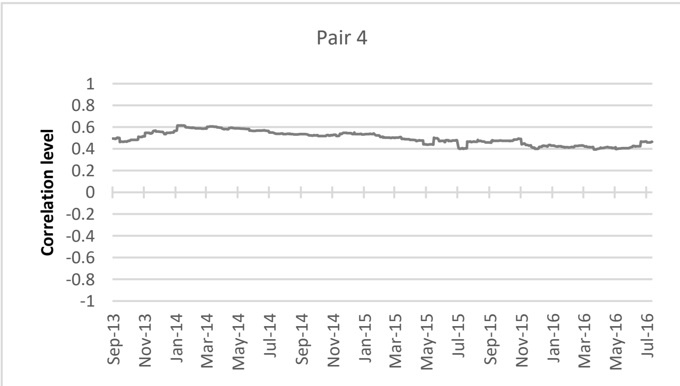
When considering the effect of sukuk, it is of interesting to observe different patterns over time. Although each pair showed its own fluctuation between bond and sukuk, there was not a clear pattern for any of the sukuk types. Also, we could not find a type of sukuk with a constant high stable correlation with its bond pair, nor could we find a type of sukuk with constant high levels of fluctuation in its correlation with bonds. Although pair 12 showed high levels of fluctuation between bond and sukuk, it is the only pair containing sukuk Ijara, so we cannot compare it to another pair.

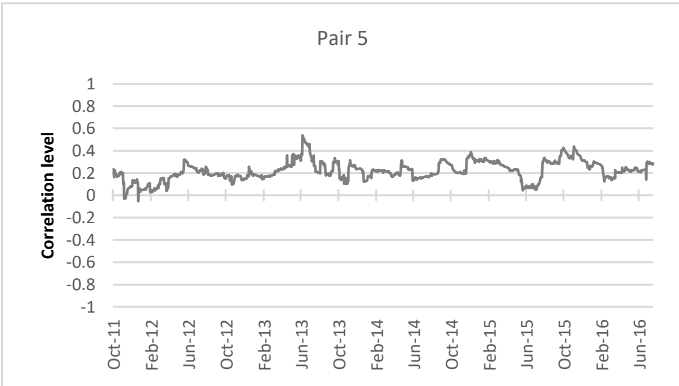
Graph 2: Pairs time series plots for GARCH-DCC

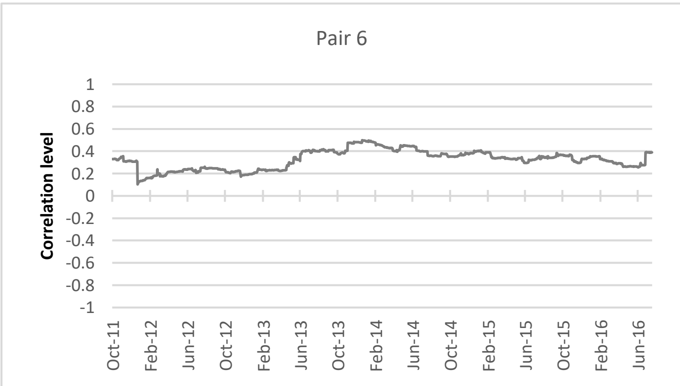
Note: This figure graphically displays the conditional correlation coefficients, as estimated using the GARCH-DCC (1,1) procedure, for each of the pairs.

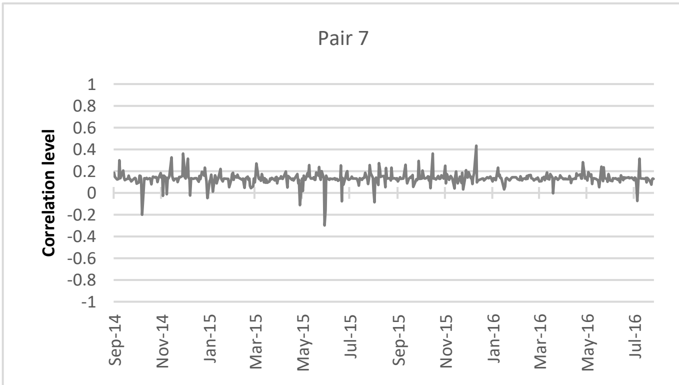


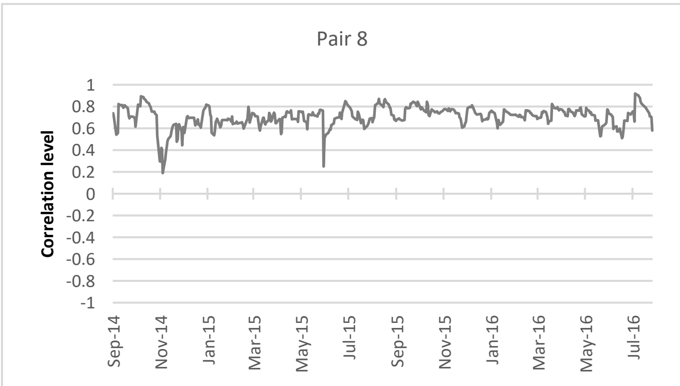


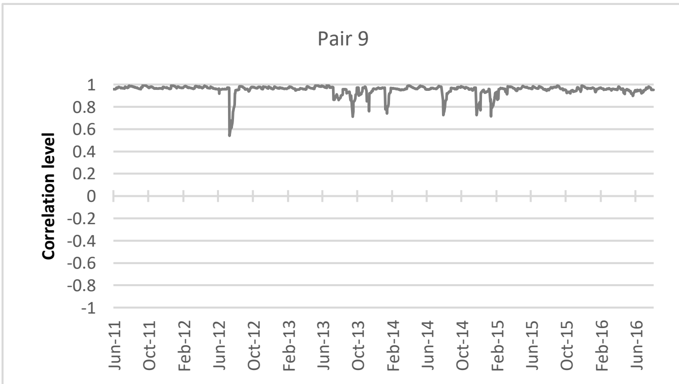




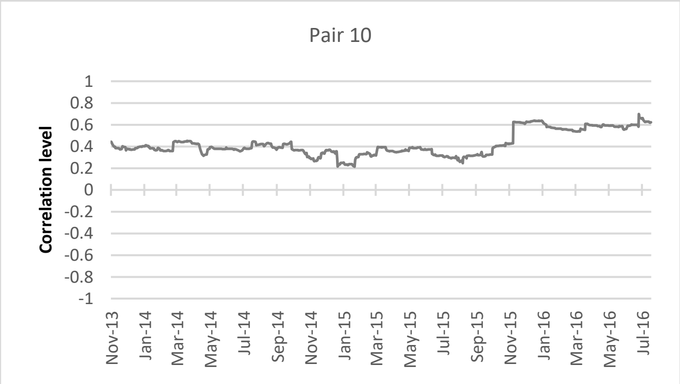


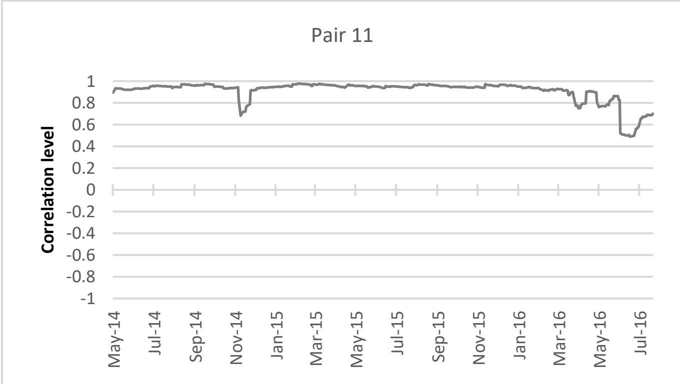


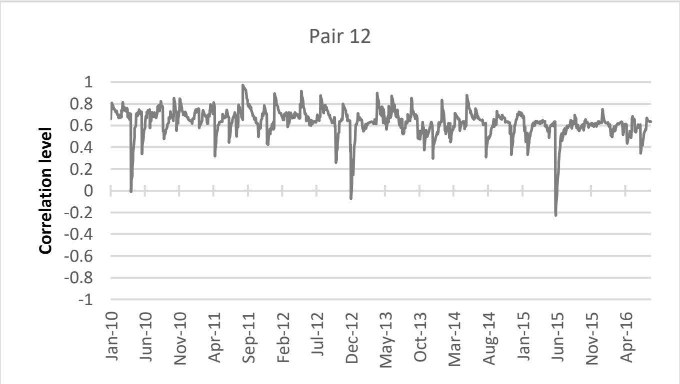


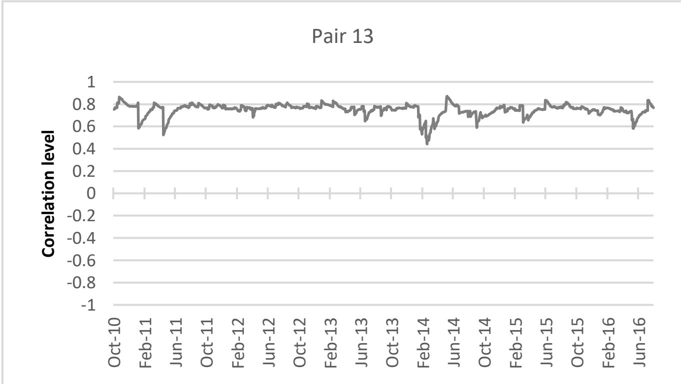


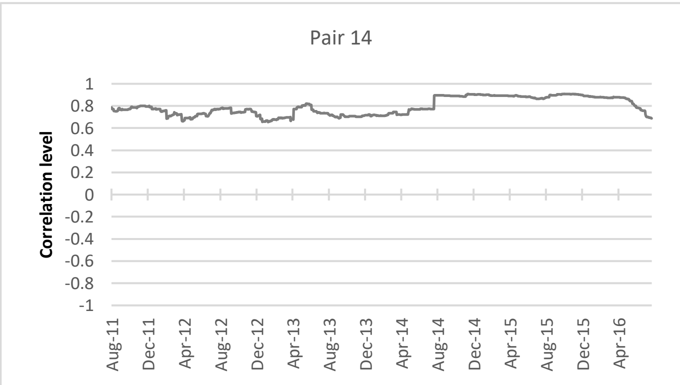
Graph 2: Pairs time series plots for GARCH-DCC (continued)

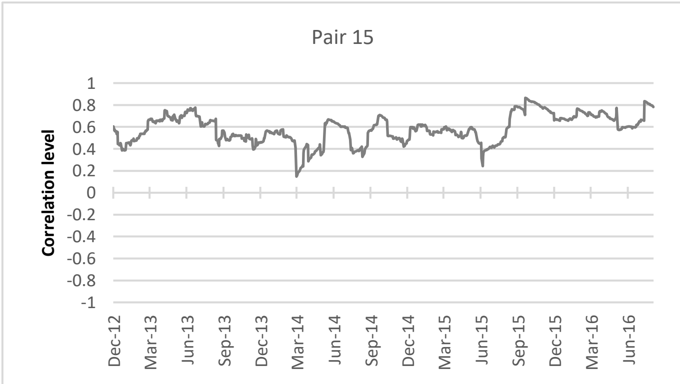


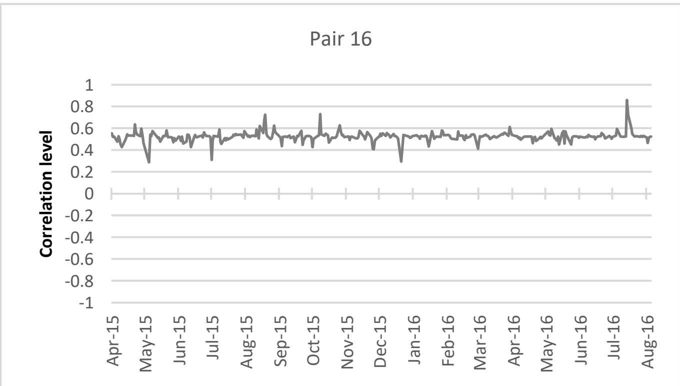


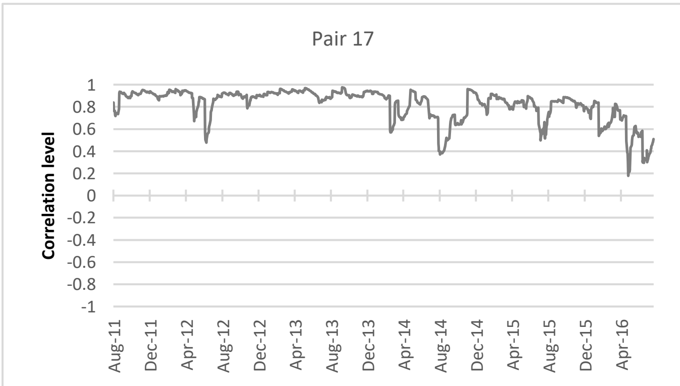




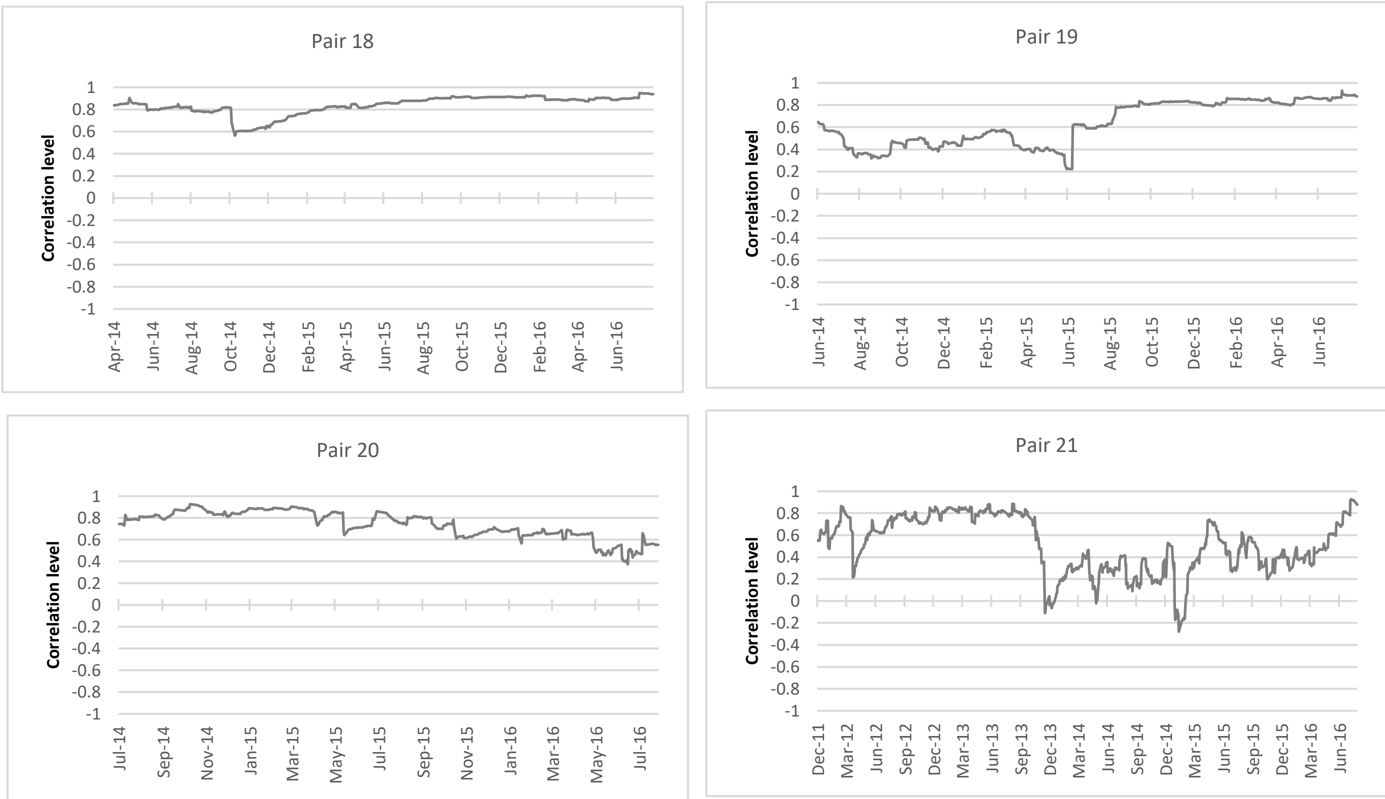








Graph 2: Pairs time series plots for GARCH-DCC (continued)



6.4 Trend over time

One of the goals for this paper was to prove the changes in sukuk behaviour over time as well as its homogenous movement with regard to a fixed income sector. To find this out, we regressed the conditional correlation over-time trend. Significant results with positive signs would indicate the integration between bonds and sukuk over time. Table 6 presents the finding for each pair, where half of the pairs showed negative signs which did not support the argument of the integration between bond and sukuk. This could be because of sukuk not being integrated to fixed income yet, or it could be influenced by individual pair behaviour, especially with the challenge of having short sample of data. For example, in Chong et al. (2012), many of the pairs tested had continuous reduction in their conditional correlation for a period of more than two years in some cases, but their overall finding for 18 years showed significant positive integration over time. From this research, pair 4 had little reduction in conditional correlation for a period of less than six months that resulted in a significant but negative sign, indicating the dispersal of bonds and sukuk. The limitation of time span on various other pairs showed significant positive signs, meaning we cannot build an argument based on them.

Table 6: Summary statistics of conditional correlations

Pairs	Average	Minimum	Maximum	SD	Trend (*1000)	t-ratio	R-Squared
Pair 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pair 2	0.36529	0.31689	0.41713	0.02029	-0.00315	-2.166651**	0.00473
Pair 3	0.40589	-0.16084	0.88230	0.27009	-0.60686	-31.52012***	0.57880
Pair 4	0.49324	0.39445	0.61661	0.05984	-0.15935	-34.82501***	0.65387
Pair 5	0.21996	-0.05338	0.53709	0.08804	0.06349	12.93201***	0.13302
Pair 6	0.32426	0.10288	0.49838	0.08468	0.06860	15.08308***	0.16673
Pair 7	0.13265	-0.29879	0.43374	0.05937	0.00820	0.59848	0.00077
Pair 8	0.70738	0.18926	0.91995	0.09540	0.10730	5.01794***	0.05126
Pair 9	0.95290	0.54088	0.99617	0.04720	-0.00799	-3.30491***	0.00857
Pair 10	0.42124	0.21492	0.69851	0.11147	0.22744	18.51654***	0.34120
Pair 11	0.91082	0.49021	0.97651	0.09743	-0.20094	-12.94045***	0.23504
Pair 12	0.63203	-0.22794	0.97208	0.12390	-0.05438	-12.66408***	0.09236
Pair 13	0.74938	0.44157	0.87209	0.05519	-0.01445	-6.058206***	0.02556
Pair 14	0.79297	0.65412	0.90885	0.07889	0.09725	29.70509***	0.42889
Pair 15	0.58360	0.14742	0.86540	0.13087	0.11418	10.77638***	0.11554
Pair 16	0.52510	0.28842	0.85981	0.04760	0.02621	1.44629	0.00626
Pair 17	0.82149	0.17815	0.97533	0.14547	-0.15151	-22.70014***	0.30504
Pair 18	0.83803	0.56383	0.94829	0.08379	0.21756	19.91449***	0.41072
Pair 19	0.63636	0.22210	0.93014	0.19652	0.72786	36.51189***	0.71862
Pair 20	0.73872	0.37390	0.92623	0.12418	-0.47718	-34.49933***	0.70252
Pair 21	0.51428	-0.27882	0.92691	0.25856	-0.19815	-13.72379***	0.14254

Notes: 'Trend' is the slope coefficient of a regression of conditional correlations on a constant and a time trend. The sample covers the full period for each pair.
*, ** and *** indicate significance at the 10, 5 and 1% levels, respectively.

Not proving the integration over time does not mean there are differences between bonds and sukuk, but it means that there are either no changes in correlation over time or that there is a degree of dispersal over time which might be large or small. Looking back to the graph, it is clear that conditional correlation actually reduced over time for pairs, which is the reason for having negative signs.

6.5 Pair relationship in volatility

The last to consider in the relationship between bonds and sukuk is how they react during high volatility periods. This is essential from an investment perspective, and it can also support the argument of sukuk being a type of bond. To do so, we tested the relationship between conditional correlation and conditional volatility by regressing the former on the latter as shown below:

$$\rho_t = \alpha + \beta_{B-index}\sqrt{h_{B-index}} + \varepsilon_t \qquad (13)$$

We used Thomson Reuter Government 5-year Bond Index as the conditional volatility obtained through the estimation of a standard GARCH (1,1) model. As in section 6.3, we obtained the best mean model for this index, ran autoregressive tests and then tested the existing Arch effect. These results can be found in appendices. Having positive beta coefficients suggests pairs' conditional correlations rise with bond index increased volatility. Although we found only 11 of the 20 pairs have significant and positive beta, interestingly those pairs are actually the most fluctuating pairs, which is clearly noted in graph 2, pairs 3, 5, 12, 15, 17 and 21. Three pairs

Table 7: modelling conditionals correlation and volatility

	Intercept		Bond Index volatility		
Pairs	Coefficient	t-statistic	Coefficient	t-statistic	R-Squared
Pair 1	N/A	N/A	N/A	N/A	N/A
Pair 2	0.34838	461.0495***	0.85513	8.27768***	0.06492
Pair 3	0.22771	9.880046***	25.37965	8.498302***	0.09082
Pair 4	0.50521	75.42891***	-1.86482	-1.909115*	0.00565
Pair 5	0.19740	35.77811***	3.30000	4.655476***	0.01950
Pair 6	0.31754	60.32075***	0.98900	1.45132	0.00185
Pair 7	0.13338	16.3948***	-0.71835	-0.59142	0.00075
Pair 8	0.70866	52.7147***	-0.20252	-0.10093	0.00002
Pair 9	0.94706	351.7709***	0.85108	2.492915**	0.00490
Pair 10	0.44558	33.66623***	-2.74395	-1.39340	0.00292
Pair 11	0.91556	74.53493***	-0.77379	-0.41050	0.00031
Pair 12	0.59108	90.84675***	5.86223	7.120143***	0.03118
Pair 13	0.73724	244.8635***	1.73057	4.61312***	0.01498
Pair 14	0.80311	172.6217***	-1.45039	-2.507549**	0.00532
Pair 15	0.53169	53.19698***	7.68446	5.754591***	0.03591
Pair 16	0.52554	65.08312***	-0.06703	-0.05810	0.00001
Pair 17	0.77122	91.29541***	7.18266	6.837857***	0.03830
Pair 18	0.78255	80.43997***	9.06379	6.090726***	0.06121
Pair 19	0.49994	20.32816***	22.43596	5.895928***	0.06244
Pair 20	0.77345	51.08757***	-5.20289	-2.246495**	0.00991
Pair 21	0.45972	28.79373***	8.01885	3.89034***	0.01318

Noted: The results are obtained from estimating the regression $\rho_t = \alpha + \beta_{B-index}\sqrt{h_{B-index}} + \varepsilon_t$. The conditional volatilities and covariances are calculated as the fitted values. The conditional correlations are measured as the ratio of the conditional covariances to the product of the conditional volatilities. $\overline{R}^2$ is the adjusted coefficient of determination statistic. The sample covers the full period for each pair.
*, ** and *** indicate significance at the 10, 5 and 1% levels, respectively.

showed significant negative signs, and six were insignificant. Those insignificant pairs might be affected by the stability of conditional correlation over the sample period. One note to consider, having low R square is considered less favourable; however, we cannot reject the findings because they are less explanatory. Actually, it might be acceptable to have 5% correlations between bond and sukuk, as other variables might be a major influencer to the relationships.

7.0 Conclusion

This paper attempted to find a robust answer to the ways in which bonds and sukuk are the same, taking into consideration the importance of using the most comparable sukuk and bonds, then using appropriate methodologies to test them. Results from graphics, unconditional correlation and conditional correlation all found that sukuk are not different from bonds even with all the differences in their structure or type of contracts. In fact, correlation between bonds and sukuk falls within correlation of bonds themselves, making sukuk a type of bond that is less attractive from diversification perspectives. This finding is the most important point to consider as it questions the future attractiveness of sukuk and whether they will have any advantage against bonds, except for being in compliance with Islamic roles.

Another major finding is that bonds and sukuk are not only highly correlated, but there are no significant differences from sukuk to bonds. This finding questions the previously considered differences among different types of sukuk, and also supports the argument that most sukuk are not truly compliant with Islamic roles and their complicated structure, as contracts have the same risks for sukuk holders regardless of the type of sukuk, which further shows an absence of significant differences in sukuk performance compared to bonds.

Also, although this paper could not prove the increase of correlation between bonds and sukuk because of their short period, they showed high correlation in almost all of the pairs in comparison to previous studies which showed the opposite. This supports the argument that the relationship between bonds and sukuk have changed over time.

This paper tested the relationship between bonds and sukuk in volatile periods and found that they are highly linked in periods with high volatility. This finding was limited to some of the pairs; however, these are the most volatile pairs among all the pairs.

From investment perspective, sukuk best to be considered products lie within bonds boundaries. They are highly linked to bonds, mostly in violate periods, therefore, diversification advantage of adding sukuk to investment portfolio is less likely to happen.

Overall, this paper provides a clear understanding of sukuk's place within the fixed income market. Although the expected demand for sukuk is high, this might not be driven by the diversification advantage that is assumed to emerge after including sukuk in a portfolio with other assets. Kuwait and other emerging countries with strong financial ratings can still consider this option as an alternative source of funding for their major development plans. Further, those countries that are considering issuing sukuk to fund their development projects should note that, as there is no significant difference in performance between different types of sukuk, they might need to go with the type most preferable to them, or the easiest one, such as sukuk murabaha. It is not worth issuing the other, more complicated types.

8.0 Limitation

Availability of data limited this paper at various points. First, the length of data is important in understanding sukuk behaviour over lengthier time periods; this would give clearer results if returned to the early days of sukuk. Second, the number of pairs would be too concentrated if there were more than 21 pairs. Having a decent number of bonds and sukuk would result in having more pairs with different types of sukuk, insuring not to be influenced by single or few number of pairs. Lastly, some of the pairs were not specified by type of sukuk, which limited us from comparing them to other sukuk.

Another important limitation is the flexibility of the sukuk prospectus. Sukuk existing during this time do not have a standard prospectus that all issuers have to follow. Instead, each sukuk issuer writes their sukuk prospectus the way they want it, which might waive some of the risks to sukuk holders. This actually can significantly affect any sukuk value; consequently, studies with similar types of sukuk but from different issuers might show different results.

End of
The Third Paper

Chapter Five- Thesis Overall

5.1 Contributions to general literature

This thesis aims to shed light on the real estate sector in emerging markets by studying the market of Kuwait, evaluating its performance, highlighting its main challenges and finding solutions. Many emerging countries are struggling with housing development and require an understanding of their market based on reliable, empirical studies. By using Kuwait as an example, this thesis provides information on how to overcome market challenges such as data limitations and short periods, evaluating the housing market and its influences, highlighting its main challenges and ways to overcome them.

The first paper began by addressing the main challenges facing emerging markets: data limitations and the absence of indices suitable for use in research. Based on data presented in the first paper, we can conclude that there are many approaches and methodologies that can be used for converting raw data into useful indices. Even if the data are too limited to produce complicated indices, such as those focused on hedonics or repeat-sales, which is the case in most emerging countries, the average mean or median method can be used. The average mean or median method has shown how highly flexible it is and that it can be improved in different ways. This allows researchers to improve the indices' readings until they develop ones with low forecasting errors.

Different approaches can be taken based on the nature of the market under study and the availability of data. For example, large countries with several cities can construct indices based on selected data, such as transactions in cities with high property transactions. This will allow for stable readings not distracted by the major changes among all cities in the given country. Alternatively, in small countries with fewer transactions, forecasters can use the long-term average price methodology to merge cities together to produce a number of strata based on a good number of transactions.

In addition, constructing indices based on a central tendency of monthly observations and which prove to have similar performances as quarterly indices is also an important contribution to consider. Data limitations in emerging markets apply not only in terms of the detailed information available (such as number of beds, built up areas), but also in terms of length of time series data. This is another major challenge. For example, some data available for housing transactions in Kuwait refer only to 2004 to the present. If using annual, semi-annual or quarterly data, the number of observations is limited, which might hamper the construction of reliable models. Therefore, proving the comparable accuracy of monthly indices to quarterly ones would allow for the use of monthly frequency indices that have three times more observations than quarterly ones. Although this would expose the model to a higher rate of volatility, it would also allow markets with shorter data histories to conduct research. Having reliable indices is the first step to developing literature related to any market and the cornerstone for evaluating a market, finding its problems and providing solutions. Similar to what has been done in this thesis, researchers can start building blocks in their market to further understand it. This, in turn, will speed market performance and overcome limitations.

After constructing housing indices for Kuwait, the second paper uses them to understand the market dynamics and draw findings that can be generalised to the literature. In Kuwait, we noted the strong influence of housing demand driven by the demographic structure of this young country. We also noted the weak supply response to this demand, due to government involvement in planning, infrastructure and development. This mismatch between housing supply and demand has caused housing prices to increase rapidly and made affordability worsen over the years. The solution for Kuwait and other emerging countries is for their governments to step down and allow the private sector to take the lead in housing development. Further, countries should ensure the speedy process to convert uncategorised lands and large tracts of land into small housing plots developed by the private sector. There is no doubt that the demand for housing will continue to be strong and growing in these emerging countries. In addition, governments' capabilities of providing housing are very limited and cannot keep up with the levels of demand; therefore, the solution in these markets is to allow the private sector to take over and contribute to the housing supply.

Another finding to consider is the influence of investors and speculation. In those emerging markets that are struggling to provide enough to meet the demand, it imperative that the influence of other buyers of houses, such as investors and speculators, be reduced. Singapore serves as a good example of such a situation. When Singaporean authorities noted the influence of housing investors, they worked on provide alternative investment opportunities, such as REIT, so that investors would away move from housing to buy REIT stock. In addition, they introduced additional taxes targeted at non-owner-occupiers all of real estate. This had the effect of reducing investors' impact on the housing sector.

The last finding to consider from the second paper is the impact of oil prices on housing. As noted in the Kuwaiti housing market, even with a strong demand for housing and weak supply, housing prices dropped alongside major drops in oil prices. Kuwait and other emerging markets, mainly GCC states that rely completely on oil production, are vulnerable to serious housing corrections because of dropping oil prices. It is worth considering that a drop in oil prices will not only affect housing prices, but will also affect the development of the housing sector in those countries. Kuwait, for example, relies on 95% of its income coming from oil production. In response to the oil price crisis that has persisted since 2014, Kuwait has recorded three consecutive fiscal years of deficit. This means that Kuwait might not be able to meet its major development plan, which includes doubling the existing number of houses. The case of Kuwait is actually representative of many of the emerging markets where a plan is in place to develop the housing sector, but they are facing funding challenges. In this case, housing problems will not be solved unless the funding shortage is resolved. This will require those countries to consider alternative sources of funding to develop the needed supply of houses. With this in mind, the third paper focused on this concern and evaluated potential alternative sources of funding for major development plans in emerging markets.

In the third paper, this thesis considers sukuk as an alternative source of funding for major development plans in emerging countries. It is clear that sukuk is highly similar to bonds and is not expected to provide much of a diversification advantage if included in a portfolio with other assets. However, as sukuk is considered at the early stage of development and the expectation for Islamic finance, in general, has doubled in size since 2014 to reach $4 trillion, sukuk must be considered as a good source of funding for major development plans in emerging countries. We can expect the demand for sukuk to be high. This is expected to be most applicable for countries with stable, high credit ratings, such as GCC members. Another finding to consider is the performance similarity among all different types of sukuk. Based on these similarities, sukuk issuers might consider issuing the most suitable sukuk type for them, or those that are the easiest to issue.

Overall, this thesis provides a good example for emerging markets to follow. Housing, as well as other sub-sector real estate problems, can be overcome by following the approach recommended in this thesis. Many of the emerging markets' challenges can be solved, but doing so will require starting with developing and improving databases, so that those working on the problems can understand the market and highlight the main challenges. After that, they can further investigate those challenges and find ways to overcome them. Funding limitations, planning systems, processes and procedures, market openness and attractiveness, tax systems and so on are all factors that may be the reason for an underperforming market. Therefore, knowing which of these factors is affecting the market's performance, and then providing ways to address them, will consequently solve the housing problems in emerging markets.

5.2 Recommendations

5.2.1 Recommendations to governments and policy makers

Based on the findings in this thesis, key policies need to be at the top of all emerging government agendas to solve real estate and other economic problems, such as those discussed in this thesis. The recommendations below address these policies.

Based on the recommendations from the World Bank and the usefulness of indices as explained by Haan and Diewert (2011), it is of the highest priority for all emerging countries to improve their market transparency and to develop their research on real estate to construct commercial and residential indices. Following that, to use those indices in addition to other information to produce useful research that can help policymakers, investors and property owners in their decisions. Also, governments need to consider future research by working on developing the database that will be required in the future. For example, the database should contain details about houses sold, including exact location, number of bedrooms. Data about general economic conditions should be included so that greater transparency will attract local and foreign residents, investors and lenders, which, as a consequence, will contribute to economic performance and solve such issues as housing shortages and affordability. In cases where data are not available or the data to be collected is large, this study highly recommends starting with a selection of cities or the capital city to construct commercial real estate or housing indices. Based on what we found in this study, these indices will be adequate and useful if the adjustment techniques have been adopted appropriately.

By referring to the simplest lesson of investment, countries need to develop alternative sources of income and diversify according to its abilities and needs. Countries like Kuwait have been depending on its natural resources for a long time and should have diversified its income at an early stage. As noted in this thesis, Kuwait faced difficulties when oil prices crashed in 2014, which represented 95% of its income. As of the date of this thesis submission, the Kuwait economy, and the housing sector specifically, continues to suffer from the oil crisis, which might take a long time to recover or continue to have a severe impact on the economy. Therefore, it is highly recommended that countries consider diversifying their income, so they do not become vulnerable to such crisis.

This thesis, noticed the existence of investment speculation in the demand for houses, and noticed the need for funding to meet the development plans in Kuwait and other countries. Therefore, it is highly recommended that primary and secondary markets are developed for the capital market and fixed income. Although stock exchanges do exist, they need to be developed and highly regulated, and be transparent and open to local and foreign investors. Taking Singapore as an example, when they noted the pressure from investors on housing, they introduce the concept of Real Estate Investment Trust (REIT) so that people interested in investing in real estate invest in REITs rather than in housing. This can apply to capital markets and fixed income markets, which would include bonds as well as Sukuk.

Countries seeking international funding and planning major developments must consider developing its internal system and other issues concerning the international capital. Market transparency, market openness, process and speed, fighting corruption, attractiveness and exemption, will significantly improve the flow of overseas capital, which eventually will help the country overcome its main difficulties such as real estate development and housing, in particular.

As of this thesis, Sukuk contracts are not standardized based on certain classifications like bonds; however, each Sukuk issuer has his terms, which might be significantly different than other Sukuk of similar types. Such action from market participants will attract more investors and reduce their due-diligent cost for each Sukuk they intend to buy.

5.2.2 Recommendations to academics and researchers

Further research studying the performance of central tendency indices in comparison to other parametric-based methods for markets with enough data, so the flexibility of adjustments in central tendency indices might show superior performance to parametric-base methods such as hedonic and repeat-sales methods. Stratification adjustments can be considered the best adjustment for improvement of the central tendency methods. Stratification adjustments can expand in many directions and new ways of stratification could open the doors for further improvements to indices. More research on stratification techniques is highly recommended, not only for emerging countries but also for developed countries with enough data that would provide worthwhile findings.

There are two points related to this thesis worth further investigation. First, it is of interest to conduct a research that focuses on studying the relationship among Sukuk types. Although such a study will face data limitation challenges, it will provide additional information about the true differences between Sukuk types, if any. Also, this would clarify the market direction of different types of Sukuk and whether all the types will continue to be used or a few types will dominate and be used for all purposes. This might be the case because structuring Sukuk is complicated and costly, yet involves additional risks associated with underlying assets used to complete the transaction. Second, the level of relationship between bonds and Sukuk raise the concern of Sukuk being truly and completely compatible to Islamic law. Some of the share'ah scholars raise this point, so it is worth a focus study evaluation of the practice of Sukuk issuers and whether those huge contract documents are not breaching Islamic law for commercial transactions. Also, such a study would be of great interest if it explores the corporate governance of Sukuk issuers.

References

6.0 References

- Abadie, A., & Gardeazabal, J. (2001). The economic costs of conflict: a case-control study for the Basque country (No. w8478). National Bureau of Economic Research
- Abeysinghe, T., & Gu, J. (2011). Lifetime income and housing affordability in Singapore. Urban Studies, 48(9), 1875-1891.
- Abeysinghe, T., & Gu, J. (2016). Estimating fundamental and affordable housing price trends: a study based on Singapore. Applied Economics, 48(49), 4783-4798.
- Abraham JM, Hendershott PH (1996) Bubbles in metropolitan housing markets. J Hous Res 7:191–207
- Abraham, J.M. and W.S. Schauman (1991), "New Evidence on Home Prices from Freddie Mac Repeat Sales", American Real Estate and Urban Economics Association Journal 19, 333-352.
- Adair, A. S., Berry, J. N., & McGreal, W. S. (1996). Hedonic modelling, housing submarkets and residential valuation. Journal of property Research, 13(1), 67-83.
- Adams, Z., & Fuss, R. (2010). Macroeconomic Determinants of International Housing Markets. Journal Of Housing Economics, 19(1), 38-50. doi:http://dx.doi.org/10.1016/j.jhe.2009.10.005
- Aizcorbe, A., (2014).A Practical Guide to Price Index and Hedonic Techniques. Oxford, United Kingdom. Oxford University
- Al Nasser, O.M., (2007). The Determinants of the U.S. Foreign Direct Investment: Does The Region Matter? Global Econ. Rev. 36 (1), 37-51.
- Alam, N., Hassan, M. and Haque, M. (2013). Are Islamic bonds different from conventional bonds? International evidence from capital market tests. Borsa _Istanbul Review 13 (2013) 22-29
- Al-Marwani, H. A. (2014). An approach to modeling and forecasting real estate residential property market (Doctoral dissertation).
- Alsharairi, M., & Abubaker, W. E. (2016). Does Arab spring have a spillover effect on Dubai financial market?. The Journal of Developing Areas, 50(6), 319-331.
- Altman, E. I., & Eberhart, A. C. (1994). Do seniority provisions protect bondholders' investments?. The Journal of Portfolio Management, 20(4), 67-75
- Anaman, K. A. (2006). Determinants of Economic Growth in Ghana (No. 14). Institute of Economic Affairs.

- Ang, A. and Piazzesi, M. (2003) A no-arbitrage vectorautoregression of term structure dynamics with macroeconomic and latent variables, Journal of Monetary Economic, 50, 745–87.
- Anundsen, A. K., & Jansen, E. S. (2013). Self-Reinforcing Effects between Housing Prices and Credit. Journal Of Housing Economics, 22(3), 192-212. doi:http://dx.doi.org/10.1016/j.jhe.2013.07.001
- Anyanwu, J and Erhijakpor A, (2004). Trends and Determinants of Foreign Direct Investment in Africa. Eest African Journal of Monetary and Economic Integration, Second Half, 21-44
- Archer, S. (2015). Design, Implementation and Risk Aspects of Islamic Financial Products and Services -Lecture, University of Reading, Reading, UK.
- Ariff, M. and Safari, M. (2012). Are Sukuk Securities the same as conventional Bonds? Afro Eurasian Studies, Vol. 1, Issue 1, Spring 2012, 101-125 Afro Eurasian Studies, Vol. 1, Issue 1, Spring 2012, 101-125
- Ariff, M., Safari, M. and Mohamed S. (2013). Sukuk Securities and Conventional Bonds: Evidence of Significant Differences. Pertanika J. Soc. Sci. & Hum. 21 (2): 621 - 638 (2013)
- Ascheberg, M., Jarrow, R. A., Kraft, H., & Yildirim, Y. (2014). Government Policies, Residential Mortgage Defaults and the Boom and Bust Cycle of Housing Prices. Real Estate Economics, 42(3), 627-661.
- Ashhari, Z., Chun, L. and Nassir, A. (2009). Conventional vs Islamic Bond Announcements: The Effects on Shareholders' Wealth. International journal of Business and Management. Vol 4, No.6
- Assil, E. M. (2012). Constructing a real estate price index: the Moroccan experience. IFC Bulletin, 28, 134.
- Baharoglu, D., Peltier, N., & Buckley, R. (2005). The Macroeconomic and Sectoral Performance of Housing Supply Policies in Selected MENA Countries: A Comparative Analysis. Washington, DC: World Bank
- Bailey, M. J., Muth, R. F., & Nourse, H. O. (1963). A regression method for real estate price index construction. Journal of the American Statistical Association, 58(304), 933-942.

- Bali, G., & Skinner, F. S. (2006). The original maturity of corporate bonds: The influence of credit rating, asset maturity, security, and macroeconomic conditions. Financial Review, 41(2), 187-203
- Ball, M., Meen, G., & Nygaard, C. (2010). Housing supply price elasticities revisited: Evidence from international, national, local and company data. Journal of Housing Economics, 19(4), 255-268.
- Bauwens, L., Laurent, S., & Rombouts, J. K. (2006). Multivariate GARCH models: a survey. Journal Of Applied Econometrics, 21(1), 79-109.
- Beidas-Strom, S., Lian, W., & Maseeh, A. (2009). The Housing Cycle in Emerging Middle Eastern Economies and its Macroeconomic Implications. IMF Working Paper 09/288
- Belej, M., & Cellmer, R. (2014). The effect of macroeconomic factors on changes in real estate prices-response and interaction. Acta Scientiarum Polonorum. Oeconomia, 13(2).
- Bełej, M., & Cellmer, R. (2014). THE EFFECT OF MACROECONOMIC FACTORS ON CHANGES IN REAL ESTATE PRICES -- RESPONSE AND INTERACTION. Acta Scientiarum Polonorum. Oeconomia, 5-16.
- Bełej, M., & Kulesza, S. (2014). The Influence Of Financing On The Dynamics Of Housing Prices. Folia Oeconomica Stetinensia, 14(2), 101-113.
- Bin Naje, H. (2015) . Deputy General Manager at KBC.Personal Interview.
- Boamah, N. A. (2010). Housing affordability in Ghana: a focus on Kumasi and Tamale. Ethiopian Journal of Environmental Studies and Management, 3(3).
- Bollerslev, T. (1986) Generalized autoregressive conditional heteroscedasticity, Journal of Econometrics, 31,307–27.
- Bond, M.T. and Seiler, M.J. (1998). Real Estate Returns and Inflation: An added Variable Approach, The Journal of Real Estate Research, 15, 327-338.
- Boudreault, M., & Panneton, C. (2009). Multivariate Models of Equity Returns for Investment Guarantees Valuation. North American Actuarial Journal, 13(1), 36-53.
- Bracke, P. (2013). How long do housing cycles last? A duration analysis for 19 OECD countries. Journal of Housing Economics, 22(3), 213-230.
- Brissimis, S. N., & Vlassopoulos, T. (2009). The Interaction between Mortgage Financing and Housing Prices in Greece. Journal Of Real Estate Finance & Economics, 39(2), 146-164. doi:10.1007/s11146-008-9109-3

- Brooks, C. and Tsolacos, S. (2010). Real Estate Modeling and Forecasting. Cambridge, United Kingdom. University of Cambridge.
- Bunda, I., Hamann, A. J., & Lall, S. (2009). Correlations in Emerging Market Bonds: The Role of Local and Global Factors. Emerging Markets Review, 10(2), 67-96. doi:http://dx.doi.org/10.1016/j.ememar.2009.02.003
- Busse, M., & Hefeker, C. (2007). Political Risk, Institutions and Foreign Direct Investment. European Journal Of Political Economy, 23(2), 397-415.
- Cakir, S. and Raei, F. (2007). Sukuk vs. Eurobonds: Is There a Difference in Value-at-Risk? Vol., pp. 1-20, 2007.
- Caldera, A., & Johansson, A. (2013). The Price Responsiveness of Housing Supply in OECD Countries. Journal Of Housing Economics, 22(3), 231-249. doi:http://dx.doi.org/10.1016/j.jhe.2013.05.002
- Cannaday, R. E., Munneke, H. J., & Yang, T. T. (2005). A multivariate repeat-sales model for estimating house price indices. Journal of Urban Economics, 57(2), 320-342.
- Cao, j. A., & Keivani, R. (2014). The Limits and Potentials of the Housing Market Enabling Paradigm: An Evaluation of China's Housing Policies from 1998 to 2011. Housing Studies, 29(1), 44-68. doi:10.1080/02673037.2013.818619
- Case K, Shiller R (2003) Is there a bubble in the housing market? Brookings PapEcon Act 2:299–342
- Case, B., & Quigley, J. M. (1991). The dynamics of real estate prices. The Review of Economics and Statistics, 50-58.
- Case, B., Yang, Y., & Yildirim, Y. (2012). Dynamic correlations among asset classes: REIT and stock returns. The Journal of Real Estate Finance and Economics, 44(3), 298–318.
- Case, K.E. and R. J. Shiller (1989), “The Efficiency of the Market for Single-family Homes”, The American Economic Review, 79 (1), 125-137.
- Case, K.E. and Shiller, R.J. (1990). Forecasting Prices and Excess Returns in the Housing Market, American Real Estate and Urban Economics Association Journal,18, 3, 253–273.
- Chan, Y. C., & Wei, K. J. (1996). Political risk and stock price volatility: the case of Hong Kong. Pacific-Basin Finance Journal, 4(2), 259-275.

- Chau, K. (1997). Political uncertainty and the real estate risk premiums in Hong Kong. Journal of Real Estate Research, 13(3), 297-315.
- Chau, K. W., Wong, S. K., & Yiu, C. Y. (2005). Adjusting for non-linear age effects in the repeat sales index. The Journal of Real Estate Finance and Economics, 31(2), 137-153.
- Cheshire, P (2014) 'Turning Houses into Gold: The Failure of British Planning', CentrePiece 19:1 (http://cep.lse.ac.uk/pubs/download/cp421.pdf).
- Cheshire, P, M Nathan and H Overman (2014) Urban Economics and Urban Policy: Challenging Conventional Policy Wisdom, Edward Elgar.
- Chong, J., Krystalogianni, A., & Stevenson, S. (2012). Dynamic correlations between REIT sub-sectors and the implications for diversification. Applied Financial Economics, 22(13), 1089-1109. doi:10.1080/09603107.2011.639735
- Chong, J., Miffre, J., & Stevenson, S. (2009). Conditional correlations and real estate investment trusts. Journal of Real Estate Portfolio Management, 15(2), 173–184.
- Choudhury, A. (2014). Lead-lag association of mortgage rate with housing price. Journal Of Economics & Economic Education Research, 15(1), 103-114.
- Chu, Y. (2014). Credit Constraints, Inelastic Supply, and the Housing Boom. Review Of Economic Dynamics, 17(1), 52-69. doi:http://dx.doi.org/10.1016/j.red.2013.06.001
- Clapp, J. M., & Giaccotto, C. (1998). Price indices based on the hedonic repeat-sales method: application to the housing market. The Journal of Real Estate Finance and Economics, 16(1), 5-26.
- Clapp, J. M., Giaccotto, C., & Tirtiroglu, D. (1991). Housing price indices based on all transactions compared to repeat subsamples. Real Estate Economics, 19(3), 270-285
- Clare, A., O'Brien, R. and Smith, P. N. (1996) Global macroeconomics shocks, time-varying covariances and tests of the international CAPM, Applied Economics Letters, 3, 109–13.
- Clayton, J. and MacKinnon, G. (2001) The time-varying nature of the link between REIT, real estate and financial returns, Journal of Real Estate Portfolio Management, 7, 43–54.
- Coleman, D. (2013). Foreign Investment Climate. Kuwait Country Review, 81-84.

- Congressional Budget Office (2007), “Housing Wealth and Consumer Spending”, Background paper, January. Available at http://www.cbo.gov
- Cotter, J., & Stevenson, S. (2006). Multivariate Modeling of Daily REIT Volatility. Journal Of Real Estate Finance & Economics, 32(3), 305-325. doi:10.1007/s11146-006-6804-9
- Cotter, J., & Stevenson, S. (2008). Modeling Long Memory in REITs. Real Estate Economics,36(3), 533-554. doi:10.1111/j.1540-6229.2008.00221.
- Coulson, N. E., & Kim, M. S. (2000). Residential investment, non-residential investment and GDP. Real Estate Economics, 28(2), 233-247.
- Country Conditions. (2012). Political Risk Yearbook: Kuwait Country Report, 1-18.
- Crone, T. M., & Voith, R. P. (1992). Estimating house price appreciation: a comparison of methods. Journal of Housing Economics, 2(4), 324-338.
- Davidoff, T. (2013). Supply Elasticity and the Housing Cycle of the 2000s.Real Estate Economics, 41(4), 793-813. doi:10.1111/1540-6229.12019
- Davis, M. A., & Heathcote, J. (2007). The price and quantity of residential land in the United States. Journal of Monetary Economics, 54(8), 2595-2620
- Davis, M. A., & Palumbo, M. (2006). The price of residential land in large US cities
- Diewert, W. E. (2010). Alternative approaches to measuring house price inflation. WP, University of of British Columbia.
- Diewert, W.E. (1998), “High Inflation, Seasonal Commodities and Annual Index Numbers”, Macroeconomic Dynamics 2, 456-471.
- Dombrow, J., Knight, J. R., & Sirmans, C. F. (1997). Aggregation bias in repeat-sales indices. The Journal of Real Estate Finance and Economics, 14(1-2), 75-88.
- Draper, N. and Smith, H. (1998). Applied Regression Analysis. Hoboken, New Jersey. John Wiley & Sons, Inc.
- Du, H., Ma, Y., & An, Y. (2011). The impact of land policy on the relation between housing and land prices: Evidence from China. The Quarterly Review of Economics and Finance, 51(1), 19-27.
- Engle, R. (1982), Autoregressive conditional heteroskedasticity with estimates of the variance of U.K. inflation, Econometrica 50, 987-1008.
- Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. Journal of Business & Economic Statistics, 20(3), 339–350.

- Engle, R. (2004). Risk and volatility: Econometric models and financial practice. The American Economic Review, 94(3), 405–420.
- Engle, R. F., & Kroner, K. F. (1995). Multivariate simultaneous generalized ARCH. Econometric Theory, 11(1), 122–150.
- Erb, C., Harvey, C. and Viskanta, T. (1994). Forecasting International Equity Correlations. Financial Analysts Journal / November-December 1994
- Ernst and Young, (2013). Engaging the private sector. The growing crisis of affordable housing in MENA. Ernst and Young
- Escobari, D., Damianov, D., & Bello, A. (2015). A time series test to identify housing bubbles. Journal Of Economics & Finance, 39(1), 136-152. doi:10.1007/s12197-013-9251-5
- Euroweek, (2004). Dubai sells record $1bn 5yr sukuk, Pakistan to follow. Euroweek, (878), 24.
- Euroweek, (2006). DP World's Nakheel storms markets with $3.5bn sukuk CB. Euroweek (982), 19.
- Euroweek, (2013). Hard work pays off for SEC in landmark 30yr sukuk. Euroweek, (1298), 5.
- Fathurahman, H. and Fitriati, R. (2013). Comparative Analysis of Return on Sukuk and Conventional Bonds. American Journal of Economics 2013, 3(3): 159-163
- Feng, Y. (1997). Democracy, political stability and economic growth. British Journal of Political Science, 27(3), 391-418.
- Filardo, A.J.(2000). Monetary Policy and Asset Prices, Economic Review, Third Quarter, 12 – 37.
- Fingleton, B. (2008). Housing supply, housing demand, and affordability. Urban Studies, 45(8), 1545-1563.
- Fisher, I. (1922). The Making of Index Numbers. A Study of Their Varieties, Tests, and Reliability. Boston and New York: Houghton Mifflin Company.
- Fletcher, M., Gallimore, P., & Mangan, J. (2000a). Heteroscedasticity in hedonic house price models. Journal of Property Research, 17(2), 93-108.
- Fletcher, M., Gallimore, P., & Mangan, J. (2000b). The modelling of housing submarkets. Journal of Property Investment & Finance, 18(4), 473-487.
- Forbes, K. J., & Rigobon, R. (2002). No contagion, only interdependence: measuring stock market comovements. The Journal of Finance, 57(5), 2223–2261.

- Forbes, K. J., & Rigobon, R. (2002). No contagion, only interdependence: measuring stock market comovements. The journal of Finance, 57(5), 2223-2261
- Fridson, M. S., & Garman, M. C. (1997). Valuing like-rated senior and subordinated debt. Journal of Fixed Income, 7(3), 83-93
- General Secretariat of the Supreme Council for Planning and Development, (2011). Following up report Development Plan 2010-2011/2013-2014 and Yearly Plan 2010/2011 Kuwait (Arabic Version).
- Glaeser, E. L., Gyourko, J., & Saiz, A. (2008). Housing supply and housing bubbles (No. w14193). National Bureau of Economic Research
- Glascock, J., Lu, C. and So, R. (2000) Further evidence on the integration of REIT, bond, and stock returns, Journal of Real Estate Finance and Economics, 20, 1–9.
- Godlewski, C. J., Turk-Ariss, R., & Weill, L. (2013). Sukuk vs. conventional bonds: A stock market perspective. Journal Of Comparative Economics, 41(3), 745-761.
- Godlewski, C. J., Turk-Ariss, R., & Weill, L. (2014). Do the type of sukuk and choice of shari'a scholar matter?. BOFIT Discussion Papers, (21), 1-4.
- Goodhart, C. (2001). What Weight Should be Given to Asset Prices in the Measurement of Inflation, The Economic Journal, 111, 472, 335-356.
- Goodhart, C. and B. Hofmann (2007), “Financial Conditions Indices,” in House Prices and the Macroeconomy: Implications for Banking and Price Stability, Charles Goodhart (ed.), Oxford: Oxford University Press.
- Goodman, A. C., & Thibodeau, T. G. (1995). Age-related heteroskedasticity in hedonic house price equations. Journal of Housing Research, 25-42.
- Goodman, A. C., & Thibodeau, T. G. (1997). Dwelling-age-related heteroskedasticity in hedonic house price equations: An extension. Journal of Housing Research, 299-317.
- Goodman, A. C., & Thibodeau, T. G. (1998). Dwelling age heteroskedasticity in repeat sales house price equations. Real Estate Economics, 26(1), 151-171.
- Gopalan, K., & Venkataraman, M. (2015). Affordable housing: Policy and practice in India. IIMB Management Review, 27(2), 129-140
- Granger C. W. J. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. Econometrica, 37(3), 424-438.

- Grosse, R., & Trevino, L. J. (2005). New Institutional Economics and FDI Location in Central and Eastern Europe. Management International Review (MIR), 45(2), 123-145.
- Gurran, N., & Phibbs, P. (2013). Housing supply and urban planning reform: the recent Australian experience, 2003–2012. International Journal Of Housing Policy, 13(4), 381-407. doi:10.1080/14616718.2013.840110
- Haan, J. D., & Diewert, W. E. (2011). Handbook on Residential Property Price Indices. Tech. rep.
- Habib, M. M., & Zurawicki, L. L. (2001). Country-level investments and the effect of corruption--some empirical evidence. International Business Review, 10(6), 687.
- Hansen J (2006), 'Australian house prices: a comparison of hedonic and repeat-sales measures', Reserve Bank of Australia Research Discussion Paper No 2006-03.
- Hartwich, O. (2017). 13th annual Demographia International Housing Affordability Survey: 2017. Demographia. Retrivied on September 2017 from: http://www.demographia.com/dhi.pdf
- Hashim, Z. A. (2010). House price and affordability in housing in Malaysia. Akademika, 78(2010), 37-46.
- Hayakawa, K., Kimura, F., & Lee, H. (2013). How Does Country Risk Matter for Foreign Direct Investment?.Developing Economies, 51(1), 60-78.
- Heinke, V. G. (2006). Credit spread volatility, bond ratings and the risk reduction effect of watchlistings. International Journal of Finance & Economics, 11(4), 293-303.
- Hiang Liow, K. (2012). Co-movements and Correlations Across Asian Securitized Real Estate and Stock Markets. Real Estate Economics, 40(1), 97-129. doi:10.1111/j.1540-6229.2011.00314.x
- Hilber, C. A. (2015). UK Housing and Planning Policies: the evidence from economic research.
- Hilber, CAL and W Vermeulen (2010) 'The Impacts of Restricting Housing Supply on House Prices and Affordability – Final Report', London: Department for Communities and Local Government.
- Hill, T.P. (1988), "Recent Developments in Index Number Theory and Practice", OECD Economic Studies 10, 123-148.
- Hill, T.P. (1993), "Price and Volume Measures", pp. 379-406 in SNA (1993).

- Himmelberg C, Mayer C, Sinai T (2005) Assessing high house prices: bubbles, fundamentals, and misperceptions. J Econ Perspect 19:67–92
- HM revenue & customs, (2016). Capital Gains Tax for non-residents: UK residential property. UK. retrieved from https://www.gov.uk/guidance/capital-gains-tax-for-non-residents-uk-residential-property
- Hunter, D. M., & Simon, D. P. (2005). A Conditional Assessment of the Relationships between the Major World Bond Markets. European Financial Management, 11(4), 463-482. doi:10.1111/j.1354-7798.2005.00293.x
- Hwang, M. and J.M. Quigley (2004), "Selectivity, Quality Adjustment and Mean Reversion in the Measurement of House Values", Journal of Real Estate and Finance and Economics 28(2/3), 161-178.
- Hwang, S., Park, M., Lee, H. S., Yoon, Y., & Son, B. S. (2010). Korea n real estate market and boosting policies: Focusing on mortgage loans. International Journal of Strategic Property Management, 14(2), 157-172.
- Iacovello M., Minetti R.,(2003). Financial Liberalization and the Sensitivity of House Prices to Monetary Policy: Theory and Evidence. The Manchester School 71, 1, 20–34.
- Ihlanfeldt, K., & Mayock, T. (2014). Housing bubbles and busts: the role of supply elasticity. Land Economics, 90(1), 79-99.
- İkizlerli, D., & Ülkü, N. (2012). Political Risk and Foreigners' Trading: Evidence from an Emerging Stock Market.Emerging Markets Finance & Trade, 48(3), 106-121.
- ILO, IMF, OECD, Eurostat, United Nations, World Bank (2004), Consumer Price Index Manual: Theory and Practice, Geneva.
- Ivancic, L., Diewert, W. E., & Fox, K. J. (2011). Scanner data, time aggregation and the construction of price indexes. Journal of Econometrics, 161(1), 24-35
- Jiang, L., Phillips, P. C., & Yu, J. (2015). New methodology for constructing real estate price indices applied to the Singapore residential market. Journal of Banking & Finance, 61, S121-S131.
- JLL, (2015). Why Middle-Income Housing MattersMiddle-Income Housing in the Middle East and North Africa – Progress & Priorities. JLL MENA
- Jong-A-Pin, R. (2009). On the measurement of political instability and its impact on economic growth. European Journal of Political Economy, 25(1), 15-29.

- Karpoff, J.M. (1987), ‘The relations between price changes and trading volume: A survey’, Journal of Financial and Quantitative Analysis, Vol. 22, pp. 109-126.
- Kasparova D., White M., (2001). The Responsiveness of House Prices to Macroeconomic Forces: a Cross-Country Comparison. European Journal of Housing Policy 1, 3, 385–416.
- Kavussanos, M. G., Marcoulis, S. N. and Arkoulis, A. G. (2002) Macroeconomic factors and international industry returns, Applied Financial Economics, 12, 923–31.
- Kenny, G. (1999). Modeling the Demand and Supply Sides of the Housing Market: Evidence from Ireland, Economic Modeling, 16, 3, 389-409.
- Khan, M. M., & Akbar, M. (2013). The Impact of Political Risk on Foreign Direct Investment. International Journal Of Economics & Finance, 5(8), 147-156.
- Kim, K. H., & Cho, M. (2010). Structural changes, housing price dynamics and housing affordability in Korea. Housing Studies, 25(6), 839-856.
- Kiyotaki, N., Michaelides, A., & Nikolov, K. (2011). Winners and losers in housing markets. Journal of Money, Credit and Banking, 43(2-3), 255-296
- KPMG, (2014) Decoding housing for all by 2022. KPMG-India
- Kuang, W., & Liu, P. (2015). Inflation and house prices: theory and evidence from 35 major cities in China. International Real Estate Review, 18(2), 217-240.
- Kupke, V., & Rossini, P. (2011). Housing affordability in Australia for first home buyers on moderate incomes. Property management, 29(4), 357-370.
- Kuwait Credit Bank, (2015). property of mortgages . Retrieved on 15/11/2015 from: http://www.kcb.gov.kw/sites/Arabic/Pages/LoanTypes.aspx
- Kuwait Finance House, (2015). Department of housing mortgage.
- La Grange, A., & Pretorius, F. (2002). Private Rental Housing in Hong Kong. Housing Studies, 17(5), 721-740. doi:10.1080/0267303022000009772
- Laspeyres, K. (1871). IX. Die Berechnung einer mittleren Waarenpreissteigerung. Jahrbücher für Nationalökonomie und Statistik, 16(1), 296-318.
- Leung, C. (2004). Macroeconomics and housing: a review of the literature. Journal of Housing Economics, 13(4), 249-267.
- lhlanfeldt, K., & Mayock, T. (2014). Housing Bubbles and Busts: The Role of Supply Elasticity. Land Economics, 90(1), 79-99.

- Li Y, Wang K (1995) The predictability of REIT returns and market segmentation. J Real Estate Res 10:471–482
- Li, L. F. (2002) Macroeconomic factors and the correlation of stock and bond returns, Yale ICF Working Paper.
- Lin, C. L., Wang, M. C., & Gau, Y. F. (2007). Expected risk and excess returns predictability in emerging bond markets. Applied Economics, 39(12), 1511-1529
- Longin, F. and Solnik, B. (1993). "Is the Correlation in International Equity Returns Constant: 1960-1990?" Groupe HEC.
- Mahama, C., & Antwi, A. (2006). Land and property markets in Ghana. In World Urban Forum.
- Mallick, H., & Mahalik, M. K. (2015). Factors determining regional housing prices: evidence from major cities in India. Journal of Property Research, 32(2), 123-146.
- Malpezzi, S. (1999). A simple error correction model of house prices. Journal of housing economics, 8(1), 27-62.
- Mankiw, N. G., & Weil, D. N. (1989). The baby boom, the baby bust, and the housing market. Regional science and urban economics, 19(2), 235-258.
- Mapa, D. S., (2014). Error Correction Model (ECM) and Vector AutoRegressiveModel (VAR). [PowerPoint slides]. Retrieved on September 2014 from http://www.upecon.org.ph/epdp/wp-content/uploads/2016/07/ECM.pdf
- Mark, J. H., & Goldberg, M. A. (1984). Alternative housing price indices: an evaluation. Real Estate Economics, 12(1), 30-49.
- Mark, J. H., & Goldberg, M. A. (1984). Alternative housing price indices: an evaluation. Real Estate Economics, 12(1), 30-49
- McDonnell, T. (2018) What's the World's Fastest-Growing Economy? Ghana Contends for the Crown. The New York Times-Africa. Retrieved on 1-7-2018 from: https://www.nytimes.com/2018/03/10/world/africa/ghana-worlds-fastest-growing-economy.html
- McGibany, J. M., & Nourzad, F. (2004). Do lower mortgage rates mean higher housing prices?. Applied Economics, 36(4), 305-313. doi:10.1080/0003684041000167423
- McLaren, J., Yeo, A., & Sweet, M. (2016). Australia is facing a housing affordability crisis: Is the solution to this problem the Singapore model of housing?. Australasian Accounting Business & Finance Journal, 10(4), 38.

- McMillen, D. P., & Thorsnes, P. (2006). Housing Renovations and the Quantile Repeat-Sales Price Index. Real Estate Economics, 34(4), 567-584.
- MEED, (2003). Emaar gears up for sukuk. Middle East Economic Digest, 47(44), 27.
- MEED, (2003). Government to issue debut leasing sukuk. Middle East Economic Digest, 47(37), 9.
- MEED, (2004). Roadshows launched for Durrat sukuk. Middle East Economic Digest, 48(39), 22.
- MEED, (2007). Dana Gas appoints banks for $1bn sukuk: Middle East Economic Digest, 51(27), 29.
- MEED, (2007). Dar al-Arkan Sukuk closes massively oversubscribed: Middle East Economic Digest, 51(10), 35.
- Meen, G. (2011). A long-run model of housing affordability. Housing Studies, 26(7-8), 1081-1103
- Meese R, Wallace N (1994) Testing the present value relation for housing prices: should I leave my house in San Francisco? J Urban Econ 35:245–266
- MIFC, (2014). 2014 - A landmark year for global Islamic Finance industry. Malaysia.
- Mikhed, V., & Zemčík, P. (2009). Testing for Bubbles in Housing Markets: A Panel Data Approach. Journal Of Real Estate Finance & Economics, 38(4), 366-386. doi:10.1007/s11146-007-9090-2
- Ministerial reshuffles, (2013). Council of Ministers General Secretariat. Retrieved on 15/08/2016 from: http://www.cmgs.gov.kw/netahtml/main.htm?frame_page
- Ministry of Housing (2017). Ministry of housing releasing 280 thousand housing unit and financing products all over KSA. Eskan magazine Volume (1) page (6)
- Minović, J. (2007). Application of multivariate GARCH models in Serbian financial market analysis. In International Scientific Conference, Economic Faculty, Belgrade, Serbia
- Minović, J. Z. (2009). Modeling Multivariate Volatility Processes: Theory and Evidence. Theoretical & Applied Economics, 16(5), 21-44.
- Mints, V. (2007). The mortgage rate and housing bubbles. Housing Finance International, 21(4), 34.
- Mosaid, F. and Boutti, R. (2014). Sukuk and Bond Performance in Malaysia. International Journal of Economics and Finance; Vol. 6, No. 2; 2014

- Mousavi, M. M., & Ouenniche, J. (2014). The impact of Mena conflicts (the Arab spring) on global financial markets. The Journal of Developing Areas, 48(4), 21-40.
- Nanda, A. (2015). Personal interview
- Nandi, S., & Gamkhar, S. (2013). Urban challenges in India: A review of recent policy measures. Habitat International, 39, 55-61
- Nichols, J. B., Oliner, S. D., & Mulhall, M. R. (2013). Swings in commercial and residential land prices in the United States. Journal of Urban Economics, 73(1), 57-76
- Nienhaus, V. (2014). The Principles of Islamic Commercial Jurisprudence -Lecture, University of Reading, Reading, UK.
- Nikkinen, J., Omran, M. M., Sahlström, P., & Äijö, J. (2008). Stock returns and volatility following the September 11 attacks: Evidence from 53 equity markets. International Review of Financial Analysis, 17(1), 27-46.
- O'Neill, D., (2011). Fixed income: Aramco issues first greenfield project sukuk. Euromoney. Retrived on March 2015 from : https://www.euromoney.com/article/b12kjc4n461tq1/fixed-income-aramco-issues-first-greenfield-project-sukuk
- Ochieng, D. E., Abdulai, R., Obeng-Odoom, F., & Malienė, V. (2017). Real estate, construction and economic development in emerging market economies.
- Oikarinen, E., Peltola, R., & Valtonen, E. (2015). Regional Variation in the Elasticity of Supply of Housing, and Its Determinants: The Case of a Small Sparsely Populated Country. Regional Science And Urban Economics, 5018-30. doi:http://dx.doi.org/10.1016/j.regsciurbeco.2014.10.004
- Ooi, J. L., & Le, T. T. (2012). New Supply and Price Dynamics in the Singapore Housing Market. Urban Studies, 49(7), 1435-1451.
- Overman, H (2012) 'The UK's Housing Crises', CentrePiece 17:3, (http://cep.lse.ac.uk/pubs/download/cp382.pdf).
- Owusu-Ansah, A. (2014). Measuring and understanding the house price dynamics of the Aberdeen housing market (Doctoral dissertation, Aberdeen University).
- Oxford Business Group, (2018). Egypt looking to meet housing deficit. Oxford Business Group. Retrieved on 1-7-2018 from: https://oxfordbusinessgroup.com/analysis/stand-and-deliver-looking-ways-address-housing-deficit

- Oxford Business Group, (2018). Egyptian government works to address the housing deficit. Oxford Business Group. Retrieved on 1-7-2018 from: https://oxfordbusinessgroup.com/analysis/place-call-home-government-bodies-are-working-mitigate-housing-deficit
- Paasche, H. (1874). Über die Preisentwicklung der letzten Jahre nach den Hamburger Borsennotirungen. Jahrbücher für Nationalökonomie und Statistik, 12, 168-178.
- Paciorek, A. (2013). Supply Constraints and Housing Market Dynamics.Journal Of Urban Economics, 7711-26. doi:http://dx.doi.org/10.1016/j.jue.2013.04.001
- Pagourtzi, E., Assimakopoulos, V., & Litsa, A. (2005). Theta model forecasts of quarterly and monthly dwelling prices in the UK. Briefings in real estate finance, 5(3-4), 75-105.
- Park, S. W., Bahng, D. W., & Park, Y. W. (2010). Price run-up in housing markets, access to bank lending and house prices in Korea. The journal of real estate finance and economics, 40(3), 332-367.
- Peláez R (2012) The housing bubble in real-time: the end of innocence. J Econ Financ 36:211–225
- Phang, S. Y., & Helble, M. (2016). Housing policies in Singapore
- Phang, S. Y., Lee, D., Cheong, A., Phoon, K. F., & Wee, K. (2014). Housing policies in Singapore: Evaluation of recent proposals and recommendations for reform. The Singapore Economic Review, 59(03), 1450025.
- Pink, B. (2009). House Price Indexes: Concepts, Sources and Methods, Australia. Australian Bureau of Statistics Information Paper.
- Poon, J., & Garratt, D. (2012). Evaluating UK housing policies to tackle housing affordability. International Journal of Housing Markets and Analysis, 5(3), 253-271.
- Prasad, N., & Richards, A. (2006). Measuring housing price growth–using stratification to improve median-based measures (No. rdp2006-04). Reserve Bank of Australia.
- Prasad, N., & Richards, A. (2008). Improving median housing price indexes through stratification. Journal of Real Estate Research, 30(1), 45-72
- Public Authority of Housing Welfare regulations, (2015). Public Authority of Housing Welfare- Kuwait. Retrieved on 15/08/2016 from: http://www.housing.gov.kw/PAHW_Laws.aspx

- Pyun, C.S., Lee, S.Y. and Nam, K. (2000), 'Volatility and information flows in emerging equity market – A case of the Korean stock exchange', International Review of Financial Analysis, Vol. 9, pp. 405-420.
- Qiu W. (2011). Housing Price Variation and CPI, Journal of Beijing Technology and Business University, 1, 43-46.
- Rahman, M. M. (2010). The Australian housing market - understanding the causes and effects of rising prices. Policy Studies, 31(5), 577-590. doi:10.1080/01442872.2010.497261
- Rappaport, J. (2007). A guide to aggregate house price measures. Economic Review-Federal Reserve Bank of Kansas City, 92(2), 41.
- Rasameel (2014). Quarterly Global Sukuk Report, 2014(3).
- Real Estate Association, (2015). Private housing murshid 2015. Kuwait
- Real Estate Association. (2013). Recommended strategy for housing in Kuwait: Reality and solutions. Kuwait housing conference, Kuwait 2013.
- Real Estate Association. (2014). Private housing Murshid, Kuwait 2013.
- Reilly, F. K., Wright, D. J., & Gentry, J. A. (2009). Historic Changes in the High Yield Bond Market. Journal Of Applied Corporate Finance, 21(3), 65-79. doi:10.1111/j.1745-6622.2009.00240.
- Reinhart, C.M. and K.S. Rogoff (2009), This Time is Different; Eight Centuries of Financial Folly, Princeton and Oxford: Princeton University Press.
- Ro, S. and Ziobrowski, A. J. (2011) Does focus really matter? Specialized versus diversified REITs, Journal of Real Estate Finance and Economics, 42, 68–83
- Robinson, M., Scobie, G. M., & Hallinan, B. (2006). Affordability of housing: concepts, measurement and evidence. Month, 6(04).
- Sae Woo, P., Doo Woan, B., & Park, Y. W. (2010). Price Run-up in Housing Markets, Access to Bank Lending and House Prices in Korea. Journal Of Real Estate Finance & Economics, 40(3), 332-367. doi:10.1007/s11146-008-9143-1
- Scanlon, K., Lunde, J., & Whitehead, C. (2011). Responding to the Housing and Financial Crises: Mortgage Lending, Mortgage Products and Government Policies.International Journal Of Housing Policy, 11(1), 23-49.
- Schindler, F. (2013). Predictability and Persistence of the Price Movements of the S&P/Case-Shiller House Price Indices. Journal Of Real Estate Finance & Economics, 46(1), 44-90. doi:10.1007/s11146-011-9316-1

- Schneider, G., & Troeger, V. E. (2006). War and the world economy: Stock market reactions to international conflicts. Journal of conflict resolution, 50(5), 623-645.
- Schwert, G. W. (1989). Why Does Stock Market Volatility Change Over Time?. Journal Of Finance, 44(5), 1115-1153.
- Shi, S., Jou, J. B., & Tripe, D. (2014). Can interest rates really control house prices? Effectiveness and implications for macroprudential policy. Journal of Banking & Finance, 47, 15-28.
- Shiratsuka S. (1999). Asset Price Fluctuation and Price Indices, Monetary and Economic Studies, 12, 103-128.
- Silvennoinen, A., & Thorp, S. (2007). Financialization, crisis and commodity correlation dynamics. Journal of International Financial Markets, Institutions & Money. 24 (2013) 42– 65
- Silvennoinen, A., & Thorp, S. (2013). Financialization, crisis and commodity correlation dynamics. Journal Of International Financial Markets, Institutions & Money, 2442-65. doi:10.1016/j.intfin.2012.11.007
- Silverstein, J. M. (2014). House price indexes: Methodology and revisions. Research Rap Special Report, (Jun).
- Sirmans, C. F., & Slade, B. A. (2012). National transaction-based land price indices. The Journal of Real Estate Finance and Economics, 45(4), 829-845
- Sivam, A. (2002). Constraints affecting the efficiency of the urban residential land market in developing countries: a case study of India. Habitat International, 26(4), 523-537
- Sliogeris, E., Crabtree, L., Phibbs, P., Johnston, K., & O'Neill, P. (2008). Housing affordability literature review and affordable housing program audit.
- Spurgin, R., Martin, G., & Schneeweis, T. (2001). A method of estimating changes in correlation between assets and its application to hedge fund investment. Journal Of Asset Management, 1(3), 217.
- Standard & Poor’s, (2013). Ratings Direct. Investor Appetite Is Pushing Sukuk Into The Mainstream. Retrieved on 15/06/2015 from: http://t.co/Zn6xls0k3v
- Steele, M., & Goy, R. (1997). Short holds, the distributions of first and second sales, and bias in the repeat-sales price index. The Journal of Real Estate Finance and Economics, 14(1), 133-154.

- Stevenson, S. (2002). An examination of volatility spillovers in REIT returns. Journal of Real Estate Portfolio Management, 8(3), 229–238.
- Stevenson, S. (2004). New empirical evidence on heteroscedasticity in hedonic housing models. Journal of Housing Economics, 13(2), 136-153.
- Stevenson, S. (2008). Modeling housing market fundamentals: Empirical evidence of extreme market conditions. Real Estate Economics, 36(1), 1-29.
- Stevenson, S., & Young, J. (2014). A Multiple Error-Correction Model of Housing Supply. Housing Studies, 29(3), 362-379.
- Stiglitz JE (1990) Symposium on bubbles. J Econ Perspect 4:13–18
- Stock, J.H. and Watson, M.W. (1999). Forecasting Inflation, Journal of Monetary Economics, 44, 2, 293-335.
- Stone, M. E. (2006). A housing affordability standard for the UK. Housing Studies, 21(4), 453-476.
- Stone, M. E., Burke, T., & Ralston, L. (2011). The residual income approach to housing affordability: the theory and the practice.
- Sungjoo, H., Moonseo, P., Hyun-Soo, L., Yousang, Y., & Bo-Sik, S. (2010). Korean real estate market and boosting policies: Focusing on mortgage loans.International Journal Of Strategic Property Management, 14(2), 157-172. doi:10.3846/ijspm.2010.12
- Taylor, J. B. (2009). The financial crisis and the policy responses: An empirical analysis of what went wrong (No. w14631). National Bureau of Economic Research
- The Heritage foundation, (2016). Economic freedom: Retrieved from: https://www.heritage.org/index/country/kuwait
- The Public Authority for Civil Information, (2015). Kuwait Demographic. Retrieved on 15/11/2015 from: http://publicstat.paci.gov.kw/stat/
- The World Bank (1993) Housing: Enabling Markets to Work. (Washington, D.C.: World Bank).
- The world Bank, (2014). Doing a Business. Retrieved from: http://www.doingbusiness.org/data/exploretopics/starting-a-business
- The World Bank, (2015). Poverty Reduction in Ghana: Progress and Challenges. The World Bank. Retrieved on 1-7-2018 from: http://www.worldbank.org/en/country/ghana/publication/poverty-reduction-ghana-progress-challenges

* The World Bank. (2014). Access to Affordable and Low-Income Housing in East Asia and the Pacific. Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/21100 License: CC BY 3.0 IGO
* Thomson Reuters Zawya (2014). Sukuk Perceptions and Forecast Study 2014, 2014(3).
* Trading Economic, (2018). Egypt - Economic Indicators. Retrieved on 1-7-2018 from: https://tradingeconomics.com/egypt/indicators
* Trading Economic, (2018). Ghana - Economic Indicators. Retrieved on 1-7-2018 from: https://tradingeconomics.com/ghana/indicators
* Trading Economic, (2018). India - Economic Indicators. Retrieved on 1-7-2018 from: https://tradingeconomics.com/India/indicators
* Trading Economic, (2018). Saudi Arabia - Economic Indicators. Retrieved on 1-7-2018 from: https://tradingeconomics.com/saudi-arabia/indicators
* Trading Economics, (2013). Kuwait Credit Rating. Retrieved on 15/08/2016 from: http://www.tradingeconomics.com/kuwait/rating
* Trading Economics, (2015). Kuwait Corruption Rank. Retrieved on 15/11/2015 from: http://www.tradingeconomics.com/kuwait/corruption-rank
* Tsai, I. (2012). Housing Supply, Demand and Price: Construction Cost, Rental Price and House Price Indices. Asian Economic Journal, 26(4), 381-396.
* Tsai, I. (2013). Housing affordability, self-occupancy housing demand and housing price dynamics. Habitat International, 4073-81. doi:10.1016/j.habitatint.2013.02.006
* Tsai, I. (2015). Monetary Policy and Bubbles in the National and Regional UK Housing Markets. Urban Studies, 52(8), 1471-1488.
* Tsai, I.-Chun, and Chien-Wen Peng. (2011). "Bubbles in the Taiwan housing market: The determinants and effects." Habitat International 35, no. 2: 379-390. Business Source Complete, EBSCOhost (accessed November 16, 2015).
* Tsay, R. (2010). Analysis of Financial Time Series. Hoboken, New Jersey. John Wiley & Sons, Inc.
* Usmani, M., (1998). An introduction to Islamic Finance. Cited from www.Muftitaqiusmani.com/en/?page_id=12132
* Virbickaite, A., Ausín, M. C., & Galeano, P. (2015). BAYESIAN INFERENCE METHODS FOR UNIVARIATE AND MULTIVARIATE GARCH MODELS: A SURVEY. Journal Of Economic Surveys, 29(1), 76-96. doi:10.1111/joes.12046

- Vishwanath, S. R., & Azmi, S. (2009). An Overview of Islamic Sukuk Bonds. Journal Of Structured Finance, 14(4), 58-67.
- Voyer, P. A., & Beamish, P. W. (2004). The Effect of Corruption on Japanese Foreign Direct Investment.Journal Of Business Ethics, 50(3), 211-224.
- Wallace, N. E., & Meese, R. A. (1997). The construction of residential housing price indices: a comparison of repeat-sales, hedonic-regression, and hybrid approaches. The Journal of Real Estate Finance and Economics, 14(1-2), 51-73.
- Wang, K., Erickson, J., & Chan, S. (1995). Does the REIT stock market resemble the general stock market?. Journal of Real Estate Research, 10(4), 445-460
- Wang, S., Chan, S. H., & Xu, B. (2012). The Estimation and Determinants of the Price Elasticity of Housing Supply: Evidence from China. Journal Of Real Estate Research, 34(3), 311-344.
- Watkins, S. (2011). Sukuk success. Financial Management (14719185), 32-34.
- Wei, S. (2000). Local Corruption and Global Capital Flows. Brookings Papers On Economic Activity, (2), 303.
- Weida, K., & Peng, L. (2015). Inflation and House Prices: Theory and Evidence from 35 Major Cities in China. International Real Estate Review, 18(2), 217-240.
- Wenzlick, R. (1952). As I see the fluctuations in the selling prices of single family residences. The Real Estate Analyst, 21, 541-548.
- Wheaton, W. C., & Nechayev, G. (2008). The 1998-2005 Housing "Bubble" and the Current "Correction": What's Different This Time?. Journal Of Real Estate Research, 30(1), 1-26.
- Wilcox, S., Perry, J. Stephens, M. & Williams, P. (2016). UK housing review. Coventry: Chartered Institute of Housing.
- Williams J. B. (1938). The Theory of Investment Value. Cambridge, MA: Harvard University Press.
- Wilson, J. H. and Keating B. (2009). Business Forecasting with Forecastx. Location. McGraw-Hill, 2009.
- Wood, R. (2005). A comparison of UK residential house price indices. BIS papers, 21(16), 212-227.
- Worthington, A. C. (2012). The quarter century record on housing affordability, affordability drivers, and government policy responses in Australia. International Journal of Housing Markets and Analysis, 5(3), 235-252.

- Wu, J., Deng, Y., & Liu, H. (2014). House price index construction in the nascent housing market: The case of China. The Journal of Real Estate Finance and Economics, 48(3), 522-545.
- Wu, T. (2003) Stylized facts on nominal term structure and business cycles: an empirical VAR study, Applied Economics, 35, 901–6.
- Wyngarden, H. (1927). An Index of Local Real Estate Prices. University of Michigan, School of business administration, Bureau of business research.
- Yan, S., Ge, X. J., & Wu, Q. (2014). Government intervention in land market and its impacts on land supply and new housing supply: Evidence from major Chinese markets. Habitat International, 44, 517-527.
- Yates, J., & Berry, M. (2011). Housing and Mortgage Markets in Turbulent Times: Is Australia Different?. Housing Studies, 26(7-8), 1133-1156.
- Yuen, B., KWEE, L. K., & Tu, Y. (2006). Housing affordability in Singapore: can we move from public to private housing?. Urban Policy and Research, 24(2), 253-270.
- Zhang, C., Jia, S., & Yang, R. (2016). Housing affordability and housing vacancy in China: The role of income inequality. Journal of Housing Economics, 33, 4-14.

Appendices

First Paper Appendices

7.1 Appendices for the first paper

7.1.1 Descriptive statistics

Table 15: Descriptive statistics for Alasima district (part 1 of 3)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Abdullah Alsalem	Average	770	743,577	1,062	Average	883	957,994	1,080
	minimum	375	195,000	206	minimum	226	128,000	260
	Maximum	2,000	2,700,000	2,400	Maximum	2,000	2,725,000	2,725
	Standard Deviation	436	502,098	493	Standard Deviation	255	467,029	431
	No. Transactions		43		No. Transactions		209	
	Stock				1,157			
Aldaeya	Average	644	359,204	613	Average	666	466,829	695
	minimum	375	160,000	167	minimum	267	110,000	167
	Maximum	1,500	1,050,000	1,128	Maximum	1,500	2,000,000	1,600
	Standard Deviation	310	199,615	278	Standard Deviation	293	350,106	335
	No. Transactions		26		No. Transactions		139	
	Stock				818			
aldasma	Average	504	345,762	674	Average	442	288,066	669
	minimum	250	145,000	320	minimum	238	80,000	164
	Maximum	1,000	1,050,000	1,067	Maximum	1,000	1,100,000	1,700
	Standard Deviation	222	226,503	229	Standard Deviation	179	165,583	299
	No. Transactions		22		No. Transactions		171	
	Stock				1,027			
Aldoha	Average	N/A	N/A	N/A	Average	358	141,141	394
	minimum	N/A	N/A	N/A	minimum	357	40,000	112
	Maximum	N/A	N/A	N/A	Maximum	376	329,000	920
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	2	59,132	165
	No. Transactions		5		No. Transactions		180	
	Stock				1,439			
Alfaiha	Average	550	398,357	725	Average	501	410,115	822
	minimum	375	84,372	169	minimum	203	58,929	157
	Maximum	1,000	1,175,000	1,358	Maximum	1,000	1,325,000	2,400
	Standard Deviation	219	249,646	328	Standard Deviation	145	208,880	353
	No. Transactions		41		No. Transactions		230	
	Stock				1,042			
Alkhaldiya	Average	715	606,077	865	Average	881	630,521	748
	minimum	375	195,000	260	minimum	363	100,000	101
	Maximum	1,023	1,300,000	1,313	Maximum	2,089	1,550,000	1,850
	Standard Deviation	238	265,140	270	Standard Deviation	273	302,681	350
	No. Transactions		43		No. Transactions		188	
	Stock				809			

7.1.1 Descriptive statistics (continues)

Table 15: Descriptive statistics for Alasima district (part 2 of 3)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Almansoreya	Average	N/A	N/A	N/A	Average	841	605,163	714
	minimum	N/A	N/A	N/A	minimum	375	197,000	245
	Maximum	N/A	N/A	N/A	Maximum	1,500	1,550,000	1,333
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	214	297,254	262
	No. Transactions		7		No. Transactions		64	
	Stock				406			
Alnozha	Average	693	580,423	890	Average	803	715,842	885
	minimum	375	165,000	209	minimum	250	100,000	133
	Maximum	1,000	1,350,000	1,800	Maximum	1,000	1,950,000	2,233
	Standard Deviation	269	336,734	471	Standard Deviation	165	372,718	395
	No. Transactions		20		No. Transactions		145	
	Stock				775			
Alodailiya	Average	684	518,993	803	Average	825	563,861	709
	minimum	363	210,000	320	minimum	231	100,000	100
	Maximum	1,000	1,050,000	1,714	Maximum	1,500	1,500,000	2,128
	Standard Deviation	245	202,742	309	Standard Deviation	221	256,320	320
	No. Transactions		42		No. Transactions		199	
	Stock				882			
Alqadeseya	Average	586	387,675	673	Average	557	381,368	691
	minimum	375	155,000	211	minimum	363	50,000	125
	Maximum	1,000	850,000	1,627	Maximum	2,000	1,480,000	1,867
	Standard Deviation	216	186,104	252	Standard Deviation	216	211,489	295
	No. Transactions		40		No. Transactions		258	
	Stock				1,103			
Alrawda	Average	487	358,025	761	Average	681	440,438	669
	minimum	375	145,000	333	minimum	250	92,972	143
	Maximum	750	970,000	1,493	Maximum	1,000	1,500,000	2,500
	Standard Deviation	148	160,209	326	Standard Deviation	192	233,276	328
	No. Transactions		81		No. Transactions		312	
	Stock				1,633			
Alshamiya	Average	598	702,387	1,118	Average	520	485,671	892
	minimum	251	160,000	353	minimum	238	75,000	133
	Maximum	1,500	3,000,000	2,000	Maximum	1,500	3,250,000	2,250
	Standard Deviation	295	649,038	532	Standard Deviation	280	474,056	452
	No. Transactions		14		No. Transactions		141	
	Stock				854			
Alshuwaikh	Average	821	1,208,667	1,465	Average	942	1,083,234	1,158
	minimum	375	350,000	350	minimum	333	83,333	222
	Maximum	1,064	2,000,000	2,000	Maximum	2,000	2,400,000	2,400
	Standard Deviation	293	582,284	423	Standard Deviation	349	599,126	551
	No. Transactions		16		No. Transactions		29	
	Stock				368			

7.1.1 Descriptive statistics (continues)

Table 15: Descriptive statistics for Alasima district (part 3 of 3)

		Lands Size	Lands Price	Lands PSM		Houses Size	Houses Price	Houses PSM
Alsolaibikhat	Average	639	242,823	420	Average	574	218,449	382
	minimum	300	70,000	117	minimum	250	42,500	93
	Maximum	1,000	530,000	800	Maximum	1,000	880,000	1,226
	Standard Deviation	252	113,769	218	Standard Deviation	224	152,244	199
	No. Transactions		23		No. Transactions		176	
	Stock				1,308			
Alsurra	Average	724	360,327	500	Average	674	405,959	620
	minimum	395	57,000	114	minimum	225	80,000	153
	Maximum	2,940	1,600,000	947	Maximum	1,982	1,995,000	1,750
	Standard Deviation	349	222,694	178	Standard Deviation	236	241,940	286
	No. Transactions		90		No. Transactions		392	
	Stock				2,333			
Alyarmouk	Average	666	440,291	678	Average	670	469,863	723
	minimum	375	100,000	170	minimum	232	51,000	114
	Maximum	1,145	1,400,000	1,688	Maximum	1,468	1,750,000	2,110
	Standard Deviation	231	271,716	372	Standard Deviation	236	277,121	369
	No. Transactions		63		No. Transactions		218	
	Stock				1,299			
Kaifan	Average	462	333,592	751	Average	469	365,983	785
	minimum	368	86,667	178	minimum	238	50,000	154
	Maximum	750	600,000	1,600	Maximum	1,000	1,300,000	2,000
	Standard Deviation	91	140,388	356	Standard Deviation	141	195,372	333
	No. Transactions		53		No. Transactions		355	
	Stock				1,614			
Qurnata	Average	559	326,342	605	Average	590	263,588	474
	minimum	381	80,000	160	minimum	225	59,000	94
	Maximum	1,229	650,000	1,339	Maximum	1,229	700,000	923
	Standard Deviation	171	121,926	228	Standard Deviation	244	133,894	208
	No. Transactions		72		No. Transactions		62	
	Stock				543			
Qurtoba	Average	637	372,173	596	Average	594	403,381	710
	minimum	370	73,000	130	minimum	225	100,000	117
	Maximum	1,260	1,400,000	2,522	Maximum	2,000	1,400,000	1,769
	Standard Deviation	205	255,003	381	Standard Deviation	232	203,708	301
	No. Transactions		116		No. Transactions		285	
	Stock				2,283			

7.1.1 Descriptive statistics (continues)

Table 16: Descriptive statistics for Hawali district (part 1 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Aljabriya	Average	598	317,630	563	Average	634	377,227	613
	minimum	363	102,500	157	minimum	292	90,000	169
	Maximum	3,705	2,000,000	2,933	Maximum	3,377	2,500,000	2,493
	Standard Deviation	385	230,898	380	Standard Deviation	218	242,968	313
	No. Transactions		246		No. Transactions		745	
	Stock				3,512			
Alromaithiya	Average	592	329,223	543	Average	731	365,067	517
	minimum	250	70,000	100	minimum	375	80,000	100
	Maximum	3,253	3,250,000	1,827	Maximum	2,000	2,000,000	3,173
	Standard Deviation	369	380,375	281	Standard Deviation	236	231,965	312
	No. Transactions		173		No. Transactions		561	
	Stock				2,782			
Alsalam	Average	528	476,256	891	Average	448	390,042	879
	minimum	375	48,000	114	minimum	250	60,000	150
	Maximum	2,000	3,457,500	5,763	Maximum	796	935,000	2,078
	Standard Deviation	186	507,134	805	Standard Deviation	81	176,945	388
	No. Transactions		750		No. Transactions		300	
	Stock				2,234			
Alsalmiya	Average	856	453,797	561	Average	633	452,739	732
	minimum	383	87,000	104	minimum	377	60,000	150
	Maximum	2,090	1,065,769	1,020	Maximum	2,096	2,170,000	2,637
	Standard Deviation	352	210,167	221	Standard Deviation	252	274,583	334
	No. Transactions		49		No. Transactions		100	
	Stock				4,243			
Alshaeb	Average	558	470,273	849	Average	572	467,463	830
	minimum	375	143,000	305	minimum	299	51,000	103
	Maximum	2,029	2,000,000	1,400	Maximum	2,021	2,875,000	1,625
	Standard Deviation	343	348,147	315	Standard Deviation	267	332,205	331
	No. Transactions		31		No. Transactions		98	
	Stock				713			
Alshohada	Average	436	303,784	684	Average	403	314,996	785
	minimum	375	75,500	186	minimum	233	80,000	202
	Maximum	907	2,600,000	5,200	Maximum	750	1,440,000	3,600
	Standard Deviation	73	405,086	852	Standard Deviation	43	208,847	521
	No. Transactions		386		No. Transactions		275	
	Stock				1,472			

7.1.1 Descriptive statistics (continues)

Table 16: Descriptive statistics for Hawali district (part 2 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Alsudeeq	Average	534	673,782	1,262	Average	422	575,456	1,369
	minimum	250	37,752	101	minimum	375	196,980	492
	Maximum	3,917	3,850,000	7,192	Maximum	600	1,200,000	2,824
	Standard Deviation	211	693,833	1,310	Standard Deviation	61	220,911	499
	No. Transactions		599		No. Transactions		47	
	Stock				****2,000			
Alzahra	Average	509	440,350	884	Average	434	406,922	951
	minimum	370	47,000	125	minimum	363	80,000	147
	Maximum	4,198	2,100,000	5,250	Maximum	1,320	3,180,000	7,794
	Standard Deviation	249	450,044	925	Standard Deviation	76	459,692	1,128
	No. Transactions		936		No. Transactions		444	
	Stock				2,287			
Bayan	Average	492	263,826	566	Average	472	257,240	578
	minimum	300	76,000	194	minimum	300	37,500	125
	Maximum	1,000	650,000	1,280	Maximum	1,000	850,000	1,625
	Standard Deviation	172	134,359	281	Standard Deviation	202	136,188	272
	No. Transactions		72		No. Transactions		421	
	Stock				3,526			
Hotten	Average	505	348,535	684	Average	445	347,084	798
	minimum	250	54,000	105	minimum	250	60,000	150
	Maximum	1,000	2,772,000	4,049	Maximum	1,000	815,000	1,867
	Standard Deviation	153	408,016	712	Standard Deviation	89	158,125	370
	No. Transactions		268		No. Transactions		213	
	Stock				1,829			
Mishref	Average	552	355,411	691	Average	698	406,811	604
	minimum	370	100,000	160	minimum	375	75,000	130
	Maximum	1,000	1,280,000	1,867	Maximum	1,000	1,250,000	2,053
	Standard Deviation	213	194,631	359	Standard Deviation	163	215,223	320
	No. Transactions		94		No. Transactions		313	
	Stock				2,275			
Mobarak Alabdullah	Average	434	319,960	753	Average	419	361,270	862
	minimum	375	60,000	150	minimum	375	97,500	244
	Maximum	660	1,200,000	3,200	Maximum	613	800,000	2,133
	Standard Deviation	68	235,552	612	Standard Deviation	48	170,522	393
	No. Transactions		119		No. Transactions		63	
	Stock				993			
Salwa	Average	821	532,163	614	Average	691	402,664	577
	minimum	363	93,000	110	minimum	248	60,000	116
	Maximum	4,683	4,310,000	4,620	Maximum	4,032	4,310,000	4,310
	Standard Deviation	439	776,755	719	Standard Deviation	281	410,759	370
	No. Transactions		276		No. Transactions		1,001	
	Stock				3,938			

7.1.1 Descriptive statistics (continues)

Table 17: Descriptive statistics for Alfarwaniya district (part 1 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Abdullah Almobarak	Average	N/A	N/A	N/A	Average	400	227,052	568
	minimum	N/A	N/A	N/A	minimum	400	61,000	153
	Maximum	N/A	N/A	N/A	Maximum	400	1,550,000	3,875
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	92,713	232
	No. Transactions		-		No. Transactions		414	
	Stock				5,092			
Alandalos	Average	612	218,700	396	Average	516	237,939	468
	minimum	375	90,000	115	minimum	267	52,700	105
	Maximum	1,263	700,000	1,197	Maximum	1,250	865,000	1,453
	Standard Deviation	237	96,472	202	Standard Deviation	110	110,098	209
	No. Transactions		102		No. Transactions		667	
	Stock				2,593			
Alardiya	Average	436	173,792	459	Average	430	183,757	454
	minimum	250	60,000	117	minimum	250	40,000	81
	Maximum	1,000	525,000	1,440	Maximum	1,000	600,000	1,000
	Standard Deviation	277	106,397	235	Standard Deviation	180	93,775	195
	No. Transactions		55		No. Transactions		439	
	Stock				3,459			
Alfarwaneya	Average	523	245,290	467	Average	677	370,049	559
	minimum	375	71,250	165	minimum	375	47,500	62
	Maximum	1,000	710,000	1,125	Maximum	1,173	1,300,000	2,027
	Standard Deviation	110	140,709	253	Standard Deviation	181	236,959	344
	No. Transactions		98		No. Transactions		143	
	Stock				1,727			
Alferdous	Average	N/A	N/A	N/A	Average	306	131,427	430
	minimum	N/A	N/A	N/A	minimum	244	40,000	133
	Maximum	N/A	N/A	N/A	Maximum	400	345,000	930
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	22	52,779	169
	No. Transactions		-		No. Transactions		606	
	Stock				3,693			
Aljaleeb	Average	777	146,684	201	Average	678	121,562	217
	minimum	224	22,000	29	minimum	100	11,333	14
	Maximum	1,516	650,000	1,090	Maximum	3,126	1,250,000	1,389
	Standard Deviation	186	128,248	184	Standard Deviation	261	109,652	193
	No. Transactions		81		No. Transactions		1,150	
	Stock				2,870			

7.1.1 Descriptive statistics (continues)

Table 17: Descriptive statistics for Alfarwaniya district (part 2 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Alomariya	Average	N/A	N/A	N/A	Average	602	237,871	398
	minimum	N/A	N/A	N/A	minimum	292	75,000	125
	Maximum	N/A	N/A	N/A	Maximum	1,000	650,000	1,000
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	96	111,424	182
	No. Transactions		-		No. Transactions		218	
	Stock				1,182			
Alrabya	Average	N/A	N/A	N/A	Average	448	186,346	427
	minimum	N/A	N/A	N/A	minimum	250	43,000	110
	Maximum	N/A	N/A	N/A	Maximum	1,000	870,000	1,222
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	205	122,097	205
	No. Transactions		8		No. Transactions		212	
	Stock				1,105			
Alrehab	Average	N/A	N/A	N/A	Average	400	188,710	472
	minimum	N/A	N/A	N/A	minimum	400	55,000	138
	Maximum	N/A	N/A	N/A	Maximum	400	400,000	1,000
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	77,079	193
	No. Transactions		-		No. Transactions		127	
	Stock				1,356			
Ashbeliya	Average	441	232,056	535	Average	426	270,885	632
	minimum	286	61,323	150	minimum	255	76,000	160
	Maximum	1,607	2,201,720	5,871	Maximum	2,100	3,183,498	1,964
	Standard Deviation	63	314,550	763	Standard Deviation	92	186,959	303
	No. Transactions		1,187		No. Transactions		475	
	Stock				1,581			
Khaitan	Average	N/A	N/A	N/A	Average	455	172,460	445
	minimum	N/A	N/A	N/A	minimum	100	30,000	36
	Maximum	N/A	N/A	N/A	Maximum	2,975	1,100,000	1,417
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	309	140,879	246
	No. Transactions		17		No. Transactions		435	
	Stock				2,451			
Sabah Alnaser	Average	628	177,662	282	Average	525	209,752	405
	minimum	375	60,000	114	minimum	283	47,500	64
	Maximum	1,200	476,000	725	Maximum	1,125	1,000,000	1,333
	Standard Deviation	224	110,177	132	Standard Deviation	136	105,673	168
	No. Transactions		68		No. Transactions		345	
	Stock				2,082			

7.1.1 Descriptive statistics (continues)

Table 18: Descriptive statistics for Mubarak Alkaber district (part 1 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Abofatera	Average	433	212,301	492	Average	942	699,159	816
	minimum	313	52,000	104	minimum	375	32,000	85
	Maximum	4,235	2,539,855	1,995	Maximum	3,145	4,500,000	2,619
	Standard Deviation	136	143,847	280	Standard Deviation	742	796,631	459
	No. Transactions		4,278		No. Transactions		85	
	Stock				828			
Aladan	Average	N/A	N/A	N/A	Average	399	208,777	523
	minimum	N/A	N/A	N/A	minimum	267	55,000	138
	Maximum	N/A	N/A	N/A	Maximum	400	500,000	1,250
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	9	90,539	227
	No. Transactions		1		No. Transactions		245	
	Stock				3,815			
Alfonaitees	Average	437	374,775	861	Average	876	680,248	768
	minimum	350	50,000	100	minimum	375	68,000	160
	Maximum	4,699	4,530,000	9,368	Maximum	2,592	3,500,000	1,449
	Standard Deviation	181	512,495	1,175	Standard Deviation	694	720,326	323
	No. Transactions		2,821		No. Transactions		37	
	Stock				567			
Alfontas	Average	1,083	415,407	379	Average	895	363,111	434
	minimum	400	65,000	113	minimum	348	51,666	71
	Maximum	3,731	1,850,000	1,837	Maximum	3,294	2,193,093	1,400
	Standard Deviation	516	367,099	295	Standard Deviation	569	325,893	268
	No. Transactions		116		No. Transactions		133	
	Stock				842			
Almasayel	Average	490	319,182	680	Average	426	416,302	976
	minimum	322	78,630	197	minimum	375	200,000	472
	Maximum	4,988	2,530,000	4,625	Maximum	500	690,000	1,400
	Standard Deviation	519	313,707	462	Standard Deviation	51	125,736	262
	No. Transactions		426		No. Transactions		30	
	Stock				374			
Almasela	Average	544	542,314	1,017	Average	1,160	1,048,294	838
	minimum	375	60,000	120	minimum	211	71,000	206
	Maximum	4,933	5,000,000	8,840	Maximum	3,450	4,041,300	1,900
	Standard Deviation	524	971,644	1,826	Standard Deviation	866	1,025,062	534
	No. Transactions		749		No. Transactions		15	
	Stock				N/A			

7.1.1 Descriptive statistics (continues)

Table 18: Descriptive statistics for Mubarak Alkaber district (part 2 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Alqosoor	Average	N/A	N/A	N/A	Average	400	166,371	416
	minimum	N/A	N/A	N/A	minimum	300	24,500	82
	Maximum	N/A	N/A	N/A	Maximum	600	450,000	1,125
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	14	69,386	174
	No. Transactions		2		No. Transactions		281	
	Stock				3,185			
Alqurain	Average	N/A	N/A	N/A	Average	400	175,643	439
	minimum	N/A	N/A	N/A	minimum	400	33,500	84
	Maximum	N/A	N/A	N/A	Maximum	400	510,000	1,275
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	76,774	192
	No. Transactions		-		No. Transactions		298	
	Stock				2,812			
Mobarak Alkaber	Average	N/A	N/A	N/A	Average	400	205,429	514
	minimum	N/A	N/A	N/A	minimum	400	72,500	181
	Maximum	N/A	N/A	N/A	Maximum	400	420,000	1,050
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	72,937	182
	No. Transactions		2		No. Transactions		227	
	Stock				3,755			
Sabah Alsalem	Average	727	570,000	885	Average	359	174,283	488
	minimum	396	73,000	120	minimum	250	32,000	107
	Maximum	1,125	1,140,000	2,505	Maximum	1,500	1,300,000	1,375
	Standard Deviation	285	380,964	775	Standard Deviation	83	89,334	200
	No. Transactions		15		No. Transactions		564	
	Stock				6,259			

7.1.1 Descriptive statistics (continues)

Table 19: Descriptive statistics for Alahmadi district (part 1 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Alaqila	Average	467	252,701	558	Average	461	273,200	584
	minimum	375	30,000	75	minimum	315	48,333	94
	Maximum	2,190	3,009,996	7,372	Maximum	1,890	4,400,000	4,656
	Standard Deviation	106	429,752	1,024	Standard Deviation	125	234,427	317
	No. Transactions		943		No. Transactions		559	
	Stock				1,456			
Aldhahar	Average	N/A	N/A	N/A	Average	280	117,100	420
	minimum	N/A	N/A	N/A	minimum	244	52,851	126
	Maximum	N/A	N/A	N/A	Maximum	478	240,000	860
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	12	40,995	148
	No. Transactions		-		No. Transactions		364	
	Stock				2,660			
Alfahaiheel	Average	613	268,974	445	Average	645	296,516	462
	minimum	375	64,250	151	minimum	271	50,000	83
	Maximum	2,531	900,000	1,106	Maximum	1,500	1,375,000	2,750
	Standard Deviation	272	136,725	181	Standard Deviation	145		354
	No. Transactions		71		No. Transactions		157	
	Stock				1,821			
Ali Alsalem	Average	N/A	N/A	N/A	Average	400	136,174	340
	minimum	N/A	N/A	N/A	minimum	400	44,500	111
	Maximum	N/A	N/A	N/A	Maximum	400	295,000	738
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	48,621	122
	No. Transactions		-		No. Transactions		516	
	Stock				3,968			
Alkhiran	Average	411	88,098	215	Average	N/A	N/A	N/A
	minimum	400	24,000	59	minimum	N/A	N/A	N/A
	Maximum	1,688	712,000	1,780	Maximum	N/A	N/A	N/A
	Standard Deviation	96	83,145	201	Standard Deviation	N/A	N/A	N/A
	No. Transactions		1,288		No. Transactions		3	
	Stock				N/A			
Almahbola	Average	971	452,466	442	Average	1,266	757,438	551
	minimum	488	100,000	181	minimum	500	91,000	142
	Maximum	4,332	3,600,000	4,800	Maximum	3,782	2,450,000	1,640
	Standard Deviation	849	633,715	472	Standard Deviation	990	776,474	353
	No. Transactions		115		No. Transactions		16	
	Stock				1,406			

7.1.1 Descriptive statistics (continues)

Table 19: Descriptive statistics for Alahmadi district (part 2 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Almanqaf	Average	425	407,213	991	Average	409	223,034	549
	minimum	375	53,695	103	minimum	295	30,000	102
	Maximum	1,340	2,502,500	6,256	Maximum	1,200	1,150,000	1,533
	Standard Deviation	95	557,748	1,391	Standard Deviation	104	119,831	269
	No. Transactions		544		No. Transactions		447	
	Stock				2,894			
Alriqqa	Average	N/A	N/A	N/A	Average	399	138,554	348
	minimum	N/A	N/A	N/A	minimum	247	17,143	43
	Maximum	N/A	N/A	N/A	Maximum	400	562,209	1,406
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	12	65,320	163
	No. Transactions		-		No. Transactions		358	
	Stock				2,426			
Alsabahiya	Average	663	229,500	376	Average	558	185,411	337
	minimum	450	80,000	150	minimum	265	40,000	100
	Maximum	1,000	400,000	711	Maximum	1,080	646,300	1,723
	Standard Deviation	218	96,507	183	Standard Deviation	152	98,672	167
	No. Transactions		10		No. Transactions		476	
	Stock				3,299			
Alwafra	Average	N/A	N/A	N/A	Average	400	72,302	181
	minimum	N/A	N/A	N/A	minimum	257	20,000	50
	Maximum	N/A	N/A	N/A	Maximum	400	550,000	1,375
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	8	48,374	121
	No. Transactions		-		No. Transactions		323	
	Stock				375			
Hadiya	Average	732	228,115	320	Average	642	238,626	387
	minimum	375	70,000	93	minimum	375	60,000	100
	Maximum	1,500	1,807,190	2,410	Maximum	1,200	650,000	1,000
	Standard Deviation	99	149,081	214	Standard Deviation	169	121,916	190
	No. Transactions		201		No. Transactions		211	
	Stock				1,243			
Jaber Alali	Average	N/A	N/A	N/A	Average	394	166,169	424
	minimum	N/A	N/A	N/A	minimum	245	56,000	143
	Maximum	N/A	N/A	N/A	Maximum	750	330,000	1,224
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	25	63,118	168
	No. Transactions		-		No. Transactions		245	
	Stock				3,148			
Sabah Alahmad Sea-City	Average	736	158,572	228	Average	767	276,521	390
	minimum	253	24,233	58	minimum	248	82,625	92
	Maximum	4,044	2,250,000	3,516	Maximum	2,950	1,200,000	1,228
	Standard Deviation	367	121,907	147	Standard Deviation	399	161,629	196
	No. Transactions		13,211		No. Transactions		285	
	Stock				N/A			

7.1.1 Descriptive statistics (continues)

Table 20: Descriptive statistics for Aljahra district (part 1 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Alayoon	Average	N/A	N/A	N/A	Average	309	134,557	436
	minimum	N/A	N/A	N/A	minimum	260	65,000	209
	Maximum	N/A	N/A	N/A	Maximum	399	331,000	1,112
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	32	47,728	150
	No. Transactions		-		No. Transactions		327	
	Stock				2,007			
Alnaeem	Average	N/A	N/A	N/A	Average	400	167,920	420
	minimum	N/A	N/A	N/A	minimum	400	70,000	175
	Maximum	N/A	N/A	N/A	Maximum	400	350,000	875
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	64,543	161
	No. Transactions		-		No. Transactions		95	
	Stock				968			
Alnaseem	Average	N/A	N/A	N/A	Average	400	145,926	365
	minimum	N/A	N/A	N/A	minimum	400	60,000	150
	Maximum	N/A	N/A	N/A	Maximum	400	360,000	900
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	52,094	130
	No. Transactions		-		No. Transactions		140	
	Stock				1,148			
Alqairawan	Average	N/A	N/A	N/A	Average	400	237,699	594
	minimum	N/A	N/A	N/A	minimum	400	85,000	213
	Maximum	N/A	N/A	N/A	Maximum	400	472,073	1,180
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	69,033	173
	No. Transactions		-		No. Transactions		143	
	Stock				1,632			
Alqaser	Average	N/A	N/A	N/A	Average	615	220,256	353
	minimum	N/A	N/A	N/A	minimum	300	50,000	83
	Maximum	N/A	N/A	N/A	Maximum	1,000	800,000	1,267
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	122	138,376	196
	No. Transactions		4		No. Transactions		241	
	Stock				1,743			
Alwaha	Average	N/A	N/A	N/A	Average	300	113,002	377
	minimum	N/A	N/A	N/A	minimum	300	31,667	106
	Maximum	N/A	N/A	N/A	Maximum	300	658,000	2,193
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	49,374	165
	No. Transactions		-		No. Transactions		354	
	Stock				1,836			

7.1.1 Descriptive statistics (continues)

Table 20: Descriptive statistics for Aljahra district (part 2 of 2)

		Lands				Houses		
		Size	Price	PSM		Size	Price	PSM
Jaber Alahmad	Average	N/A	N/A	N/A	Average	400	275,495	689
	minimum	N/A	N/A	N/A	minimum	400	100,000	250
	Maximum	N/A	N/A	N/A	Maximum	400	500,000	1,250
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	57,798	144
	No. Transactions		-		No. Transactions		141	
	Stock				3,146			
Saad Alabdullah	Average	N/A	N/A	N/A	Average	400	199,792	499
	minimum	N/A	N/A	N/A	minimum	400	70,000	175
	Maximum	N/A	N/A	N/A	Maximum	400	435,000	1,088
	Standard Deviation	N/A	N/A	N/A	Standard Deviation	-	64,799	162
	No. Transactions		-		No. Transactions		985	
	Stock				7,613			
Aljahra	Average	675	398,321	584	Average	707	273,179	398
	minimum	400	220,000	389	minimum	298	50,000	90
	Maximum	1,887	1,200,000	1,250	Maximum	1,280	1,150,000	1,527
	Standard Deviation	342	263,455	228	Standard Deviation	228	187,980	249
	No. Transactions		58		No. Transactions		181	
	Stock				1,183			

7.1.2 Monthly transactions frequency

Table 21: Monthly transactions frequency (Lands only)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2004		115	67	128	142	154	102	86	56	63	38	51	**1,002**
2005	42	36	67	113	52	108	103	54	57	74	65	75	**846**
2006	48	38	87	120	102	86	124	182	305	150	393	348	**1,983**
2007	273	156	416	446	254	336	323	231	277	187	316	196	**3,411**
2008	179	569	324	87	75	99	250	47	30	34	210	240	**2,144**
2009	49	149	95	99	159	103	95	92	69	111	337	262	**1,620**
2010	108	105	336	322	292	226	146	132	156	186	205	256	**2,470**
2011	179	131	347	237	423	291	119	161	372	408	371	298	**3,337**
2012	406	396	301	495	374	369	316	170	179	306	450	441	**4,203**
2013	316	183	248	388	318	233	277	383	398	317	249	234	**3,544**
2014	180	176	235	263	249	357	297	368	436	302	374	263	**3,500**
2015	190	148	306	143	157	137	86	102	52	85	120	110	**1,636**
2016	100	114	154	80	147	99	109	59	51	118	74	99	**1,204**
2017	98	85*	204*										**98**
Total	**2,168**	**2,316**	**2,983**	**2,921**	**2,744**	**2,598**	**2,347**	**2,067**	**2,438**	**2,341**	**3,202**	**2,873**	**30,998**

*Not included in total of month observations to have equal number of months

Table 22: Monthly transactions frequency (Houses only)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Total**
2004		106	79	188	205	186	144	142	112	121	84	95	**1,462**
2005	76	53	100	188	103	179	176	155	106	82	86	137	**1,441**
2006	52	36	160	199	171	133	108	112	125	84	143	209	**1,532**
2007	134	138	167	283	259	246	263	140	200	201	205	160	**2,396**
2008	259	212	149	156	110	125	141	119	106	89	105	74	**1,645**
2009	83	77	95	127	153	155	142	130	84	147	156	152	**1,501**
2010	129	117	126	122	160	147	94	115	96	111	118	153	**1,488**
2011	156	110	184	148	218	185	145	109	114	131	115	158	**1,773**
2012	159	139	140	189	180	162	176	103	147	146	137	187	**1,865**
2013	146	114	148	178	154	168	173	112	163	127	142	162	**1,787**
2014	124	102	140	152	151	163	80	98	116	115	125	145	**1,511**
2015	141	117	175	137	119	140	121	83	110	100	140	131	**1,514**
2016	131	167	122	122	176	155	132	138	81	178	140	159	**1,701**
2017	166	146*	119*										**166**
Total	**1,756**	**1,488**	**1,785**	**2,189**	**2,159**	**2,144**	**1,895**	**1,556**	**1,560**	**1,632**	**1,696**	**1,922**	**21,782**

*Not included in total of month observations to have equal number of months

7.1.3 Stratum based on long-term mean price

Table 23: Stratum groups (Lands only)

stratum 1 (8 cities)	stratum 2 (15 cities)	stratum 3 (22 cities)	stratum 4 (5 cities)	stratum 5 (5 cities)
Alkhiran	Alrabya	Alsurra	Aldasma	Alnuzha
Alardiya	Alandalos	Qurnata	Alrawda	Alshaeb
Alqaser	Almanqaf	Aljabriya	Alkhaldiya	Abdullah Alsalem
Sabah Alnaser	Alaqila	Alromaithiya	Alodailiya	Alshamiya
Hadiya	Alfahaiheel	Almahbola	Alfaiha	Alshuwaikh
Alfontas	Abofatera	Almansoreya		
Alsabahiya	Aljahra	Alsalmiya		
Aljaleeb	Almasela	Hotten		
	Alfonaitees	Alzahra		
	Aladan	Qurtoba		
	Salwa	Aldaeya		
	Sabah Alsalem	Almasayel		
	Alsolaibikhat	Bayan		
	Alfarwaniya	Alshohada		
	Ashbeliya	Alsalam		
		Alqadeseya		
		Alsudeeq		
		Khaitan		
		Mobarak Alabdullah		
		Alyarmouk		
		Mishrif		
		Kaifan		

7.1.3 Stratum based on long-term mean price (continue)

Table 24: Stratum groups (Houses only)

stratum 1 (7 cities)	stratum 2 (31 cities)	stratum 3 (17 cities)	stratum 4 (13 cities)	stratum 5 (6 cities)
Alwafra	Alfontas	Aladan	Abofatera	Mobarak Alabdullah
Alqaser	Aldoha	Mishrif	Aldaeya	Alfonaitees
Ali Alsalem	Alsolaibikhat	Aljabriya	Alodailiya	Alshamiya
Alsabahiya	Aljahra	Alfarwaniya	Alkhaldiya	Abdullah Alsalem
Alriqqa	Aljaleeb	Alaqila	Hotten	Alsudeeq
Alnaseem	Aldhahar	Jaber Alahmad	Kaifan	Alshuwaikh
Alwaha	Alomariya	Almasela	Alfaiha	
	Alfahaiheel	Alsurra	Alzahra	
	Alnaeem	Aldasma	Alshaeb	
	Alqosoor	Almahbola	Almasayel	
	Alferdous	Ashbeliya	Alshohada	
	Hadiya	Almansoreya	Alsalam	
	Sabah Alnaser	Alyarmouk	Alnuzha	
	Alayoon	Alrawda		
	Alrabya	Alqadeseya		
	Saad Albdullah	Qurtoba		
	Jaber Alali	Alsalmiya		
	Alardiya			
	Alqurain			
	Alandalos			
	Alromaithiya			
	Sabah Alsalem			
	Qurnata			
	Alrehab			
	Khaitan			
	Mobarak Alkaber			
	Almanqaf			
	Salwa			
	Bayan			
	Abdullah Almobarak			
	Alqairawan			

7.1.4 Indices based on high Frequency transactions

Table 25: Cities included in "High Frequency indices"

Based on Lands transactions			Based on Houses transactions								
1	Abofatera	4278	1	Aljaleeb	1150	19	Alsurra	392	37	Jaber Alali	245
2	Alfonaitees	2821	2	Salwa	1001	20	Aldhahar	364	38	Alqaser	241
3	Alkhiran	1288	3	Saad Albdullah	985	21	Alriqqa	358	39	Alfaiha	230
4	Ashbeliya	1187	4	Aljabriya	745	22	Kaifan	355	40	Mobarak Alkaber	227
5	Alaqila	943	5	Alandalos	667	23	Alwaha	354	41	Alyarmouk	218
6	Alzahra	936	6	Alferdous	606	24	Sabah Alnaser	345	42	Alomariya	218
7	Alsalam	750	7	Sabah Alsalem	564	25	Alayoon	327	43	Hotten	213
8	Almasela	749	8	Alromaithiya	561	26	Alwafra	323	44	Alrabya	212
9	Alsudeeq	599	9	Alaqila	559	27	Mishrif	313	45	Hadiya	211
10	Almanqaf	544	10	Ali Alsalem	516	28	Alrawda	312	46	Abdullah Alsalem	209
11	Almasayel	426	11	Alsabahiya	476	29	Alsalam	300	47	Alodailiya	199
12	Alshohada	386	12	Ashbeliya	475	30	Alqurain	298	48	Alkhaldiya	188
13	Salwa	276	13	Almanqaf	447	31	Sabah Alahmad Sea City	285	49	Aljahra	181
14	Hotten	268	14	Alzahra	444	32	Qurtoba	285	50	Aldoha	180
15	Aljabriya	246	15	Alardiya	439	33	Alqosoor	281	51	Alsolaibikhat	176
16	Hadiya	201	16	Khaitan	435	34	Alshohada	275	52	Aldasma	171
17	Alromaithiya	173	17	Bayan	421	35	Alqadeseya	258			
			18	Abdullah Almobarak	414	36	Aladan	245			

Table contains each city and its total transactions

7.1.5 Indices descriptive statistics

Table 26: Indices descriptive statistics (Monthly indices)

Index	Average CGR	Return (average)	Return (Standard Deviation)	Autocorrelation* Level	Autocorrelation* First difference	Seasonality** Level	Seasonality** First difference
Index 1	0.0117	0.0247	0.2097	Yes	Yes	No	No
Index 2	0.0087	0.0088	0.0815	Yes	Yes	No	No
Index 3	0.0095	0.0095	0.0872	Yes	Yes	No	No
Index 4	0.0116	0.0292	0.2453	Yes	Yes	No	No
Index 5	0.0086	0.0080	0.0704	Yes	Yes	No	No
Index 6	0.0094	0.0098	0.0926	Yes	Yes	No	No
Index 7	0.0098	0.0117	0.1007	Yes	Yes	No	No
Index 8	0.0095	0.0075	0.0620	Yes	Yes	No	No
Index 9	0.0095	0.0074	0.0553	Yes	Yes	No	No
Index 10	0.0094	0.0112	0.0995	Yes	Yes	No	No
Index 11	0.0096	0.0078	0.0676	Yes	Yes	No	No
Index 12	0.0094	0.0074	0.0569	Yes	Yes	No	No
Index 13	0.0084	0.0101	0.0959	Yes	Yes	No	No
Index 14	0.0087	0.0080	0.0764	Yes	Yes	No	No
Index 15	0.0086	0.0072	0.0611	Yes	Yes	No	No
Index 16	0.0081	0.0100	0.0983	Yes	Yes	No	No
Index 17	0.0089	0.0088	0.0854	Yes	Yes	No	No
Index 18	0.0085	0.0073	0.0629	Yes	Yes	No	No
Index 19	0.0090	0.0107	0.1331	Yes	Yes	No	No
Index 20	0.0087	0.0092	0.0965	Yes	Yes	No	No
Index 21	0.0089	0.0074	0.0878	Yes	Yes	No	No
Index 22	0.0081	0.0113	0.1410	Yes	Yes	No	No
Index 23	0.0085	0.0107	0.1163	Yes	Yes	No	No
Index 24	0.0084	0.0077	0.0943	Yes	Yes	No	No
Index 25	0.0087	0.0083	0.0933	Yes	Yes	No	No
Index 26	0.0087	0.0080	0.0778	Yes	Yes	No	No
Index 27	0.0087	0.0066	0.0640	Yes	Yes	No	No
Index 28	0.0081	0.0079	0.0941	Yes	Yes	No	No
Index 29	0.0087	0.0090	0.0911	Yes	Yes	No	No
Index 30	0.0084	0.0065	0.0671	Yes	Yes	No	No
Index 55	0.0087	0.0087	0.0991	Yes	Yes	No	No
Index 56	0.0087	0.0080	0.0784	Yes	Yes	No	No
Index 57	0.0087	0.0066	0.0659	Yes	Yes	No	No
Index 58	0.0082	0.0075	0.0902	Yes	Yes	No	No
Index 59	0.0087	0.0090	0.0916	Yes	Yes	No	No
Index 60	0.0085	0.0063	0.0647	Yes	Yes	No	No
Index 61	0.0181	0.0303	0.2302	Yes	Yes	No	No
Index 62	0.0170	0.0612	0.3658	Yes	Yes	No	No
Index 63	0.0084	0.0096	0.1096	Yes	Yes	No	No
Index 64	0.0084	0.0082	0.0804	Yes	Yes	No	No
Index 65	0.0084	0.0068	0.0702	Yes	Yes	No	No
Index 66	0.0075	0.0084	0.1020	Yes	Yes	No	No
Index 67	0.0083	0.0093	0.0950	Yes	Yes	No	No
Index 68	0.0080	0.0065	0.0696	Yes	Yes	No	No
Index 69	0.0069	0.0092	0.1019	Yes	Yes	No	No
Index 70	0.0075	0.0092	0.0979	Yes	Yes	No	No
Index 71	0.0073	0.0073	0.0729	Yes	Yes	No	No
Index 72	0.0062	0.0068	0.0759	Yes	Yes	No	No
Index 73	0.0081	0.0072	0.0608	Yes	Yes	No	No
Index 74	0.0073	0.0060	0.0510	Yes	Yes	No	No

*To test for autocorrelation, we considered correlogram chart and Autocorrelation significance at 5%.

**To test for seasonality, we considered correlogram chart and regressing each index on months of the year.

7.1.5 Indices descriptive statistics

Table 27: Indices descriptive statistics (Quarterly indices)

Index	Average CGR	Return (average)	Return (Standard Deviation)	Autocorrelation* Level	Autocorrelation* First difference	Seasonality** Level	Seasonality** First difference
Index 31	0.0273	0.0257	0.0927	Yes	Yes	No	Yes
Index 32	0.0256	0.0191	0.0633	Yes	No	No	No
Index 33	0.0261	0.0202	0.0591	Yes	No	No	No
Index 34	0.0261	0.0245	0.0873	Yes	Yes	No	Yes
Index 35	0.0241	0.0192	0.0692	Yes	No	No	No
Index 36	0.0247	0.0198	0.0610	Yes	No	No	No
Index 37	0.0262	0.0241	0.0699	Yes	No	No	Yes
Index 38	0.0230	0.0192	0.0751	Yes	No	No	No
Index 39	0.0243	0.0204	0.0611	Yes	No	No	No
Index 40	0.0245	0.0232	0.0687	Yes	No	No	No
Index 41	0.0211	0.0197	0.0850	Yes	No	No	No
Index 42	0.0224	0.0202	0.0666	Yes	No	No	No
Index 43	0.0249	0.0315	0.1221	Yes	Yes	No	No
Index 44	0.0232	0.0218	0.0989	Yes	Yes	No	No
Index 45	0.0243	0.0231	0.0820	Yes	Yes	No	No
Index 46	0.0220	0.0356	0.1684	Yes	Yes	No	No
Index 47	0.0204	0.0225	0.1088	Yes	Yes	No	No
Index 48	0.0213	0.0239	0.0984	Yes	Yes	No	No
Index 49	0.0256	0.0261	0.0788	Yes	Yes	No	No
Index 50	0.0231	0.0202	0.0839	Yes	No	No	No
Index 51	0.0243	0.0212	0.0638	Yes	No	No	No
Index 52	0.0232	0.0262	0.0933	Yes	Yes	No	No
Index 53	0.0208	0.0208	0.0941	Yes	No	No	No
Index 54	0.0219	0.0212	0.0706	Yes	No	No	No

*To test for autocorrelation, we considered correlogram chart and Autocorrelation significance at 5%.

**To test for seasonality, we considered correlogram chart and regressing each index on months of the year.

7.1.6 Monthly observations indices

Chart 6: Indices 1,2 and 3

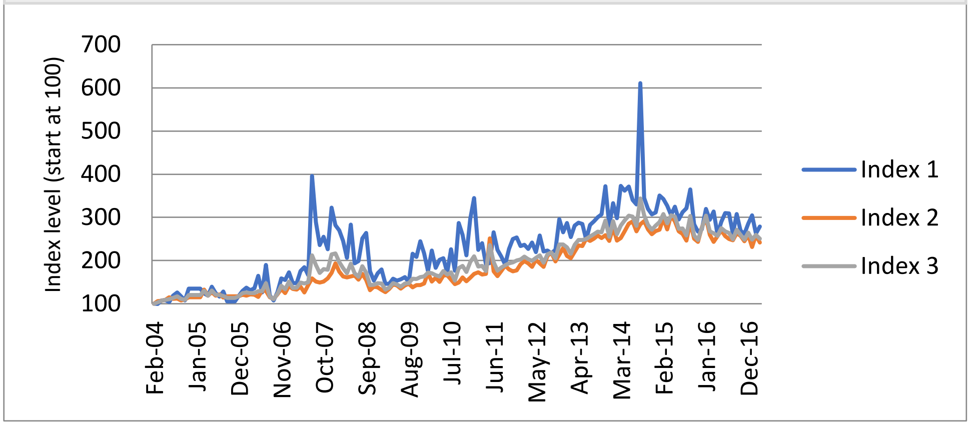


Chart 7:Indices 4, 5 and 6

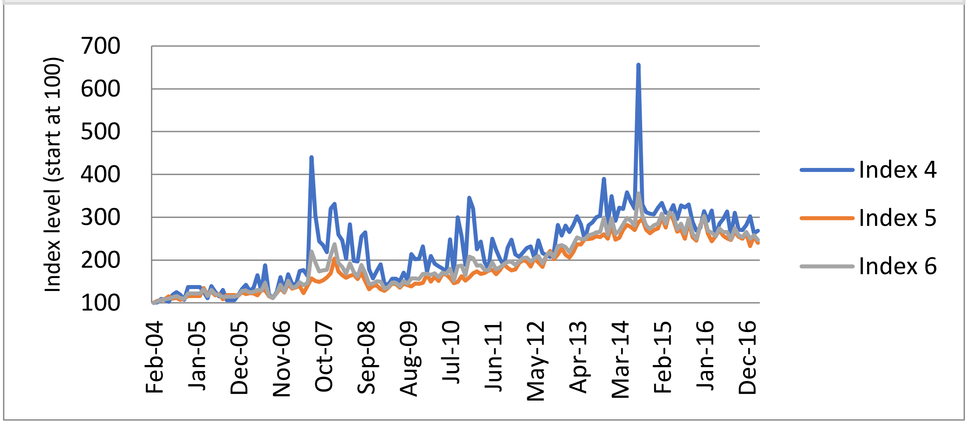
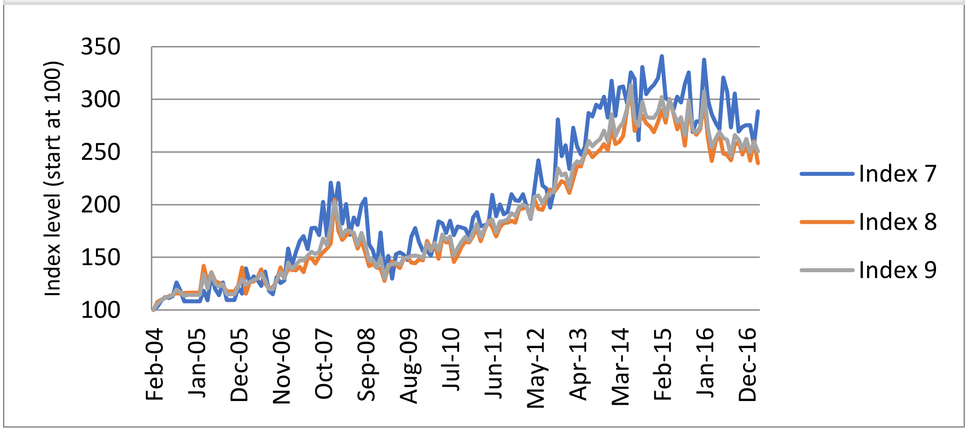


Chart 8: Indices 7, 8 and 9



7.1.6 Monthly observations indices (continued)

Chart 9: Indices 10, 11 and 12

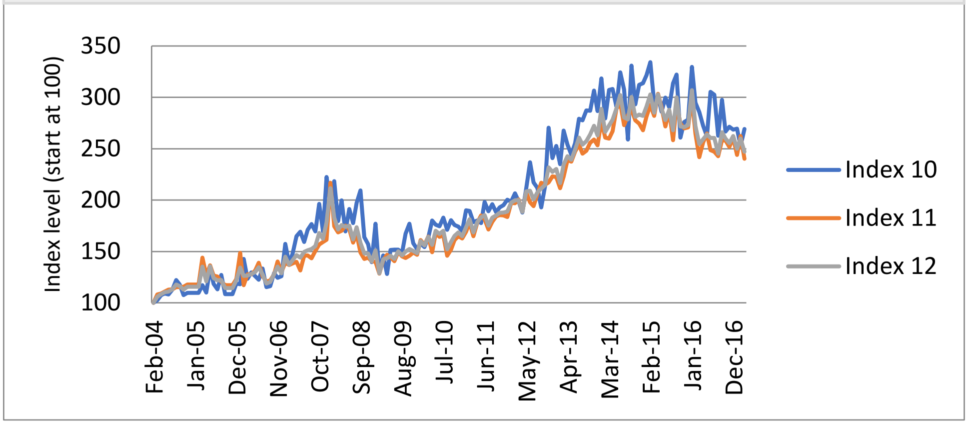


Chart 10: Indices 13, 14 and 15

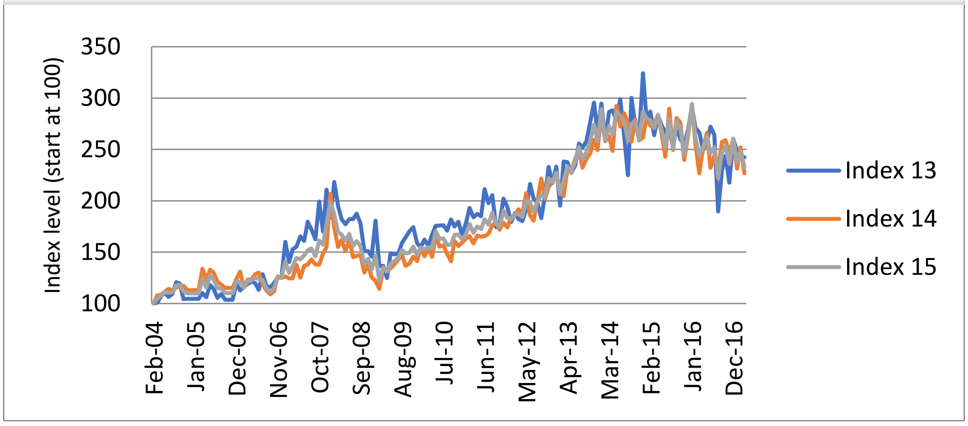
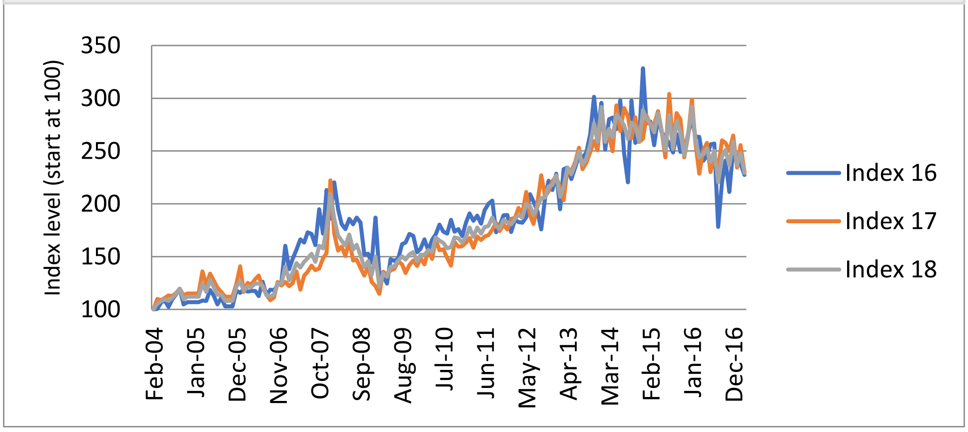


Chart 11: Indices 16, 17 and 18



7.1.6 Monthly observations indices (continued)

Chart 12: Indices 19, 20 and 21

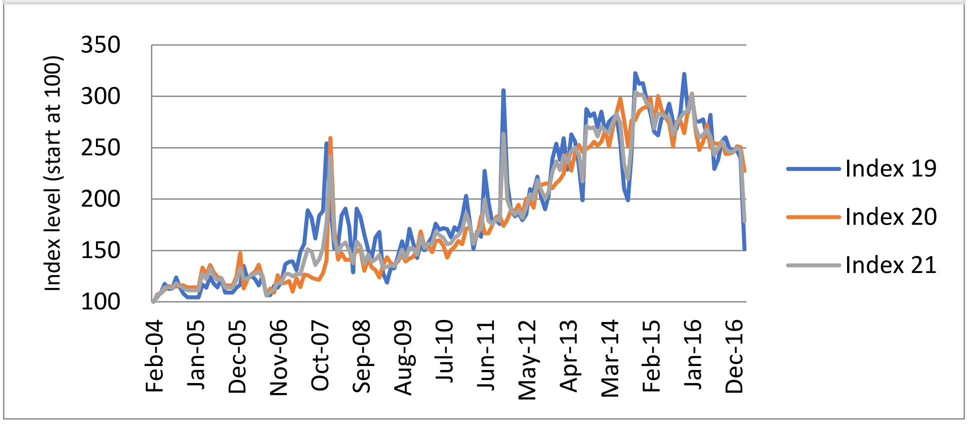


Chart 13: Indices 22, 23 and 24

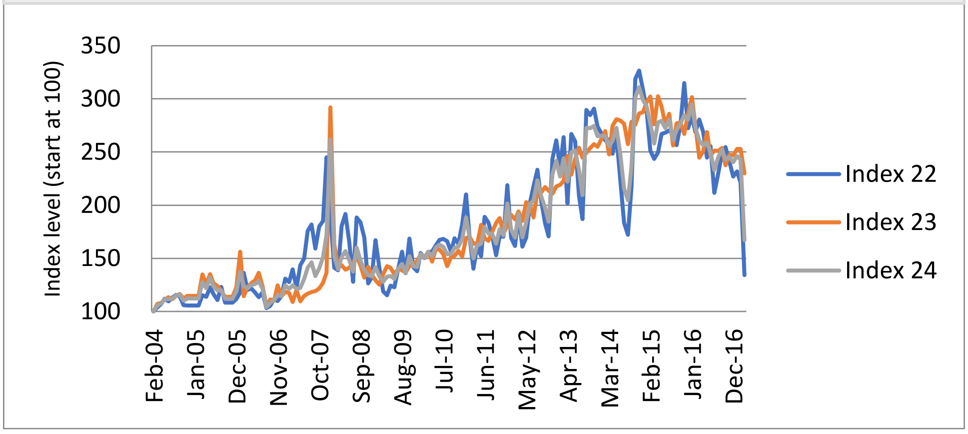
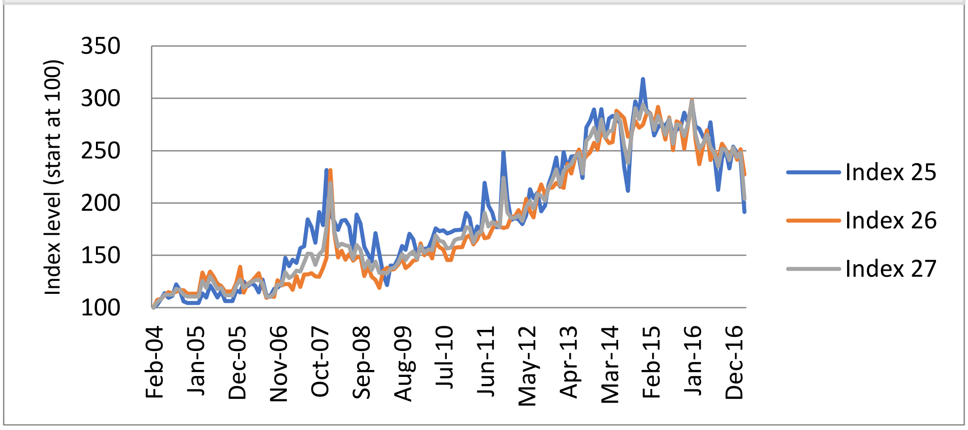


Chart 14: Indices 25,26 and 27



7.1.6 Monthly observations indices (continued)

Chart 15: Indices 28, 29 and 30

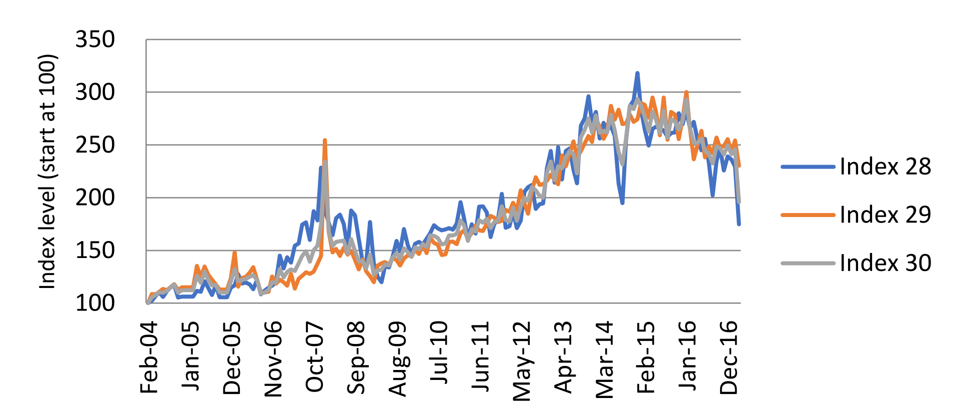


Chart 16: Indices 55, 56 and 57

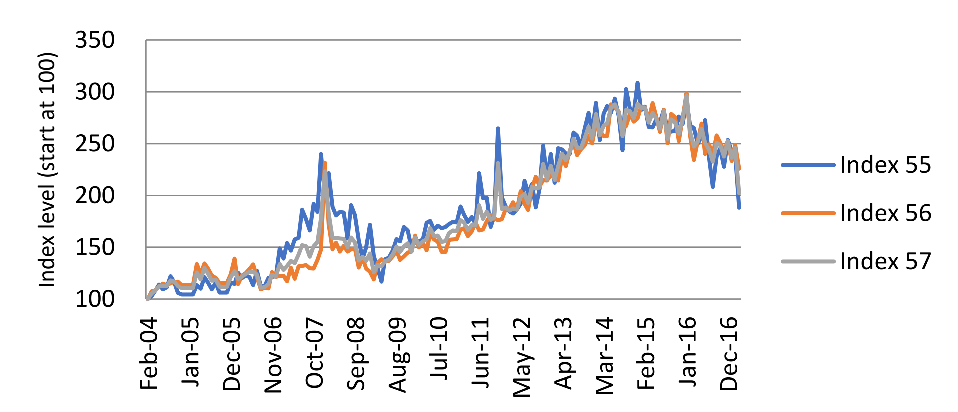
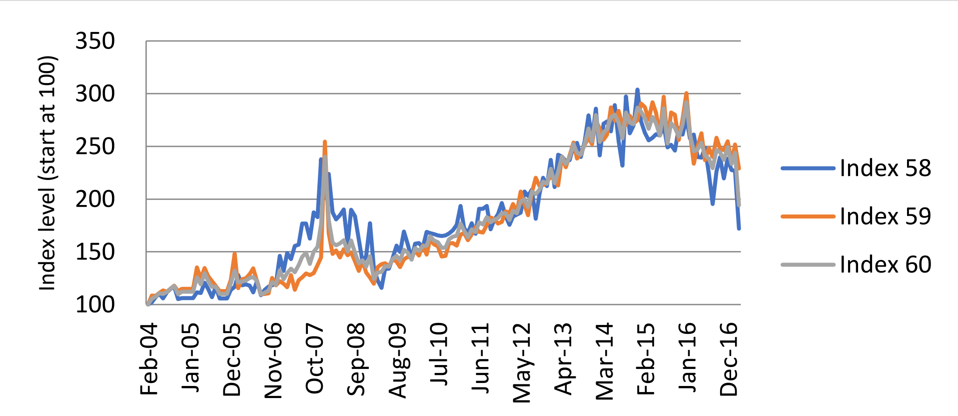


Chart 17: Indices 58, 59 and 60



7.1.6 Monthly observations indices (continued)

Chart 18: Indices 61 and 62

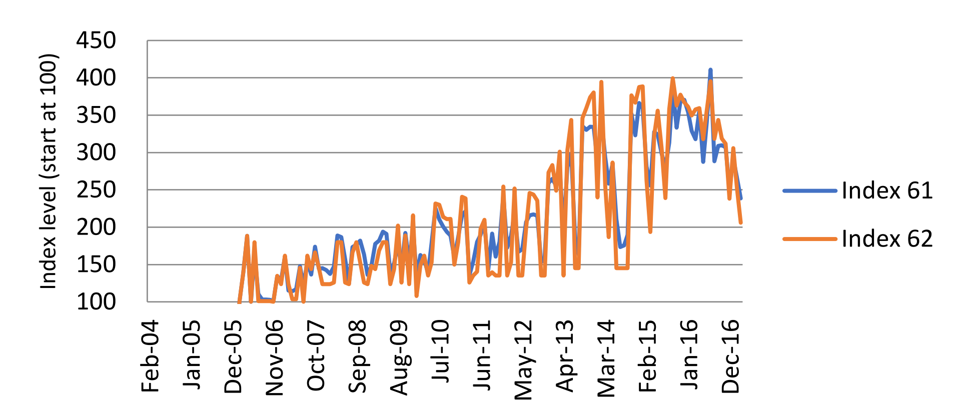


Chart 19: Indices 63, 64 and 65

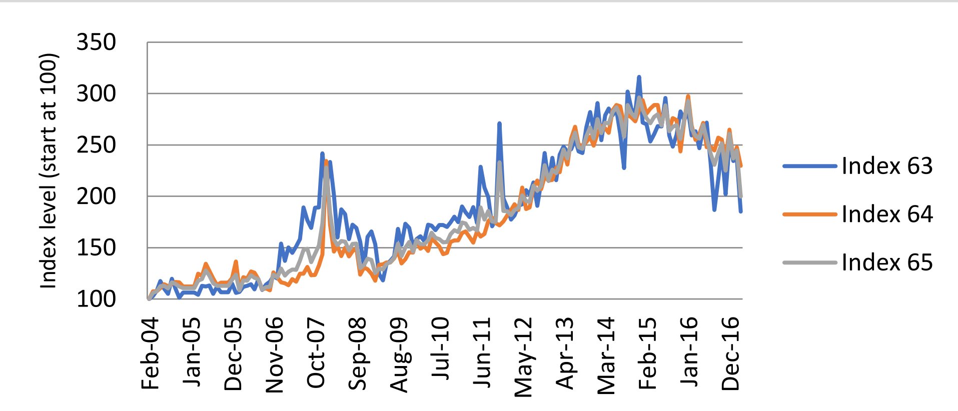
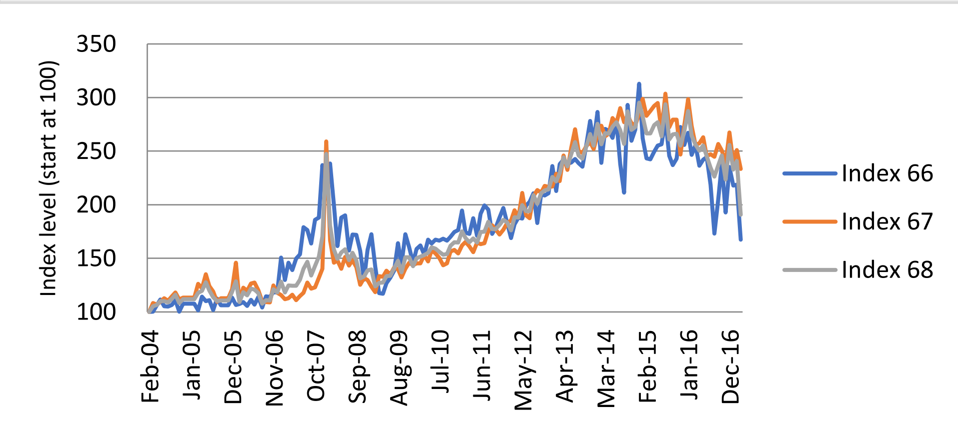


Chart 20: Indices 66, 67 and 68



7.1.6 Monthly observations indices (continued)

Chart 21: Indices 69, 70 and 71

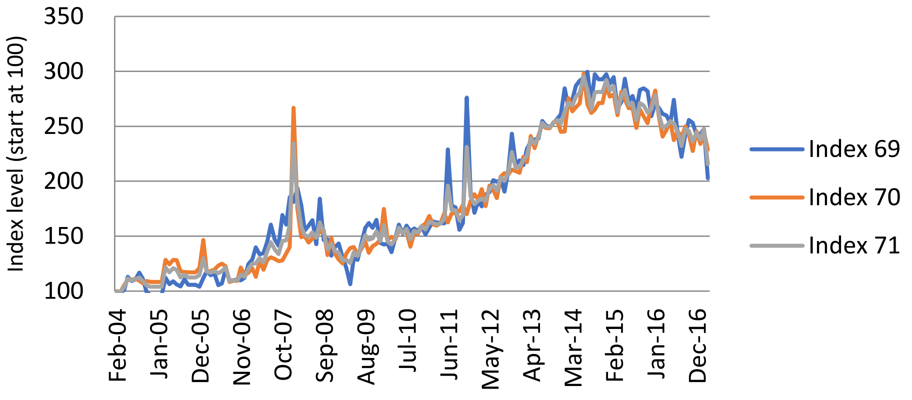
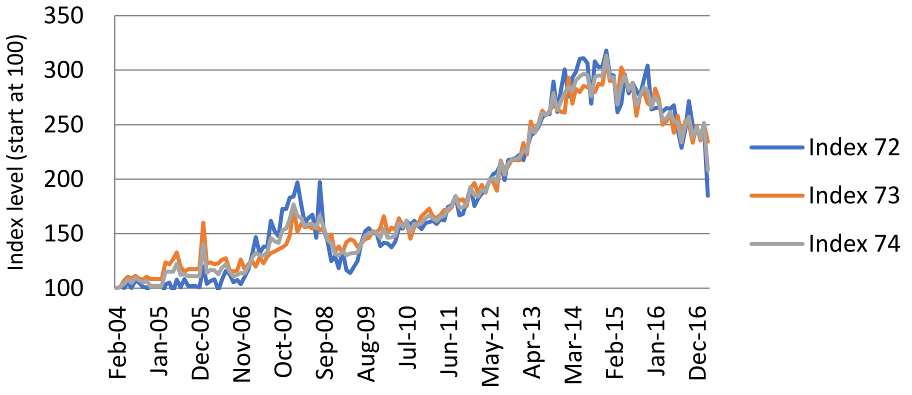


Chart 22: Indices 72, 73 and 74



7.1.7 Quarterly observations indices

7.1.7.1 Monthly observations indices converted to quarterly

Chart 23: Indices 7, 8 and 9

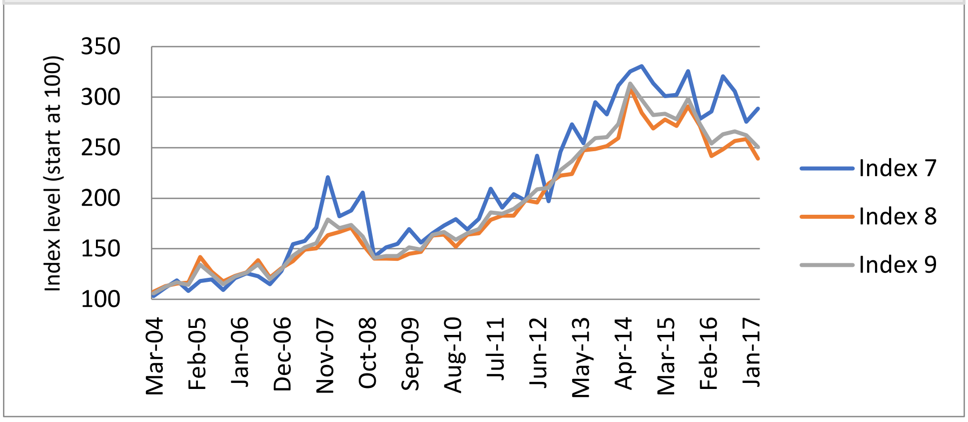


Chart 24: Indices 10, 11 and 12

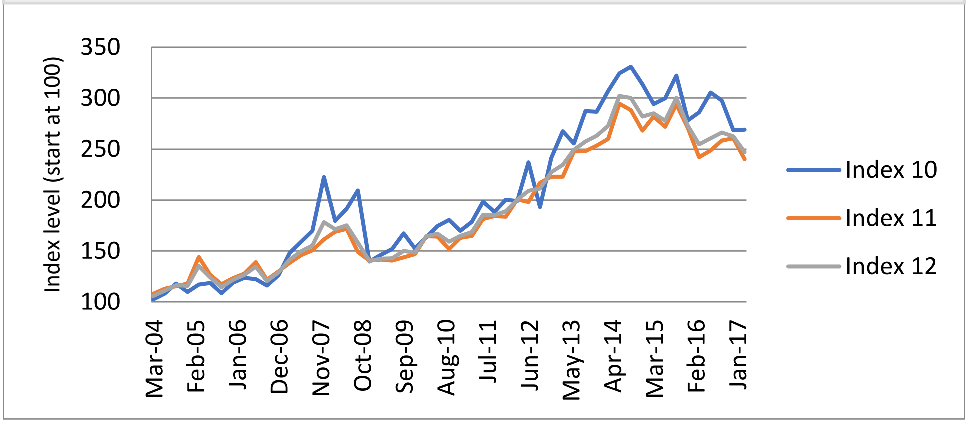
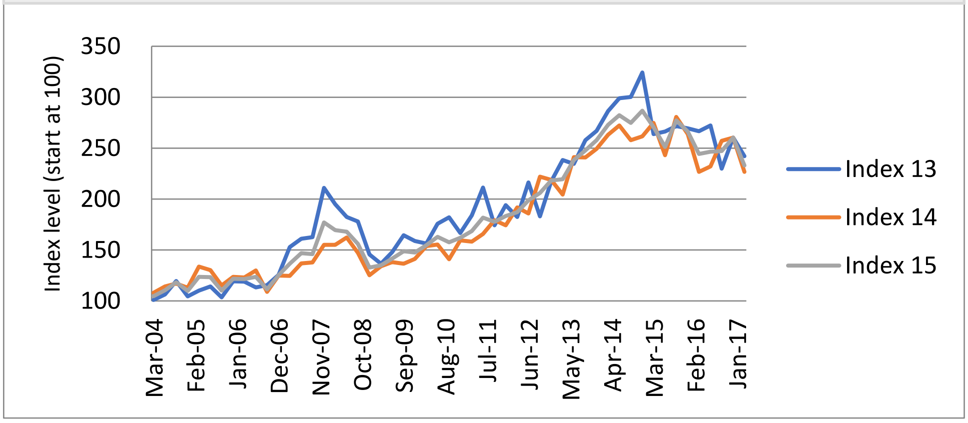


Chart 25: Indices 13, 14 and 15



7.1.7.1 Monthly observations indices converted to quarterly (continued)

Chart 26: Indices 16, 17 and 18

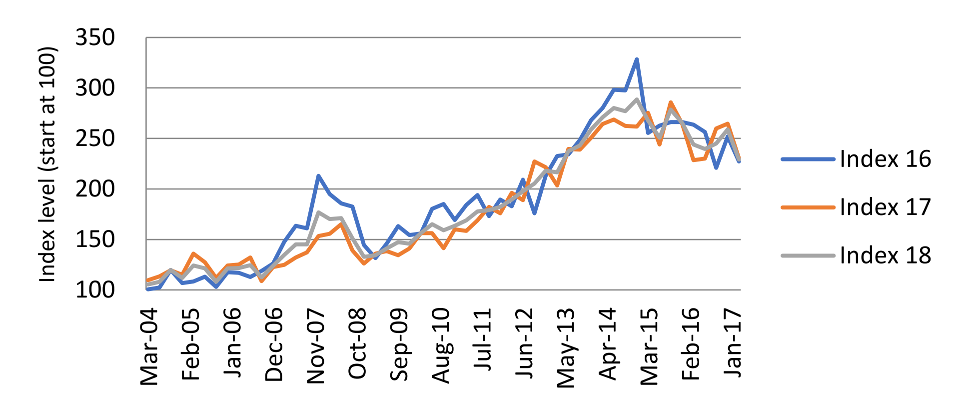


Chart 27: Indices 19, 20 and 21

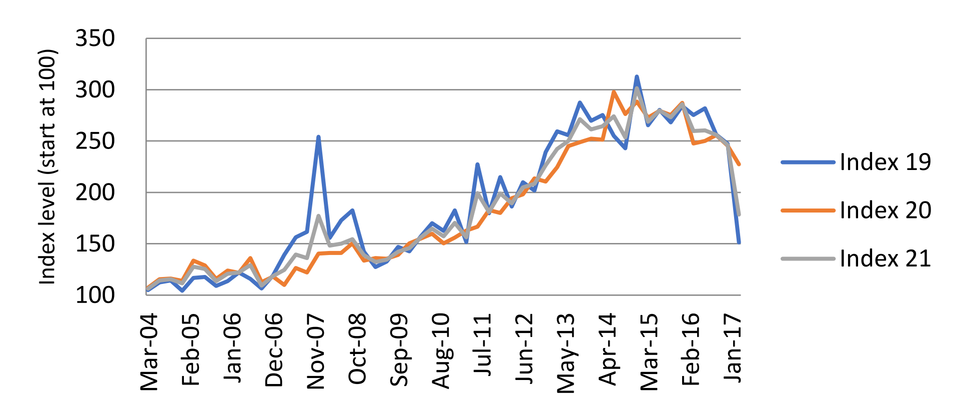
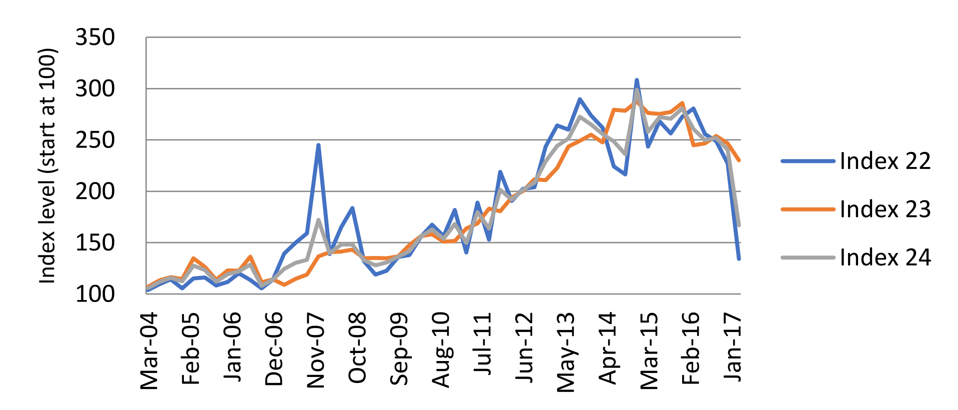


Chart 28: Indices 22, 23 and 24



7.1.7.1 Monthly observations indices converted to quarterly (continued)

Chart 29: Indices 25, 26 and 27

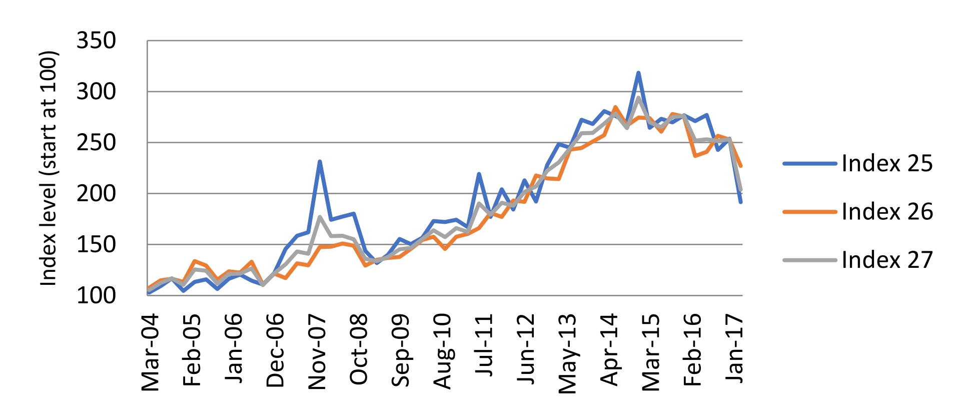
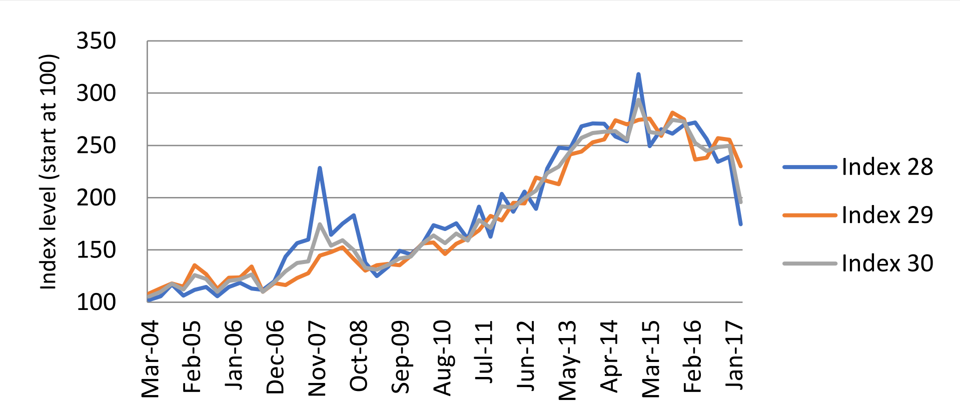


Chart 30: Indices 28, 29 and 30



7.1.7.2 Quarterly observations indices

Chart 31: Indices 31, 32 and 33

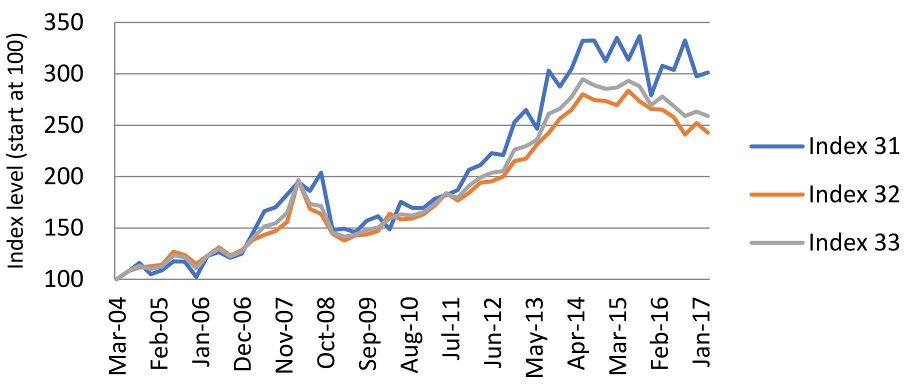


Chart 32: Indices 34, 35 and 36

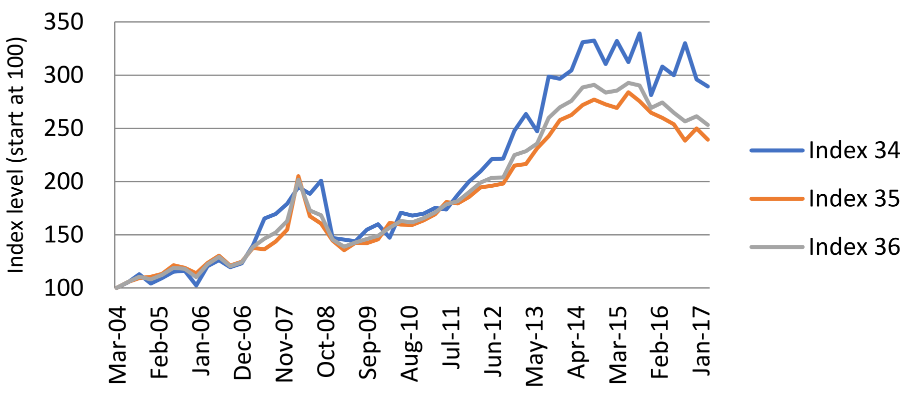
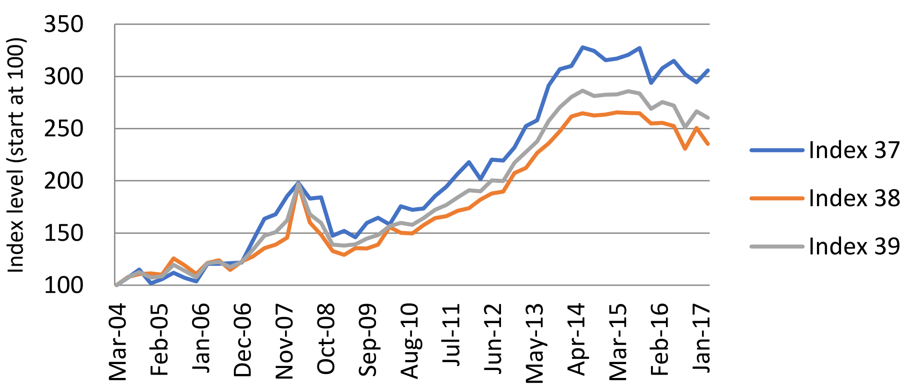


Chart 33: Indices 37, 38 and 39



7.1.7.2 Quarterly observations indices (continues)

Chart 34: Indices 40, 41 and 42

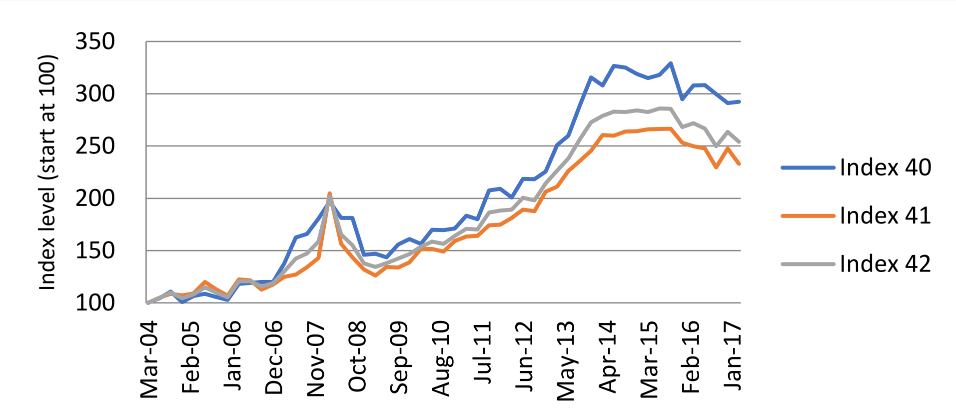


Chart 35: Indices 43, 44 and 45

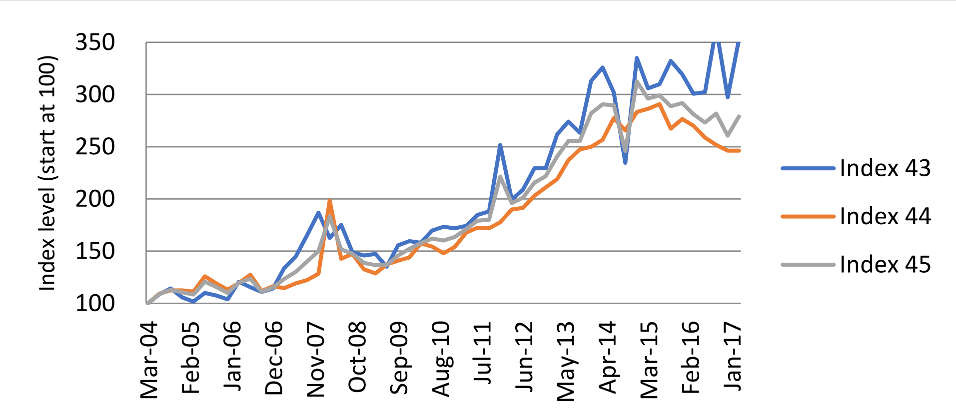
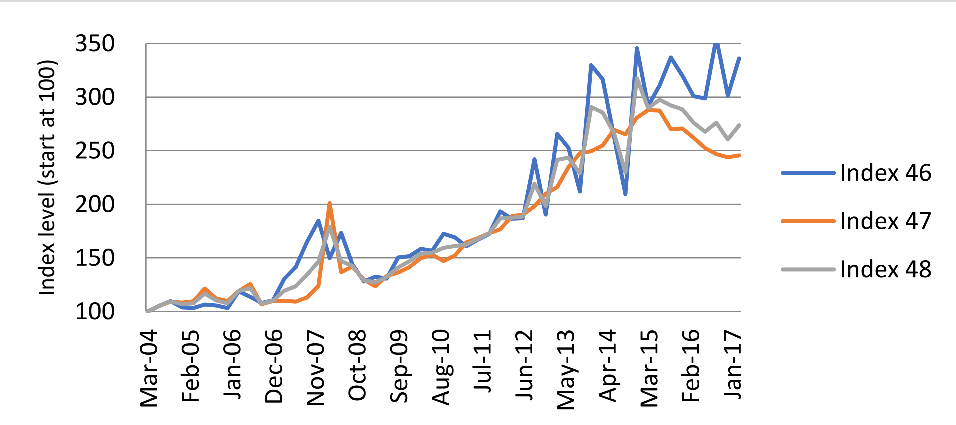


Chart 36: Indices 46, 47 and 48



7.1.7.2 Quarterly observations indices (continues)

Chart 37: Indices 49, 50 and 51

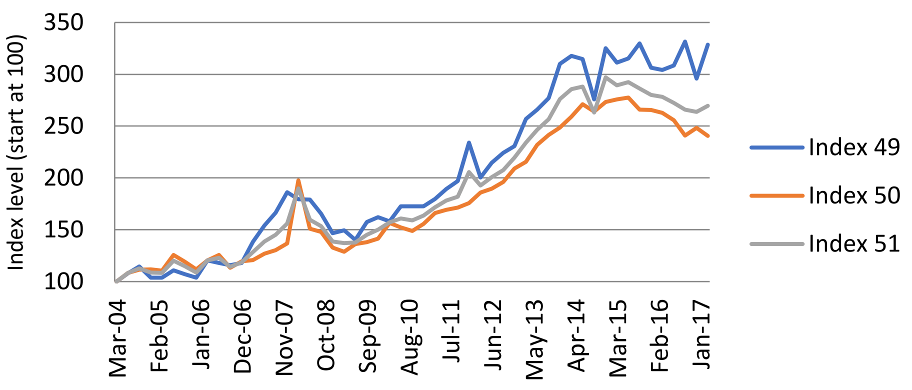
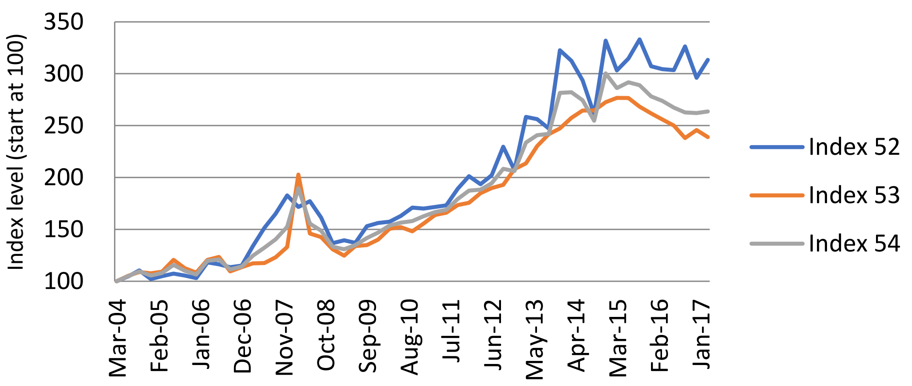


Chart 38: Indices 52, 53 and 54



Second Paper Appendices

7.2 Appendices for the second paper

7.2.1 ECM (monthly frequency)

Table 19: Normality test

Series: Residuals	
Sample 2004M05 2017M03	
Observations 155	
Mean	-7.07E-18
Median	0.00136
Maximum	0.110062
Minimum	-0.1429
Std. Dev.	0.04986
Skewness	-0.21233
Kurtosis	2.943912
Jarque-Bera	1.18502
Probability	0.552938

Table 20: Linearity test (monthly data)

Ramsey RESET Test
Specification: DLOG(HPI) DLOG(HPI(-1) DLOG(HPI(-2)) DLOG(HD(-1)) DLOG(HS) DLOG(CPI) D(IR) DLOG(OP) DLOG(KSE) DLOG(GP) U(-1) DUMMY08M2 DUMMY08M3 CDUMMY06M1 DUMMY06M2 DUMMY08M1
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.316054	138	0.1903
F-statistic	1.731999	(1, 138)	0.1903
Likelihood ratio	1.933254	1	0.1644
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	0.004746	1	0.004746
Restricted SSR	0.382853	139	0.002754
Unrestricted SSR	0.378107	138	0.00274
LR test summary:			
	Value	df	
Restricted LogL	245.3381	139	
Unrestricted LogL	246.3048	138	

Unrestricted Test Equation:

Dependent Variable: DLOG(HPI)
Method: Least Squares
Sample: 2004M05 2017M03
Included observations: 155

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(HPI(-1))	-0.367221	0.086483	-4.246165	0.0000
DLOG(HPI(-2))	-0.142918	0.069404	-2.059206	0.0414
DLOG(HD)	0.6237	0.462099	1.34971	0.1793
DLOG(HS)	-0.569077	0.442984	-1.284645	0.2011
DLOG(CPI)	0.234898	0.873551	0.2689	0.7884
D(IR)	2.440072	2.098306	1.162877	0.2469
DLOG(OP)	-0.007065	0.053576	-0.131875	0.8953
DLOG(KSE)	0.092196	0.085176	1.082422	0.281
DLOG(GP)	-0.098733	0.112765	-0.875562	0.3828
U(-1)	-0.135743	0.059447	-2.283442	0.0239
DUMMY06M1	0.370524	0.140073	2.645227	0.0091
DUMMY06M2	0.124243	0.25804	0.481489	0.6309
DUMMY08M1	2.284466	1.284228	1.778864	0.0775
DUMMY08M2	0.704644	0.725342	0.971465	0.333
DUMMY08M3	-0.099424	0.090477	-1.098893	0.2737
C	0.005766	0.007276	0.792455	0.4295
FITTED^2	-5.292479	4.021475	-1.316054	0.1903

R-squared	0.656143	Mean dependent var	0.004834
Adjusted R-squared	0.616275	S.D. dependent var	0.0845
S.E. of regression	0.052344	Akaike info criterion	-2.958771
Sum squared resid	0.378107	Schwarz criterion	-2.624976
Log likelihood	246.3048	Hannan-Quinn criter.	-2.823191
F-statistic	16.45807	Durbin-Watson stat	2.081069
Prob(F-statistic)	0		

Table 21: Heteroskedasticity Test (monthly data)

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.708325	Prob. F(15,139)	0.7729
Obs*R-squared	11.00657	Prob. Chi-Square(15)	0.7521
Scaled explained SS	8.603292	Prob. Chi-Square(15)	0.8973

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/11/17 Time: 20:43
Sample: 2004M05 2017M03
Included observations: 155

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002527	0.000439	5.750735	0.0000
DLOG(HPI(-1))	-0.011036	0.005299	-2.082463	0.0391
DLOG(HPI(-2))	-0.007613	0.004244	-1.794006	0.075
DLOG(HD)	0.002056	0.030922	0.066477	0.9471
DLOG(HS)	-0.00523	0.029643	-0.176419	0.8602
DLOG(CPI)	0.029633	0.058359	0.507775	0.6124
D(IR)	0.009797	0.140469	0.069745	0.9445
DLOG(OP)	-0.003768	0.003573	-1.054442	0.2935
DLOG(KSE)	0.00321	0.005675	0.565681	0.5725
DLOG(GP)	0.008724	0.007549	1.155641	0.2498
U(-1)	0.006132	0.003914	1.566559	0.1195
DUMMY06M1	-0.00356	0.003644	-0.976792	0.3304
DUMMY06M2	-0.000891	0.00368	-0.242219	0.809
DUMMY08M1	-0.003172	0.003812	-0.832143	0.4068
DUMMY08M2	0.003473	0.004639	0.748688	0.4553
DUMMY08M3	-0.004814	0.004679	-1.028766	0.3054

R-squared	0.07101	Mean dependent var	0.00247
Adjusted R-squared	-0.029241	S.D. dependent var	0.003455
S.E. of regression	0.003505	Akaike info criterion	-8.371687
Sum squared resid	0.001708	Schwarz criterion	-8.057527
Log likelihood	664.8057	Hannan-Quinn criter.	-8.244082
F-statistic	0.708325	Durbin-Watson stat	1.967529
Prob(F-statistic)	0.772899		

Table 22: Autoregressive test (monthly data)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.008738	Prob. F(2,137)	0.1381
Obs*R-squared	4.415826	Prob. Chi-Square(2)	0.1099

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2004M05 2017M03
Included observations: 155
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(HPI(-1))	0.055187	0.169697	0.325211	0.7455
DLOG(HPI(-2))	0.130402	0.090701	1.437715	0.1528
DLOG(HD)	0.035198	0.460126	0.076496	0.9391
DLOG(HS)	-0.063547	0.441875	-0.143812	0.8859
DLOG(CPI)	-0.080326	0.86854	-0.092484	0.9264
D(IR)	-0.302658	2.09949	-0.144158	0.8856
DLOG(OP)	0.015277	0.053672	0.284636	0.7764
DLOG(KSE)	-0.000401	0.084558	-0.004743	0.9962
DLOG(GP)	-0.000478	0.112269	-0.004258	0.9966
U(-1)	0.100135	0.082173	1.218592	0.2251
DUMMY06M1	-0.008844	0.054395	-0.162595	0.8711
DUMMY06M2	-0.005885	0.061085	-0.096334	0.9234
DUMMY08M1	0.012819	0.057024	0.224807	0.8225
DUMMY08M2	-0.021304	0.112491	-0.189382	0.8501
DUMMY08M3	-0.076012	0.097795	-0.777257	0.4383
C	0.0004	0.006543	0.061117	0.9514
RESID(-1)	-0.205472	0.225349	-0.911795	0.3635
RESID(-2)	-0.249068	0.149048	-1.671052	0.097

R-squared	0.028489	Mean dependent var	-7.07E-18
Adjusted R-squared	-0.092063	S.D. dependent var	0.04986
S.E. of regression	0.052105	Akaike info criterion	-2.962298
Sum squared resid	0.371945	Schwarz criterion	-2.61E+00
Log likelihood	247.5781	Hannan-Quinn criter.	-2.818743
F-statistic	0.236322	Durbin-Watson stat	1.971939
Prob(F-statistic)	0.999312		

7.2.1 ECM (quarterly frequency)

Table 23: Normality test (quarterly data)

Series: Residuals	
Sample 6/01/2004 3/01/2017	
Observations 52	
Mean	-3.69E-18
Median	0.003838
Maximum	0.120977
Minimum	-0.157
Std. Dev.	0.060543
Skewness	-0.33089
Kurtosis	3.172076
Jarque-Bera	1.013022
Probability	0.602594

Table 24: Linearity test (quarterly data)

Ramsey RESET Test
Specification: DLOG(HPI) DLOG(HD) DLOG(HS) DLOG(CPI) D(IR) DLOG(OP) DLOG(KSE) DLOG(GP) U(-1) DUMMY17Q1 C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.522795	41	0.6039
F-statistic	0.273315	(1, 41)	0.6039
Likelihood ratio	0.345493	1	0.5567

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.001238	1	0.001238
Restricted SSR	0.18694	42	0.004451
Unrestricted SSR	0.185702	41	0.004529

LR test summary:

	Value	df
Restricted LogL	72.5487	42
Unrestricted LogL	72.72145	41

Unrestricted Test Equation:
Dependent Variable: DLOG(HPI)
Method: Least Squares
Sample: 6/01/2004 3/01/2017
Included observations: 52

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(HD)	-0.031993	0.502868	-0.063621	0.9496
DLOG(HS)	0.004504	0.498063	0.009042	0.9928
DLOG(CPI)	1.084718	1.379542	0.786289	0.4362
D(IR)	2.191981	2.998379	0.731055	0.4689
DLOG(OP)	0.151884	0.071558	2.122538	0.0399
DLOG(KSE)	-0.02934	0.102254	-0.286933	0.7756
DLOG(GP)	-0.183173	0.157729	-1.161315	0.2522
U(-1)	-0.443471	0.152526	-2.90751	0.0059
DUMMY17Q1	-0.112923	0.106793	-1.057402	0.2965
C	0.01862	0.022101	0.842483	0.4044
FITTED^2	-4.009531	7.66941	-0.522795	0.6039

R-squared	0.308147	Mean dependent var	0.014376
Adjusted R-squared	0.139402	S.D. dependent var	0.072546
S.E. of regression	0.0673	Akaike info criterion	-2.373902
Sum squared resid	0.185702	Schwarz criterion	-1.961139
Log likelihood	72.72145	Hannan-Quinn criter.	-2.215658
F-statistic	1.826114	Durbin-Watson stat	2.157282
Prob(F-statistic)	0.086206		

Table 25: Heteroskedasticity Test (quarterly data)

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.012831	Prob. F(9,42)	0.4454
Obs*R-squared	9.273214	Prob. Chi-Square(9)	0.4124
Scaled explained SS	6.570027	Prob. Chi-Square(9)	0.6818

Dependent Variable: RESID^2
Method: Least Squares
Sample: 6/01/2004 3/01/2017
Included observations: 52

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003397	0.001459	2.328561	0.0248
DLOG(HD)	-0.011925	0.039309	-0.30336	0.7631
DLOG(HS)	0.011645	0.03894	0.299055	0.7664
DLOG(CPI)	0.030626	0.108671	0.281819	0.7795
D(IR)	0.246059	0.236401	1.040853	0.3039
DLOG(OP)	-0.002791	0.005073	-0.550238	0.5851
DLOG(KSE)	-0.003449	0.008002	-0.431028	0.6687
DLOG(GP)	0.00946	0.012428	0.761128	0.4508
U(-1)	0.026484	0.010531	2.514958	0.0158
DUMMY17Q1	-0.001111	0.006196	-0.179343	0.8585

R-squared	0.178331	Mean dependent var	0.003595
Adjusted R-squared	0.002259	S.D. dependent var	0.00535
S.E. of regression	0.005344	Akaike info criterion	-7.454666
Sum squared resid	0.001199	Schwarz criterion	-7.079426
Log likelihood	203.8213	Hannan-Quinn criter.	-7.310808
F-statistic	1.012831	Durbin-Watson stat	2.400271
Prob(F-statistic)	0.445448		

Table 26: Autoregressive test (quarterly data)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.312136	Prob. F(2,40)	0.2806
Obs*R-squared	3.201513	Prob. Chi-Square(2)	0.2017

Dependent Variable: RESID
Method: Least Squares
Sample: 6/01/2004 3/01/2017
Included observations: 52
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(HD)	0.248569	0.513457	0.484108	0.6309
DLOG(HS)	-0.234396	0.506149	-0.463097	0.6458
DLOG(CPI)	0.456037	1.387709	0.328626	0.7442
D(IR)	-0.270705	2.945428	-0.091907	0.9272
DLOG(OP)	-0.009403	0.063141	-0.148913	0.8824
DLOG(KSE)	-0.007547	0.099276	-0.07602	0.9398
DLOG(GP)	-0.06959	0.160185	-0.434438	0.6663
U(-1)	0.290949	0.23182	1.255063	0.2167
DUMMY17Q1	0.039352	0.080687	0.487718	0.6284
C	-0.008655	0.018857	-0.458967	0.6487
RESID(-1)	-0.402497	0.287457	-1.4002	0.1692
RESID(-2)	-0.271195	0.193267	-1.403213	0.1683

R-squared	0.061568	Mean dependent var	-3.69E-18
Adjusted R-squared	-0.196501	S.D. dependent var	0.060543
S.E. of regression	0.066225	Akaike info criterion	-2.392341
Sum squared resid	0.17543	Schwarz criterion	-1.942054
Log likelihood	74.20086	Hannan-Quinn criter.	-2.219711
F-statistic	0.23857	Durbin-Watson stat	1.940981
Prob(F-statistic)	0.992906		

7.3 Variables correlations

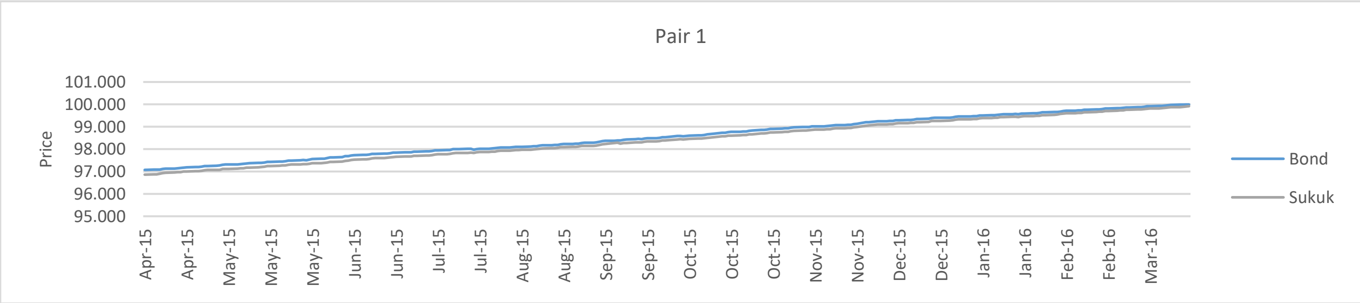
Table 27: Correlation and Variance Inflation Factor (VIF) tests for Multicollinearity

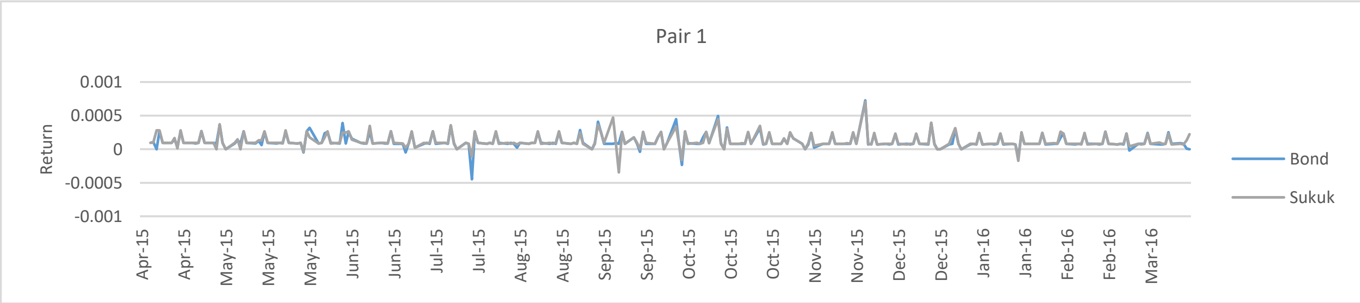
	D(LHD)	D(LHS)	D(LCPI)	D(LOP)	D(IR)	D(LKSE)	D(LGP)	VIF
D(LHD)	1	0.991327	-0.03654	0.115723	0.088149	0.066799	-0.01228	43.3802
D(LHS)	0.991327	1	-0.04108	0.100547	0.088807	0.058429	-0.01776	45.3309
D(LCPI)	-0.03654	-0.04108	1	-0.04185	-0.07515	0.009003	0.006791	1.2769
D(LOP)	0.115723	0.100547	-0.04185	1	0.238009	0.259705	0.176109	1.0731
D(IR)	0.088149	0.088807	-0.07515	0.238009	1	0.110361	0.044254	1.1898
D(LKSE)	0.066799	0.058429	0.009003	0.259705	0.110361	1	-0.08399	1.0991
D(LGP)	-0.01228	-0.01776	0.006791	0.176109	0.044254	-0.08399	1	1.0417

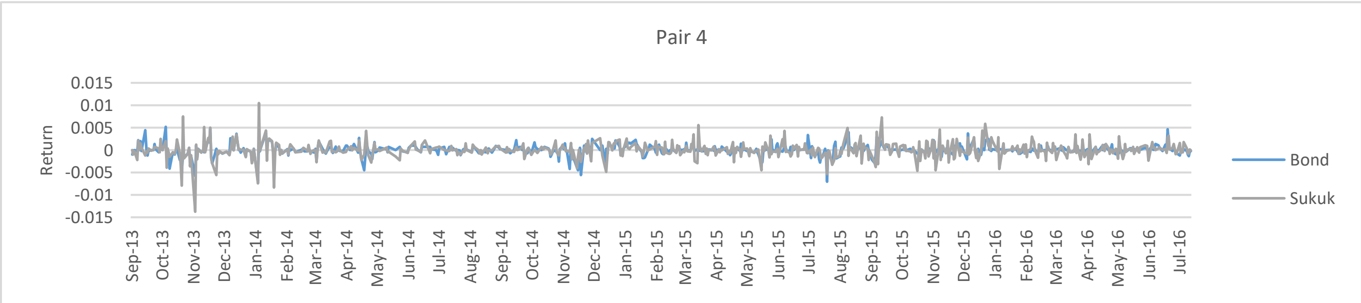
Third Paper Appendices

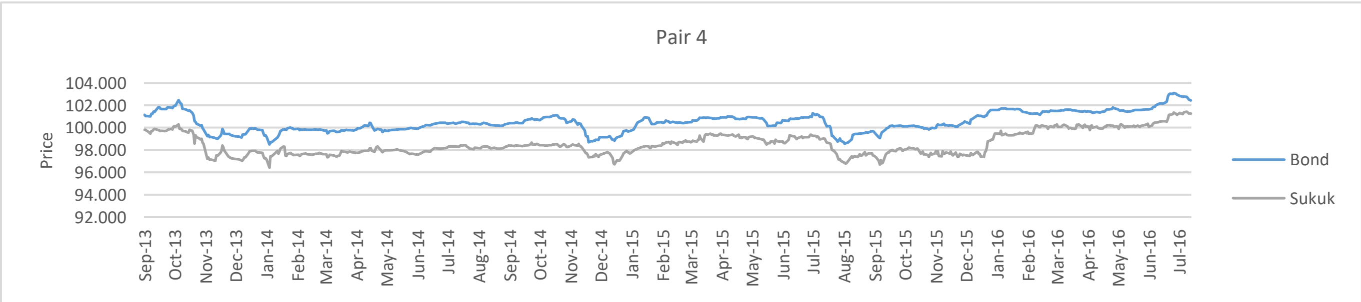
7.3 appendices for the third paper

7.3.1 Graph 3: Pairs price and return observations over time.

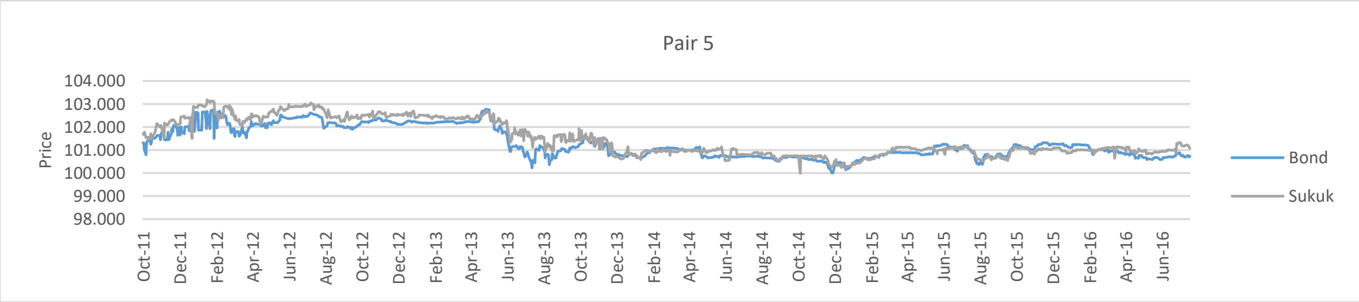


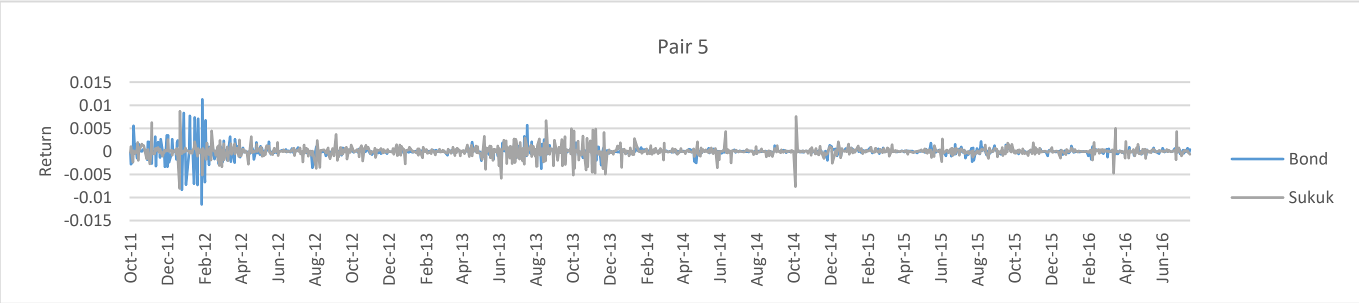


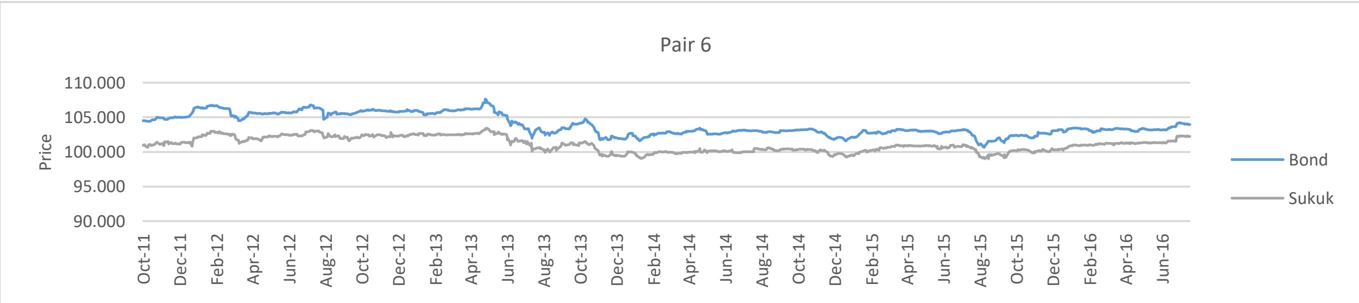


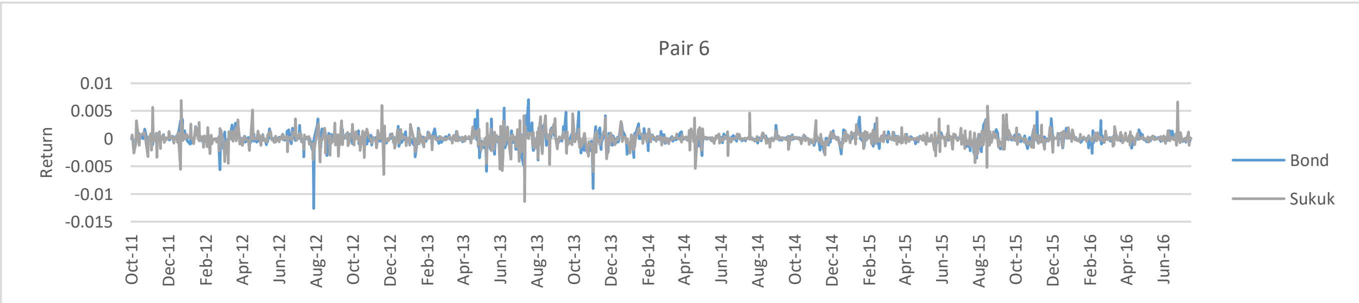


7.3.1 Graph 3: Pairs price and return observations over time(continued)

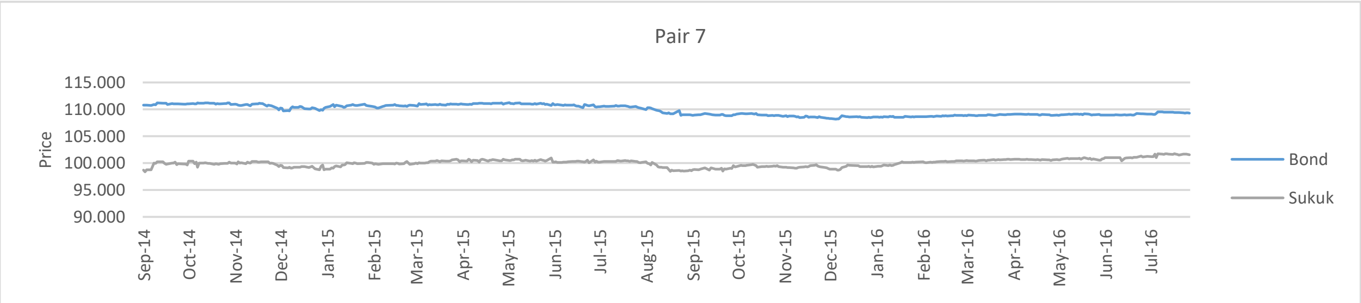


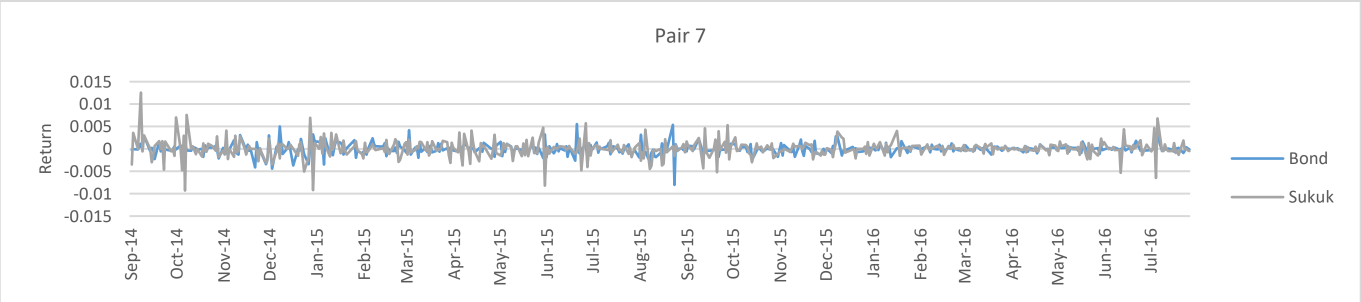


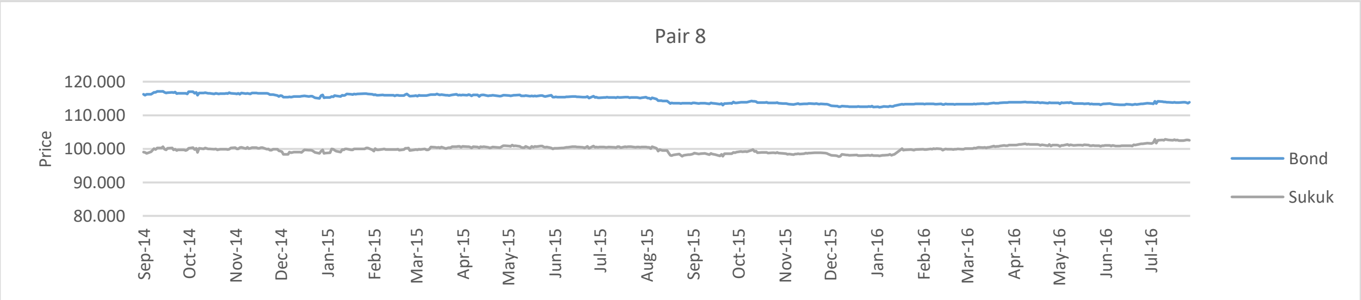


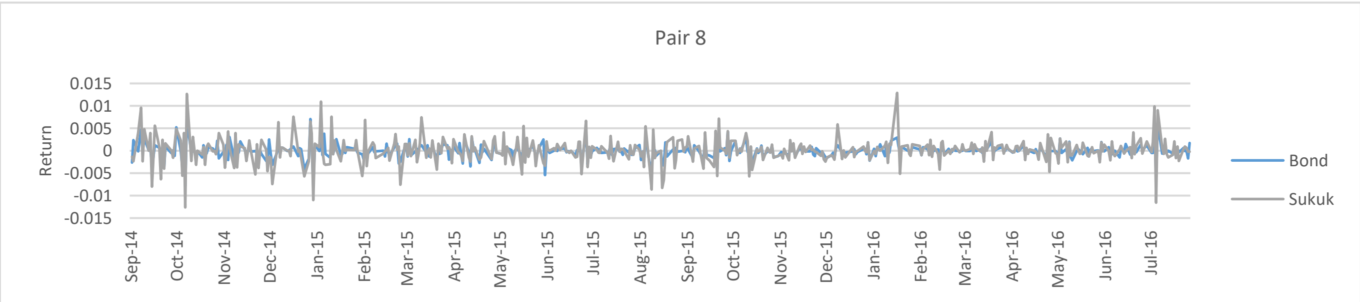


7.3.1 Graph 3: Pairs price and return observations over time(continued)

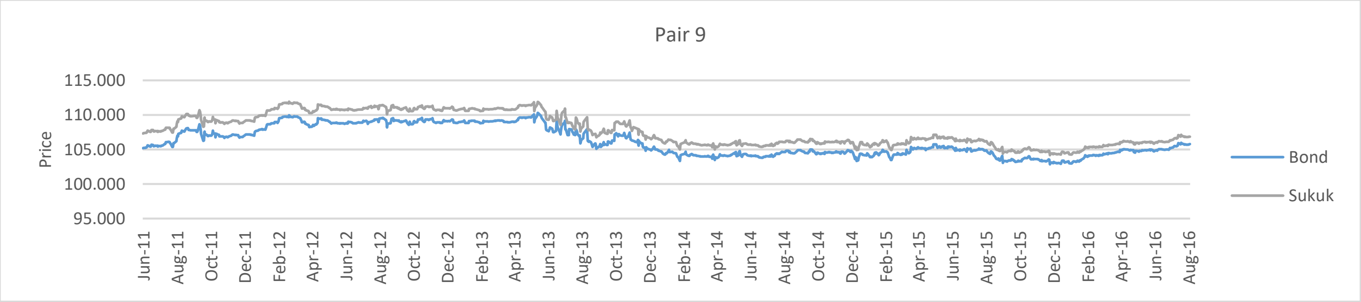


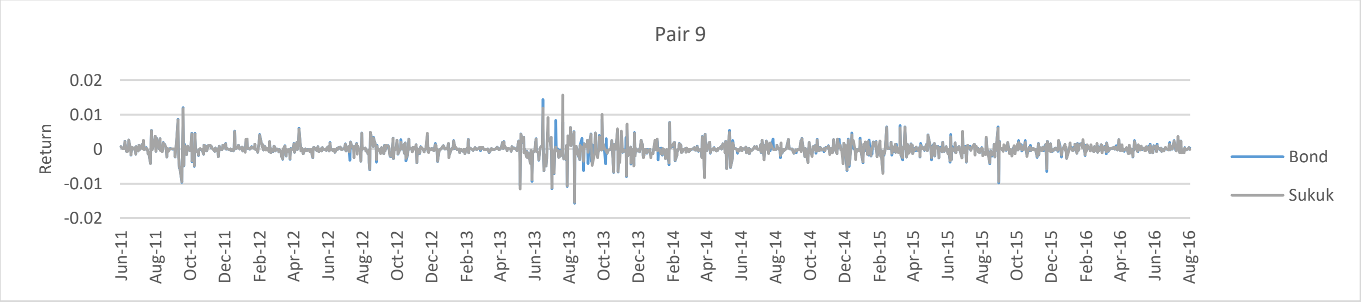


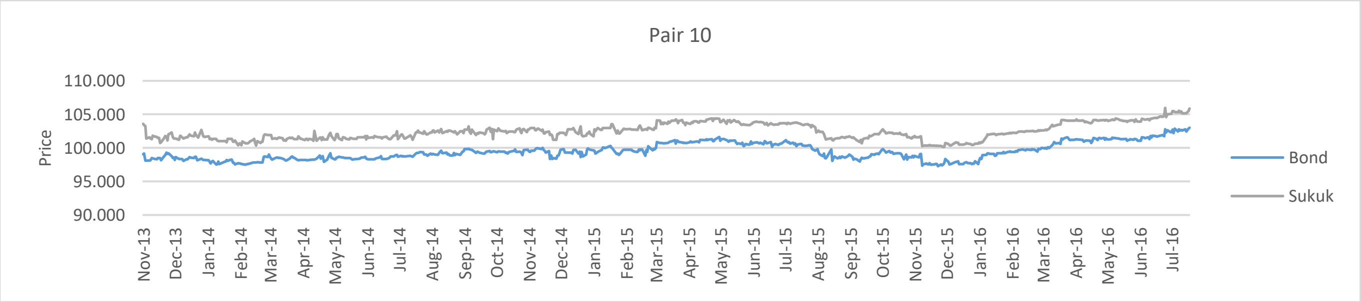


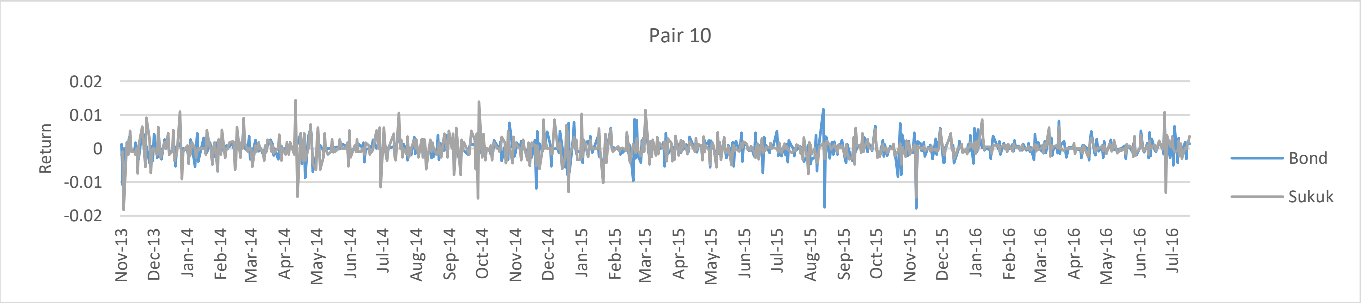


7.3.1 Graph 3: Pairs price and return observations over time(continued)

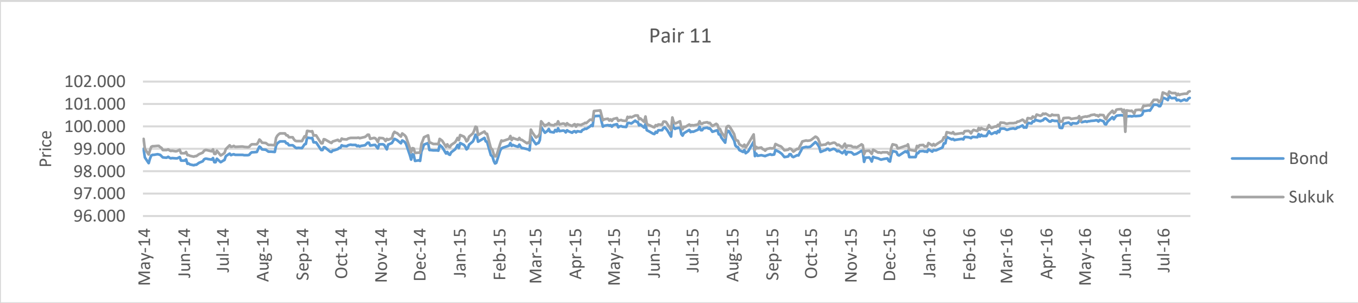


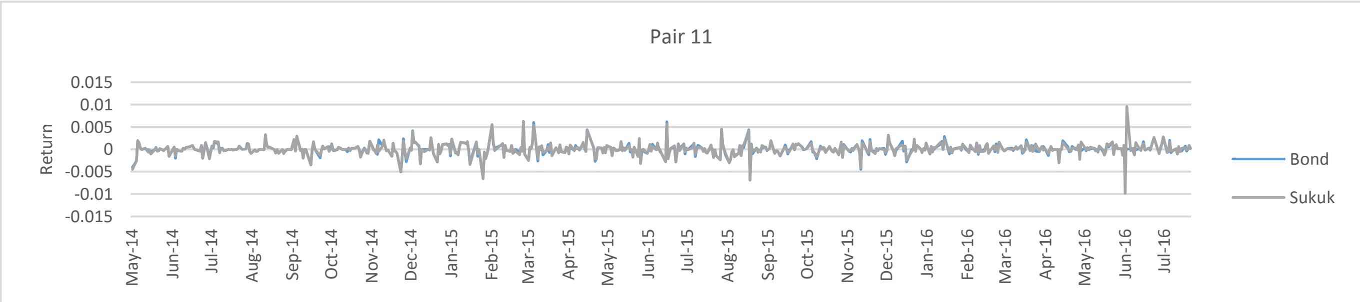


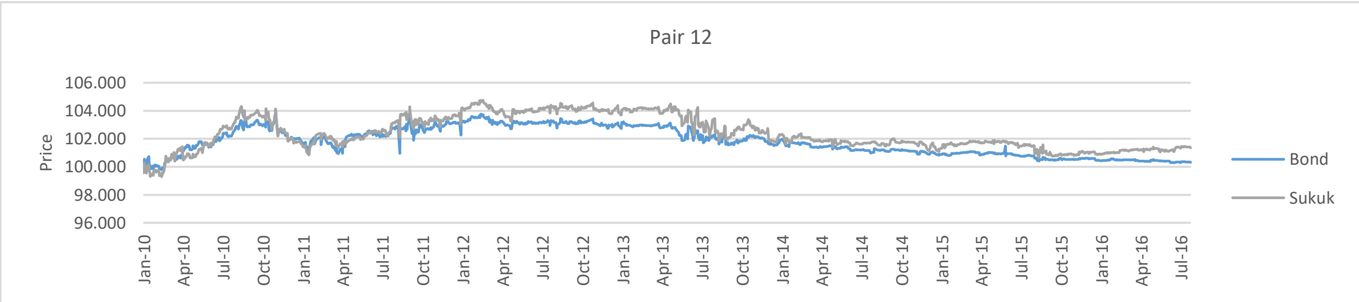


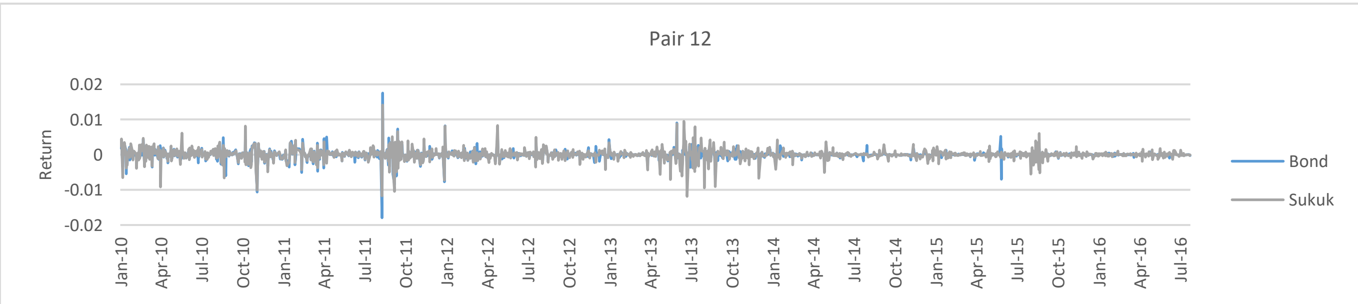


7.3.1 Graph 3: Pairs price and return observations over time(continued)

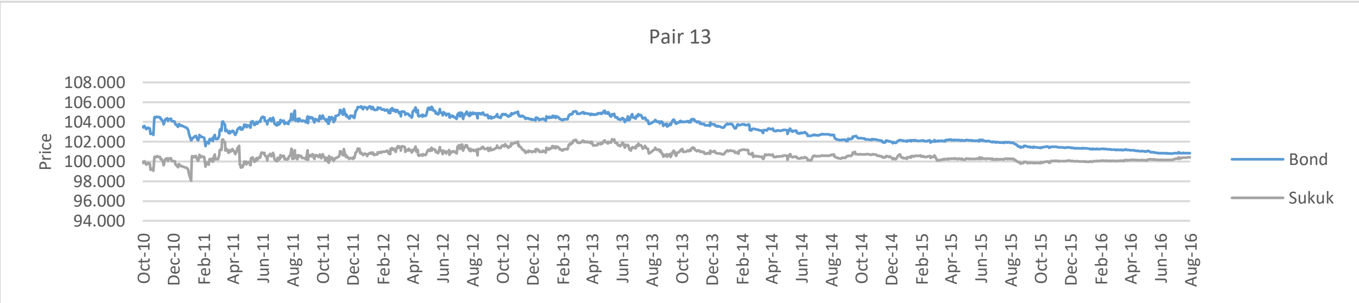


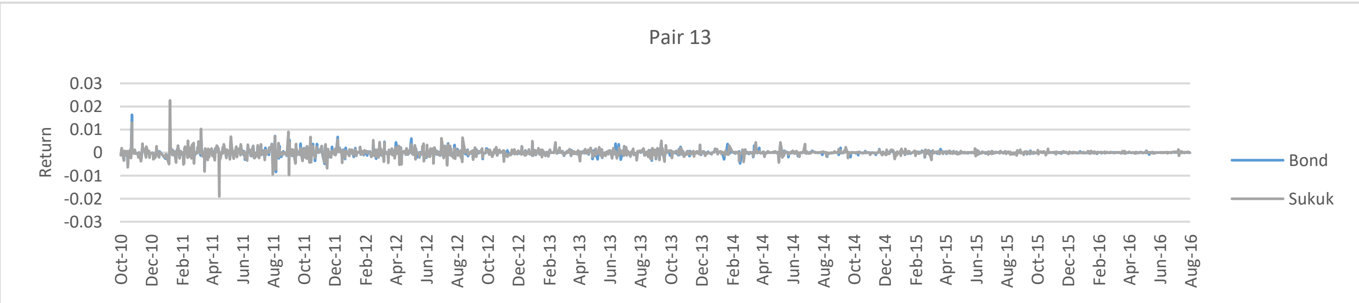


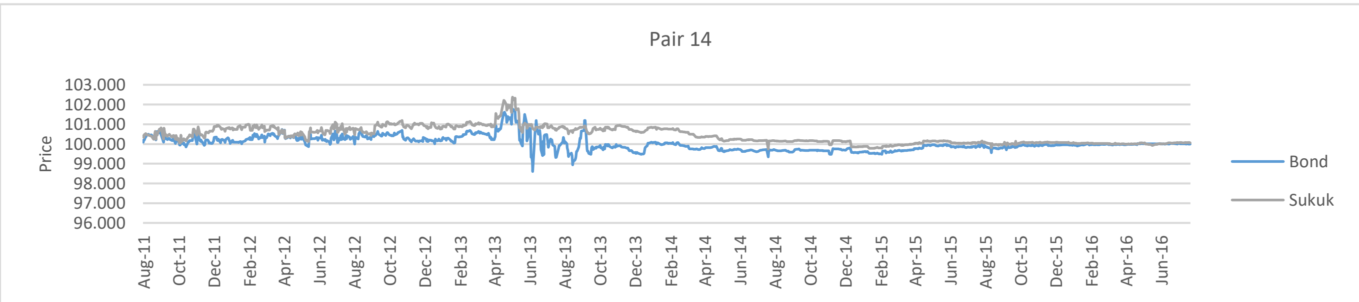


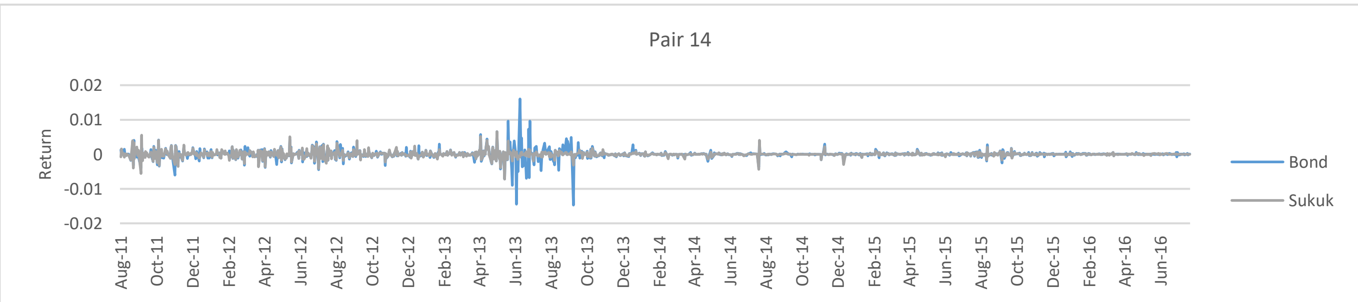


7.3.1 Graph 3: Pairs price and return observations over time(continued)

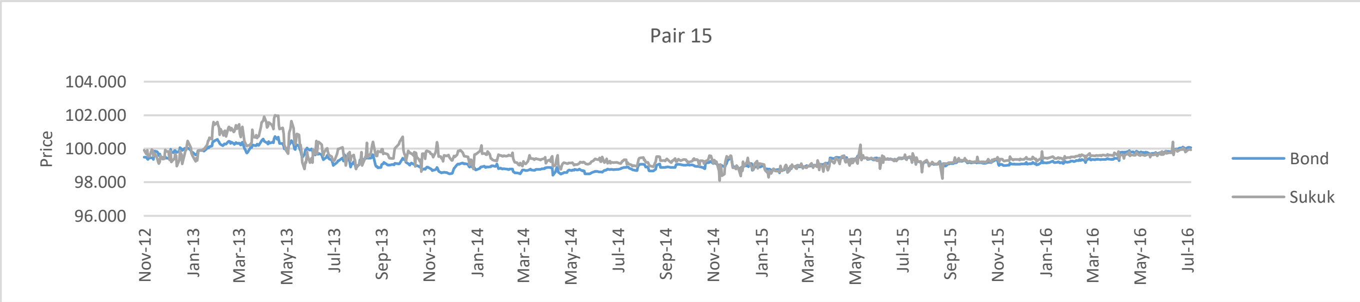


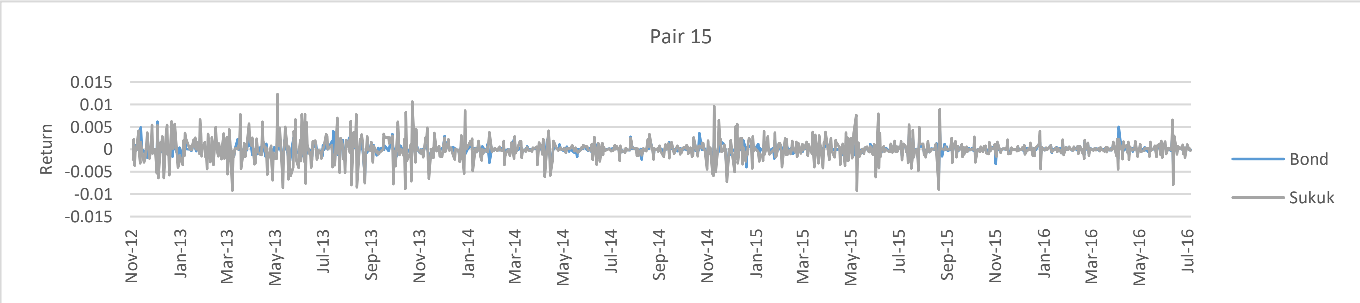


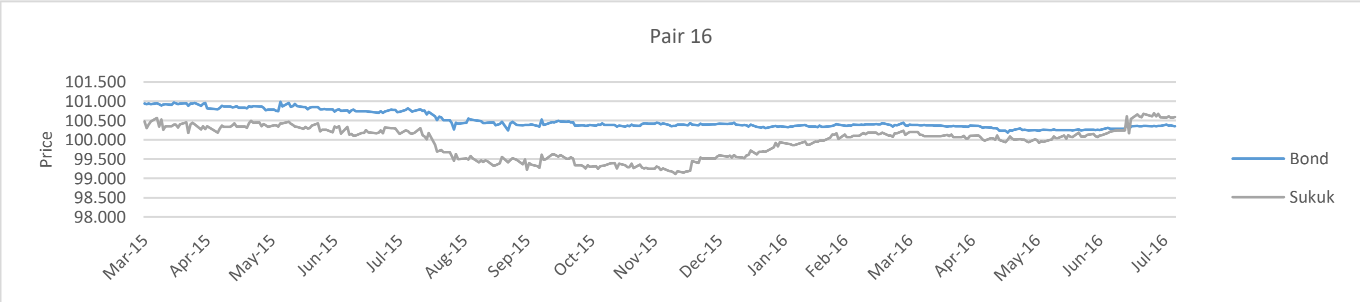


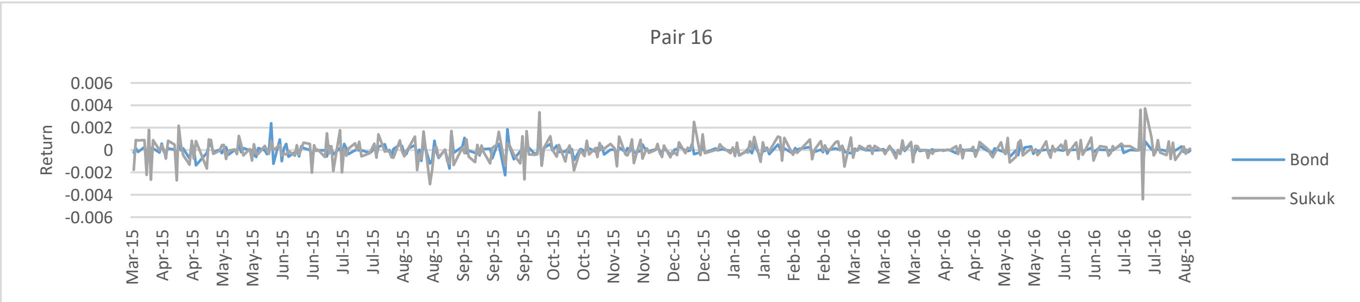


7.3.1 Graph 3: Pairs price and return observations over time(continued)

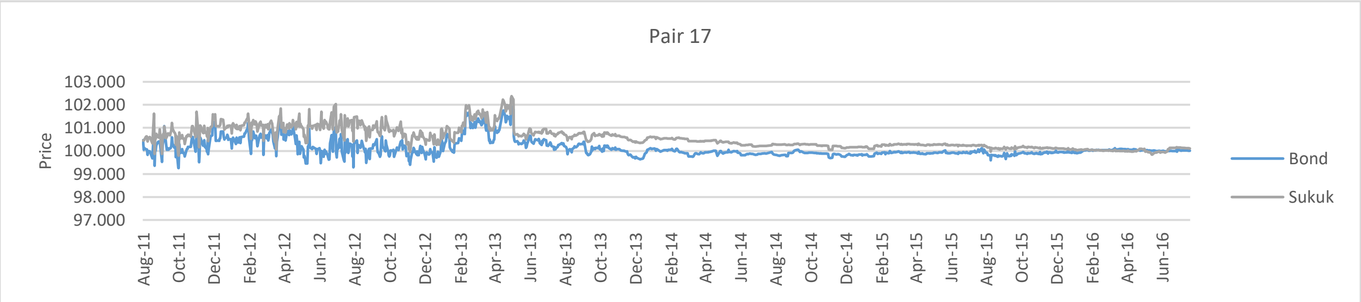


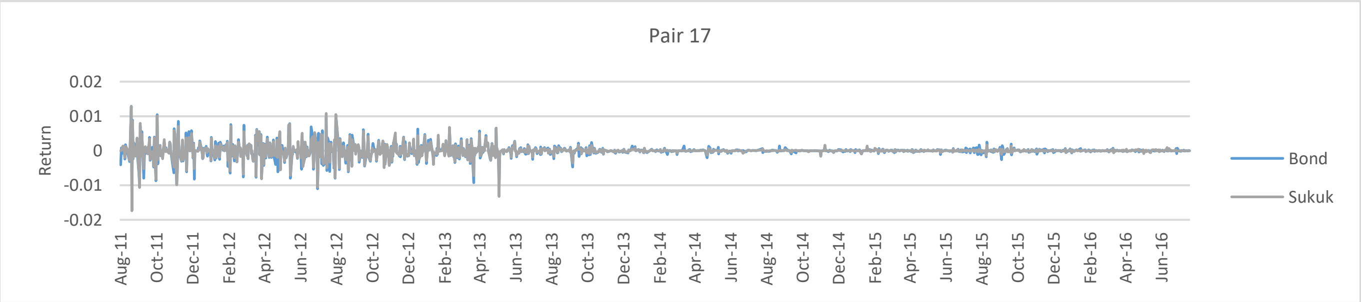


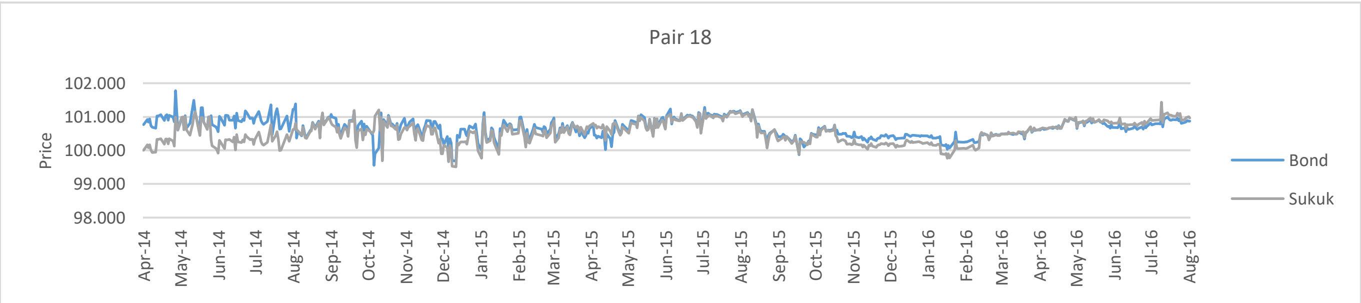


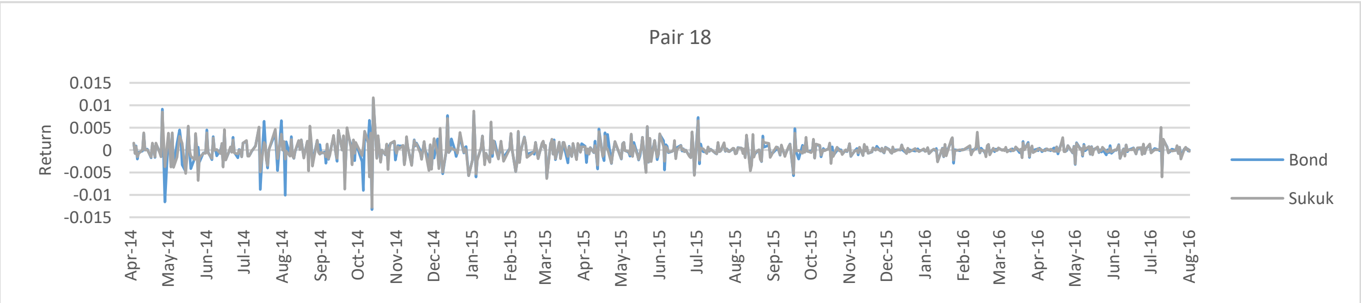


7.3.1 Graph 3: Pairs price and return observations over time(continued)

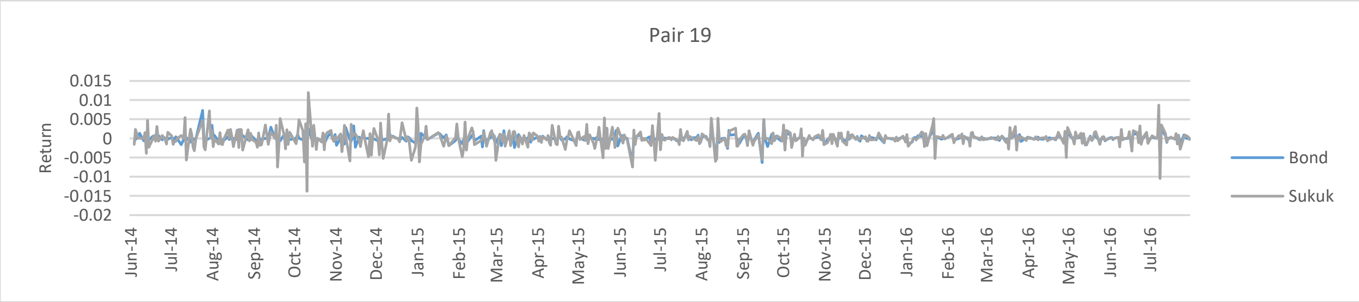


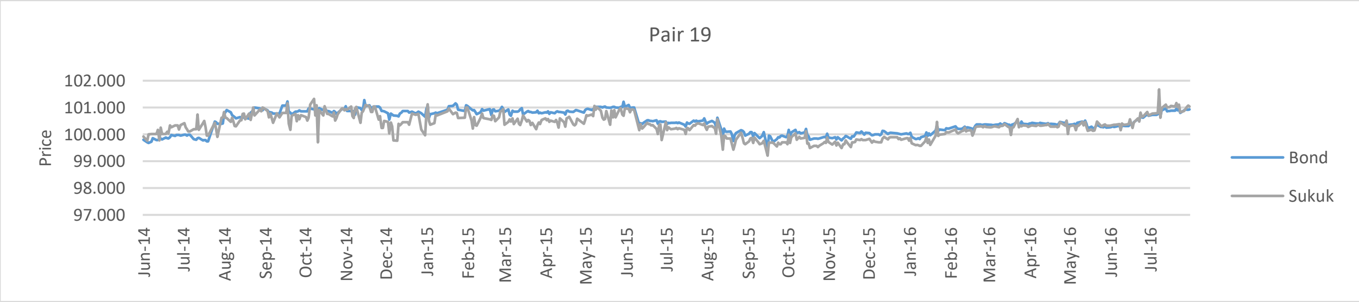


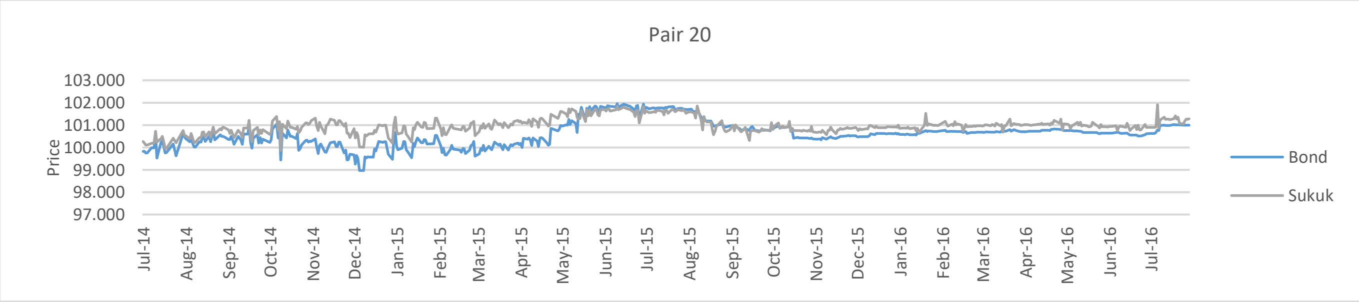


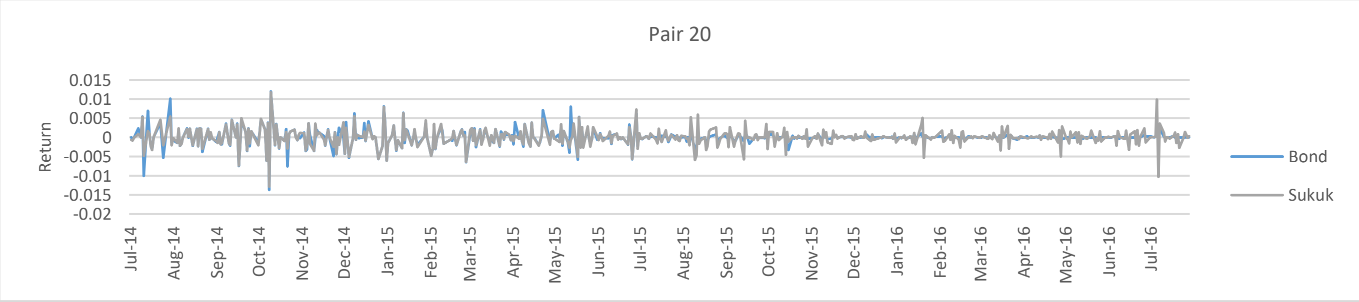


7.3.1 Graph 3: Pairs price and return observations over time(continued)

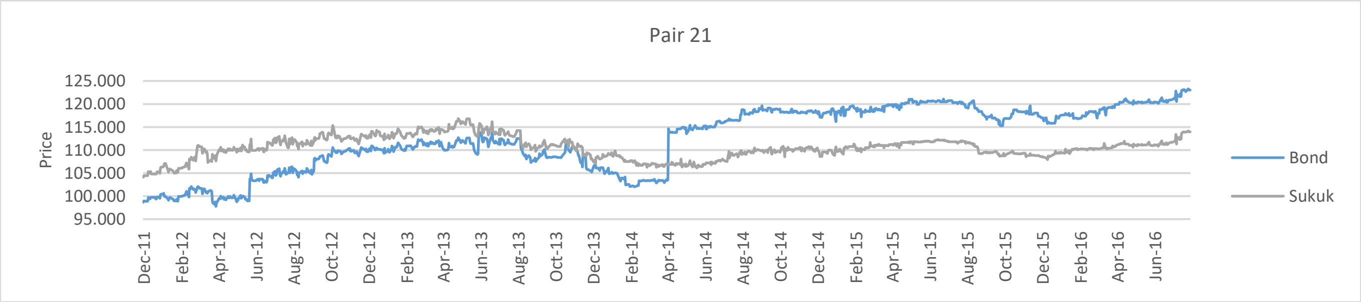


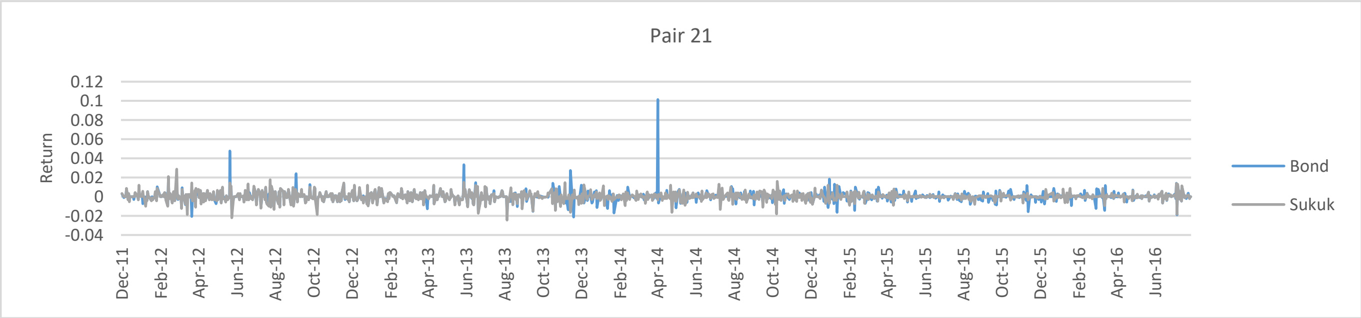






7.3.1 Graph 3: Pairs price and return observations over time(continued)





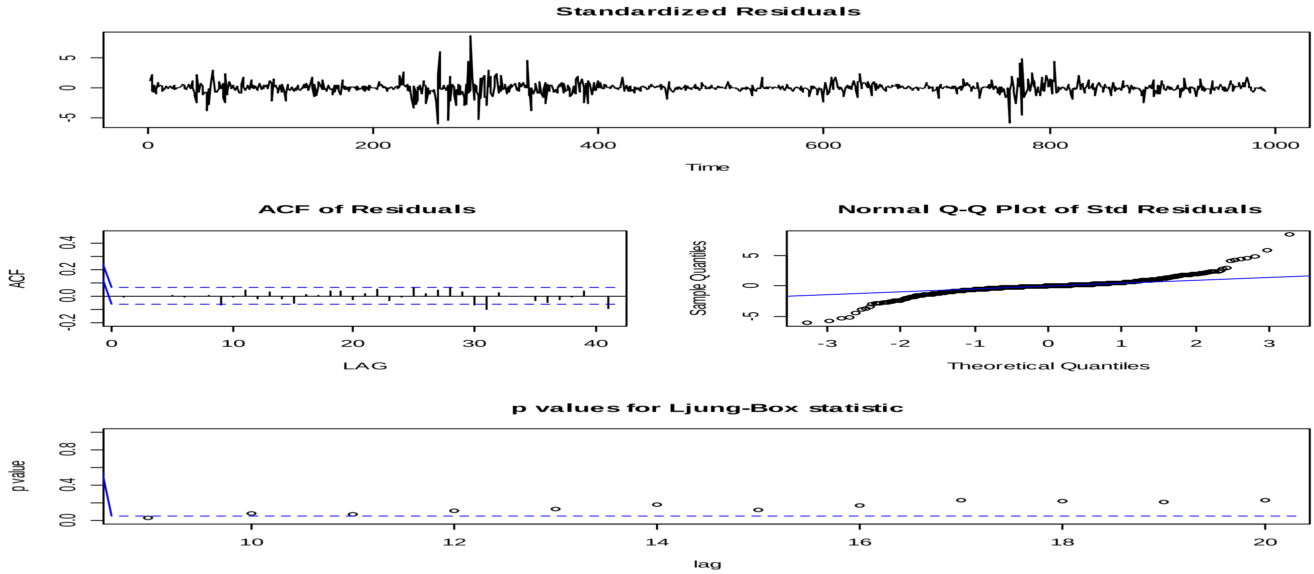
7.3.2 mean model order

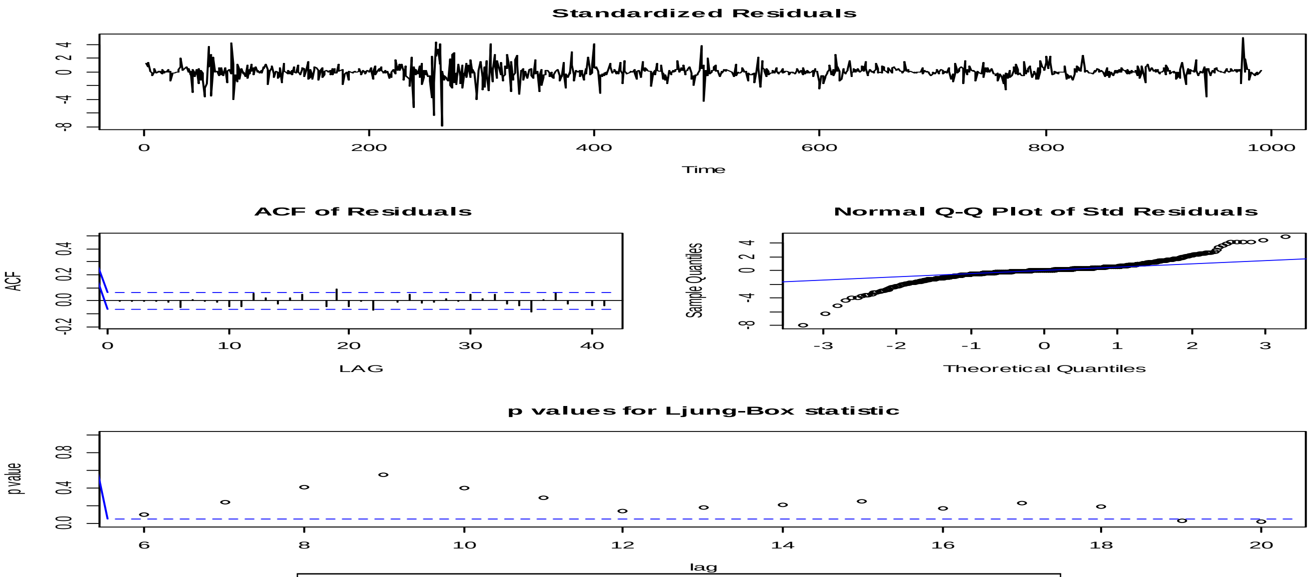
Table 8: Mean model order

Pairs	Type	AR	I	MA
Pair 1	Bond	1	0	1
	Sukuk (Bai'Inah)	1	0	1
Pair 2	Bond	8	0	0
	Sukuk (Bai Bithaman Ajil)	5	0	0
Pair 3	Bond	0	0	2
	Sukuk (Bai Bithaman Ajil)	4	0	1
Pair 4	Bond	1	0	1
	Sukuk (Murabahah)	7	0	0
Pair 5	Bond	5	0	0
	Sukuk (Bai Bithaman Ajil)	1	0	1
Pair 6	Bond	0	0	2
	Sukuk (Bai Bithaman Ajil)	0	0	1
Pair 7	Bond	0	0	1
	Sukuk (Murabahah)	0	0	1
Pair 8	Bond	0	0	1
	Sukuk (Murabahah)	0	0	1
Pair 9	Bond	0	0	5
	Sukuk (not spisified)	0	0	7
Pair 10	Bond	0	0	1
	Sukuk (not spisified)	0	0	1
Pair 11	Bond	1	0	0
	Sukuk (not spisified)	1	0	0
Pair 12	Bond	1	0	6
	Sukuk (Ijara)	1	0	6
Pair 13	Bond	1	0	1
	Sukuk (Musharakah)	1	0	1
Pair 14	Bond	4	0	4
	Sukuk (Musharakah)	0	0	4
Pair 15	Bond	2	0	1
	Sukuk (Musharakah)	2	0	1
Pair 16	Bond	0	0	1
	Sukuk (Wakala bil-Istithmar)	1	0	2
Pair 17	Bond	2	0	1
	Sukuk (Musharakah)	2	0	1
Pair 18	Bond	1	0	1
	Sukuk (Musharakah)	1	0	1
Pair 19	Bond	0	0	1
	Sukuk (Murabahah)	0	0	1
Pair 20	Bond	1	0	1
	Sukuk (Murabahah)	1	0	1
Pair 21	Bond	1	0	1
	Sukuk (Musharakah)	1	0	4

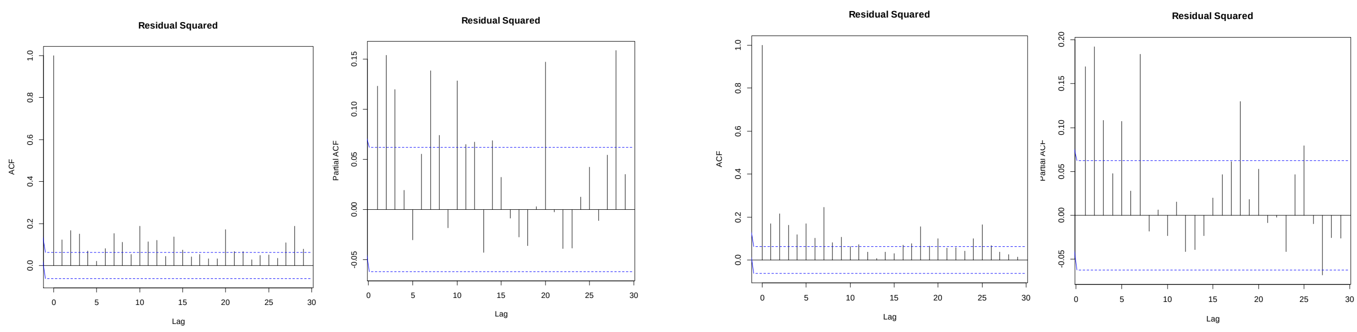
7.3.3 Diagnostic tests for each Pair

Pair 2: Autoregressive test result for bond and sukuk (respectively)



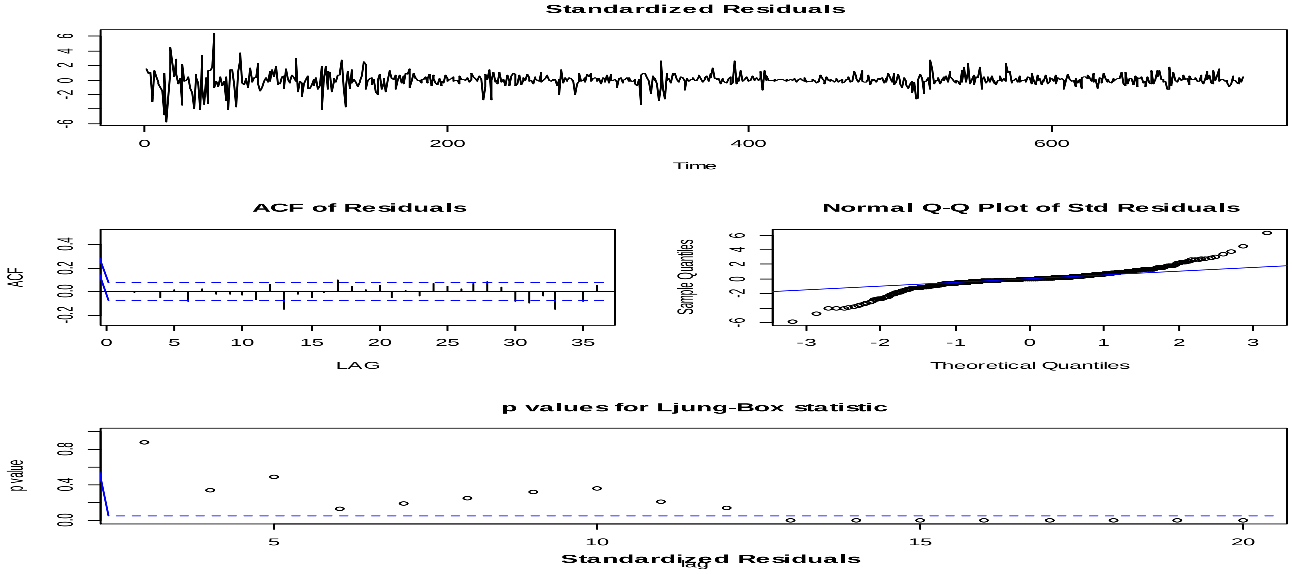


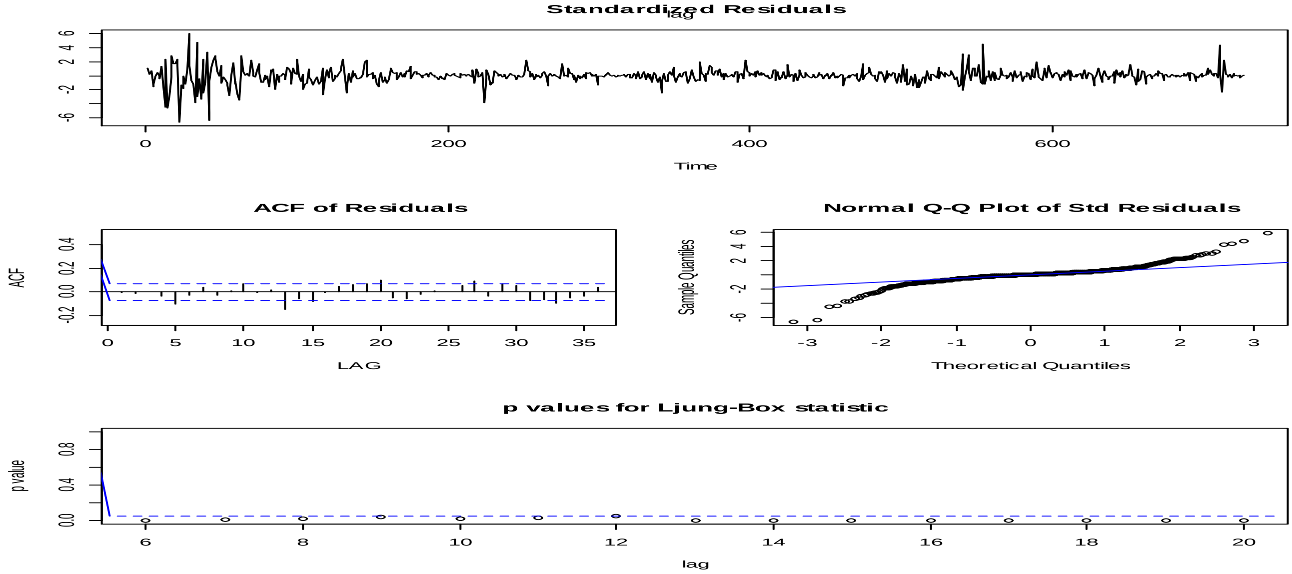
Pair 2: ARCH affect test result for bond and sukuk (respectively)



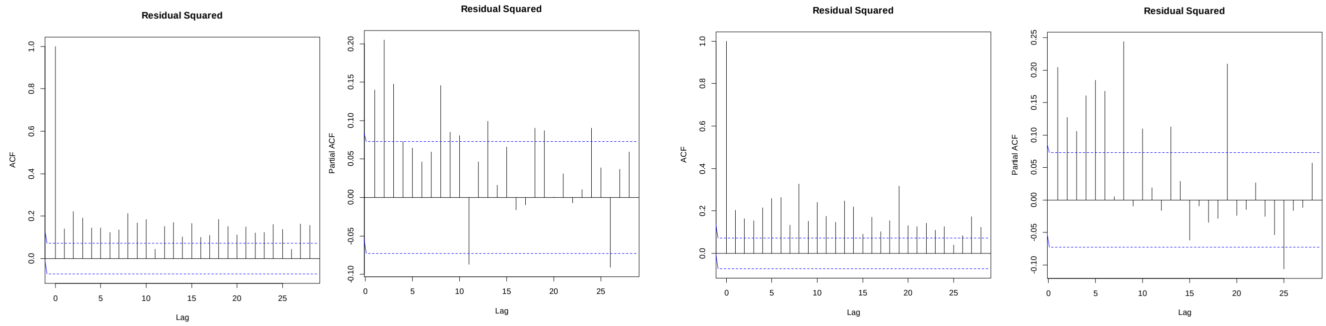
7.3.3 Diagnostic tests for each Pair (continued)

Pair 3: Autoregressive test result for bond and sukuk (respectively)



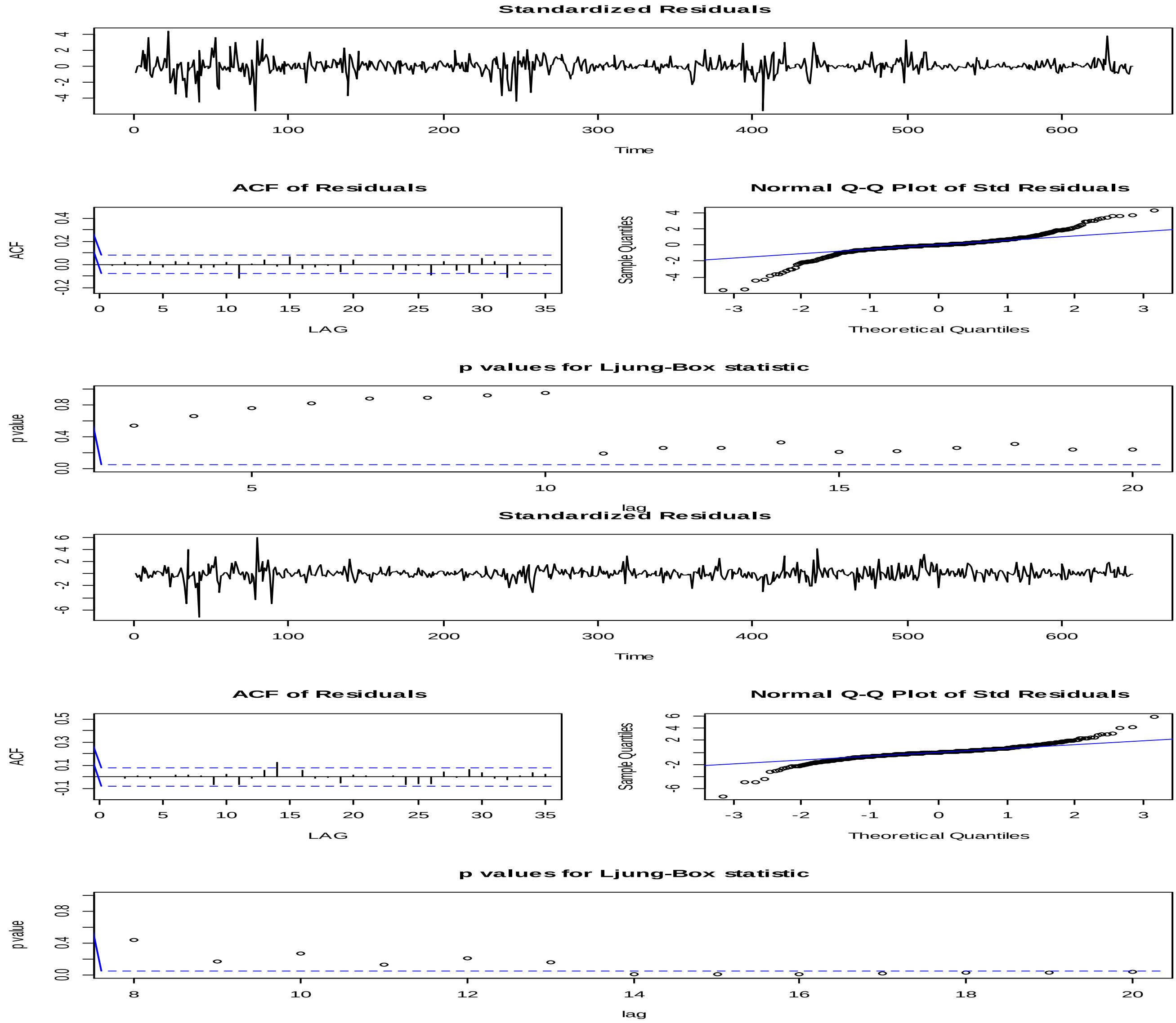


Pair 3: ARCH affect test result for bond and sukuk (respectively)

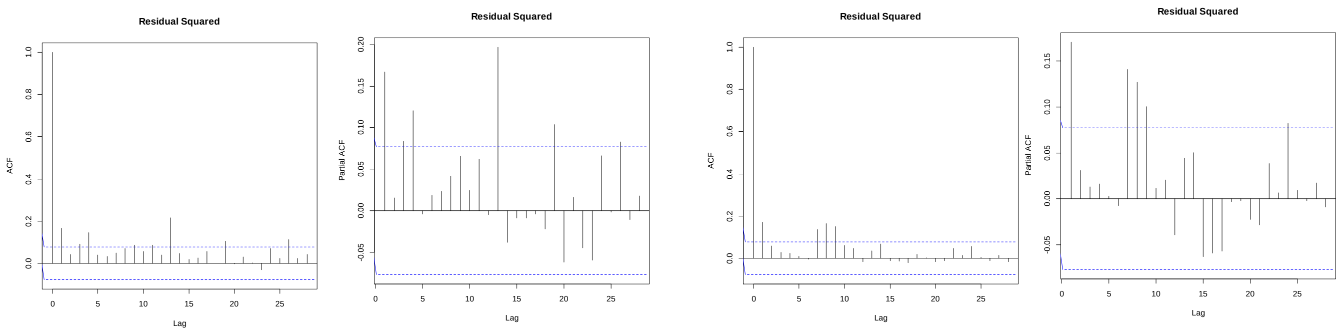


7.3.3 Diagnostic tests for each Pair (continued)

Pair 4: Autoregressive test result for bond and sukuk (respectively)

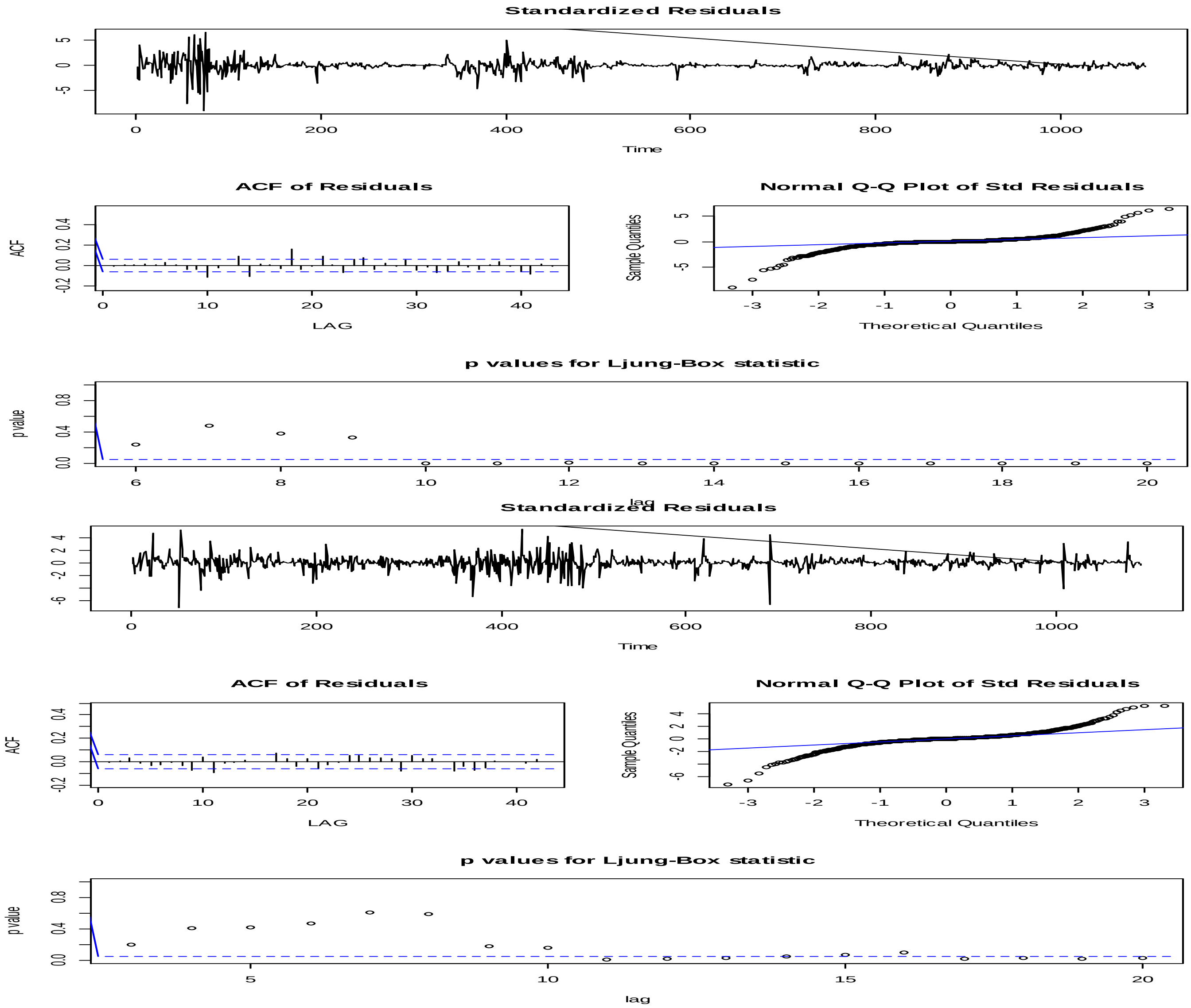


Pair 4: ARCH affect test result for bond and sukuk (respectively)

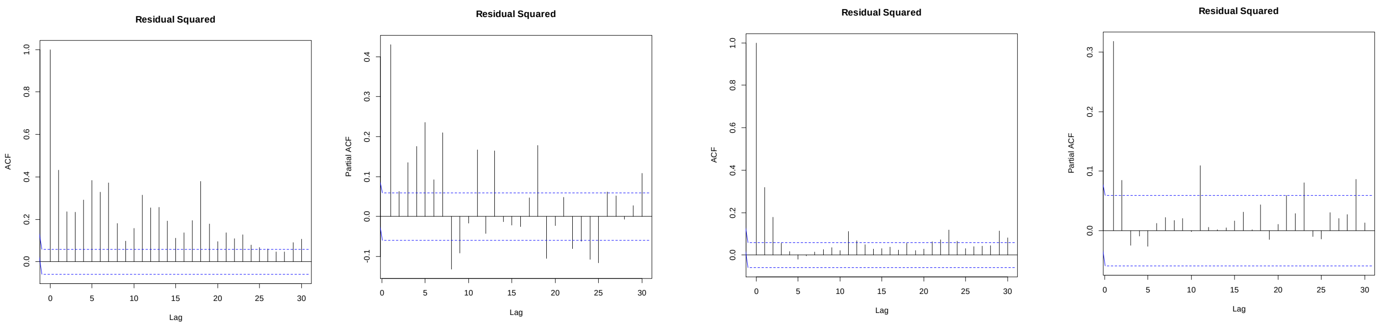


7.3.3 Diagnostic tests for each Pair (continued)

Pair 5: Autoregressive test result for bond and sukuk (respectively)

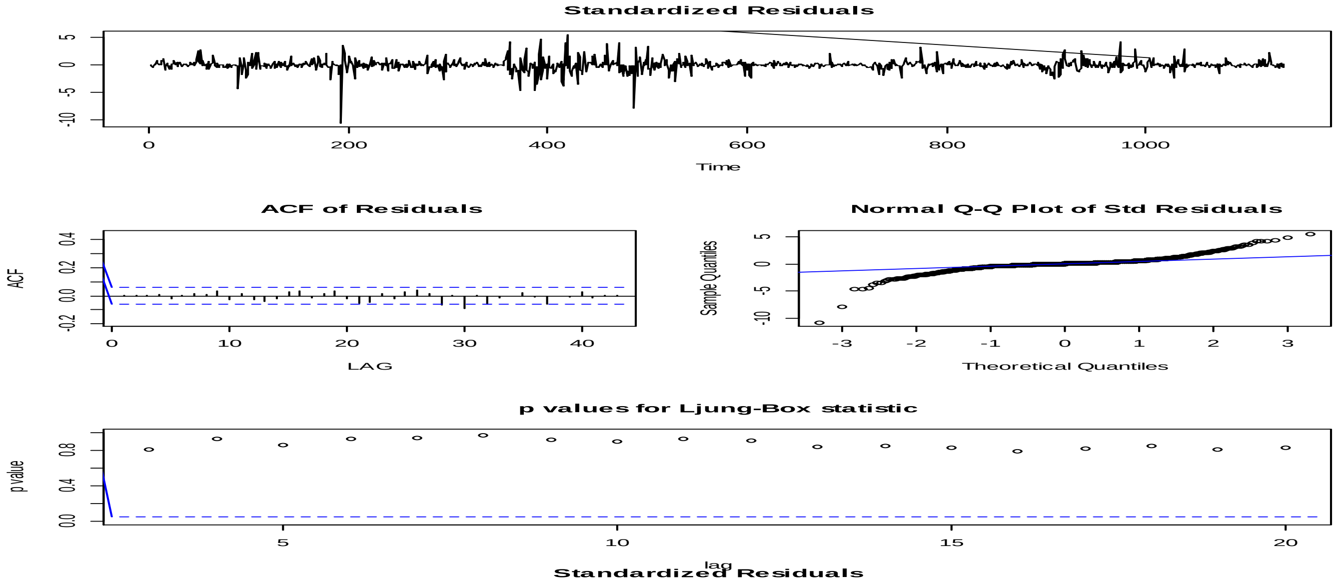


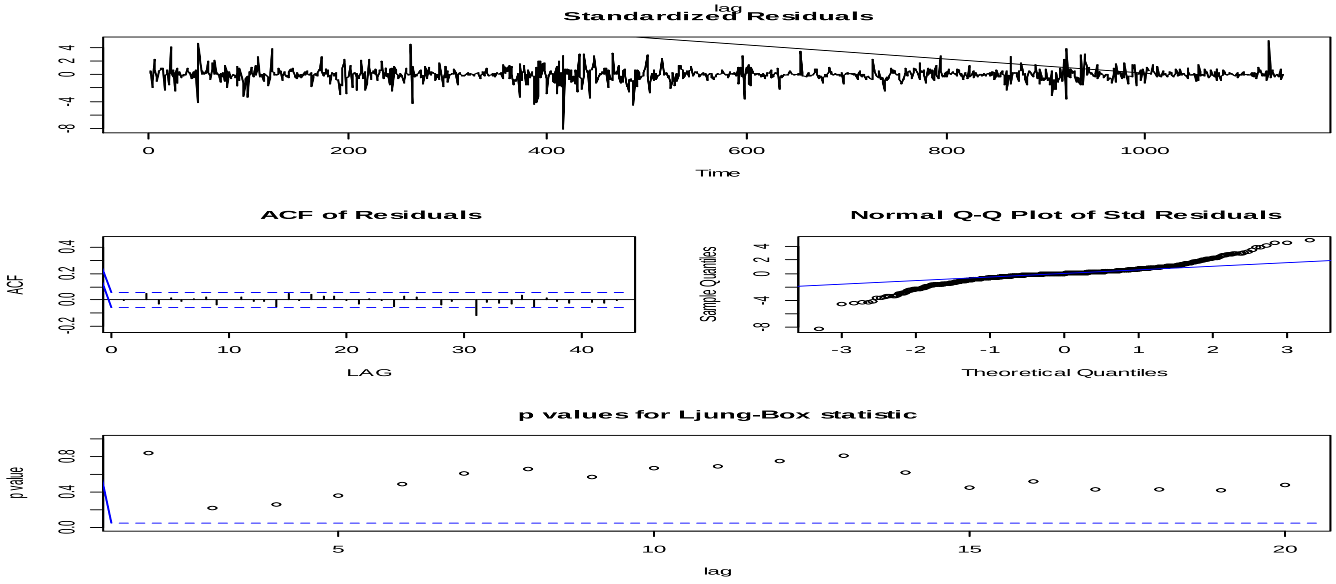
Pair 5: ARCH affect test result for bond and sukuk (respectively)



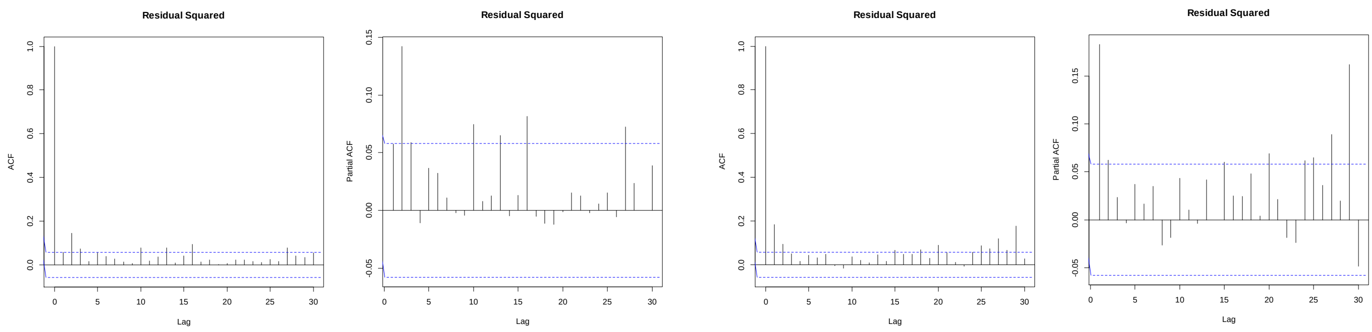
7.3.3 Diagnostic tests for each Pair (continued)

Pair 6: Autoregressive test result for bond and sukuk (respectively)



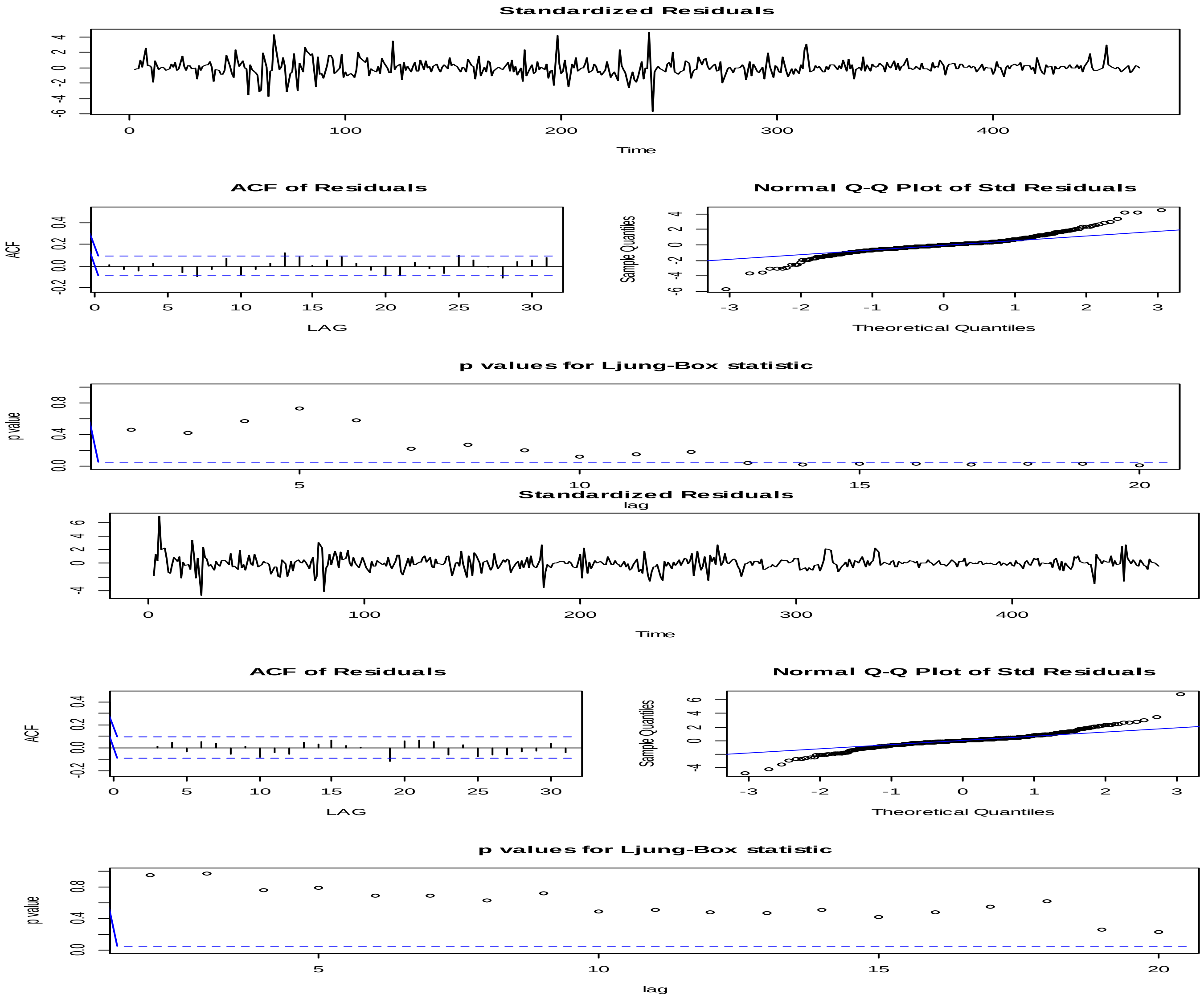


Pair 6: ARCH affect test result for bond and sukuk (respectively)

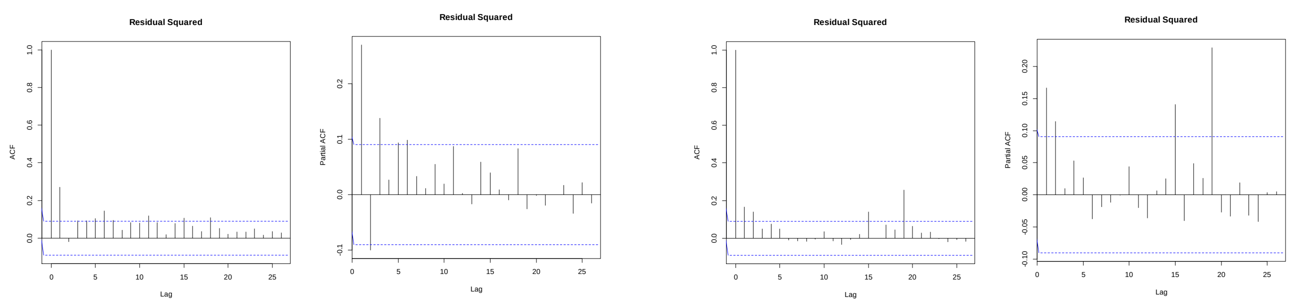


7.3.3 Diagnostic tests for each Pair (continued)

Pair 7: Autoregressive test result for bond and sukuk (respectively)

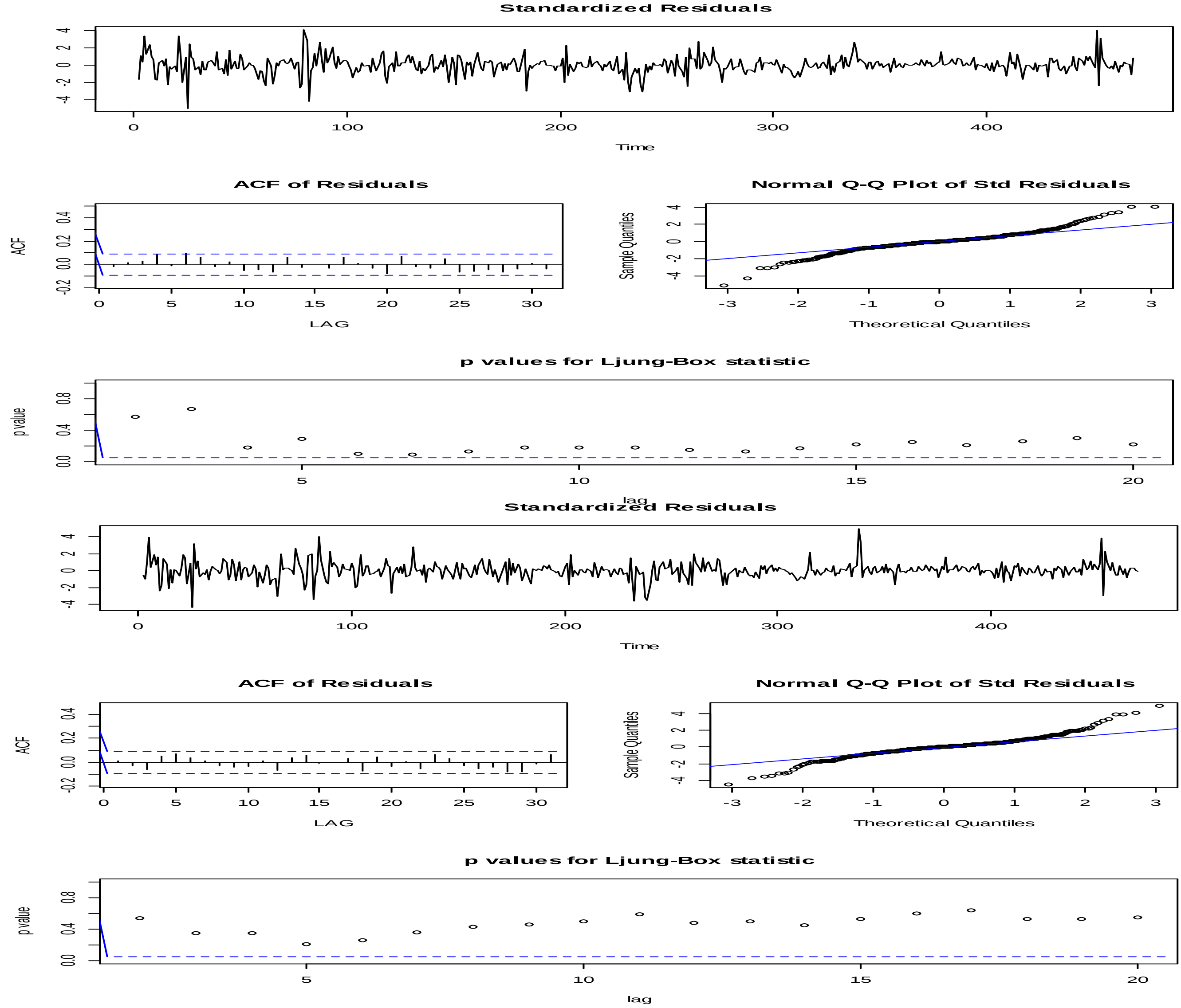


Pair 7: ARCH affect test result for bond and sukuk (respectively)

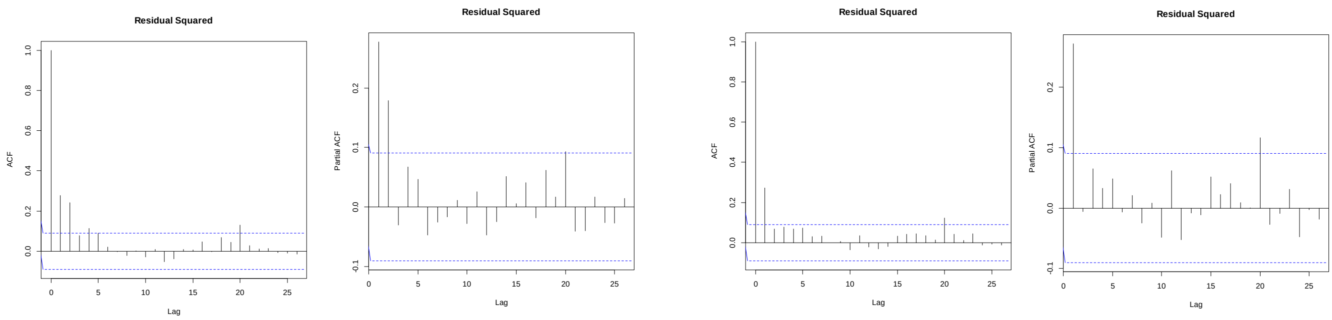


7.3.3 Diagnostic tests for each Pair (continued)

Pair 8: Autoregressive test result for bond and sukuk (respectively)

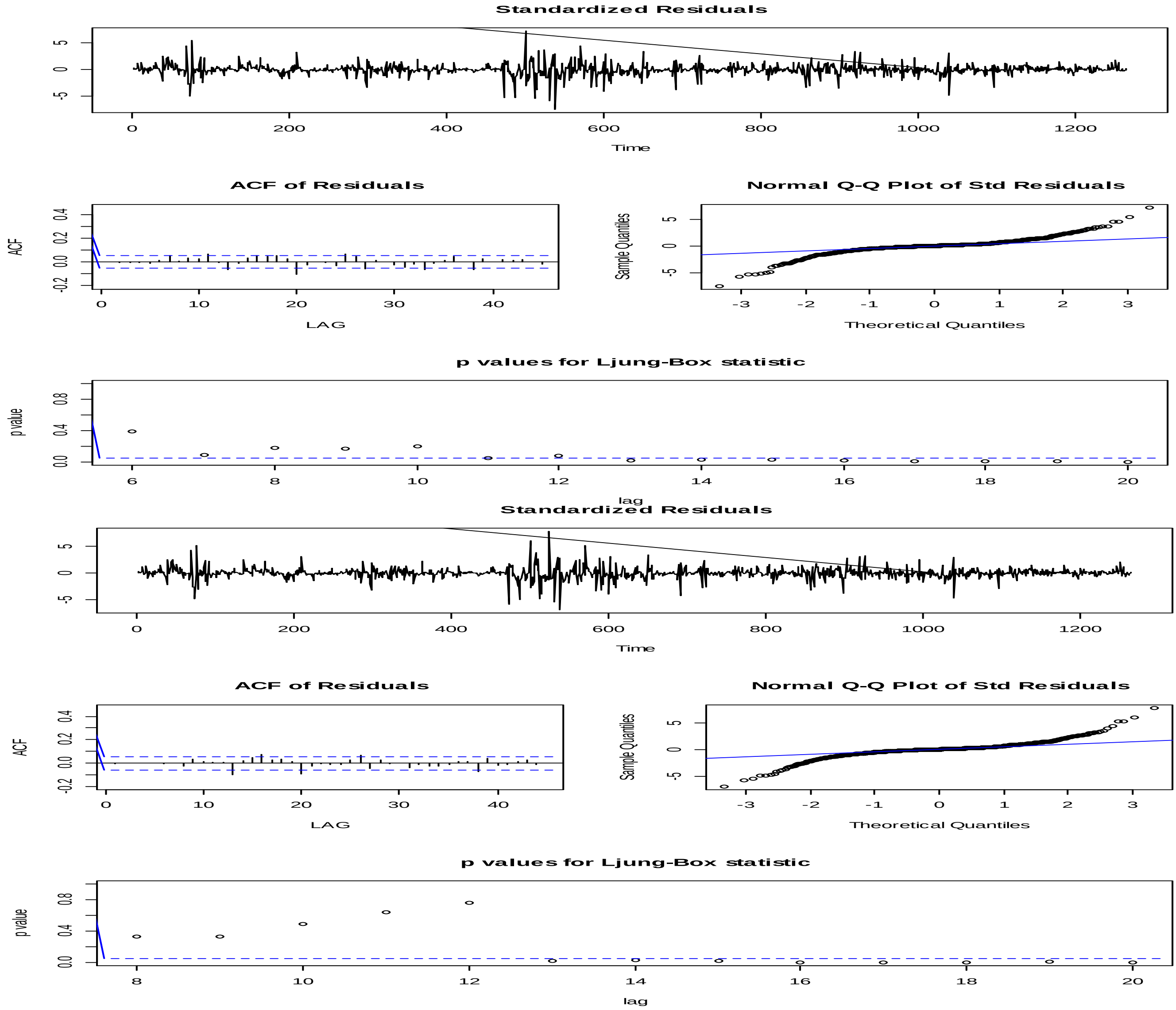


Pair 8: ARCH affect test result for bond and sukuk (respectively)

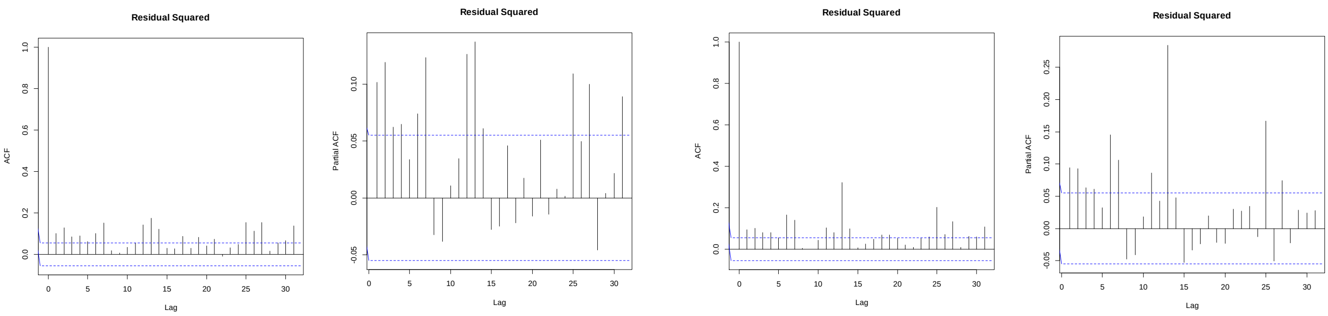


7.3.3 Diagnostic tests for each Pair (continued)

Pair 9: Autoregressive test result for bond and sukuk (respectively)

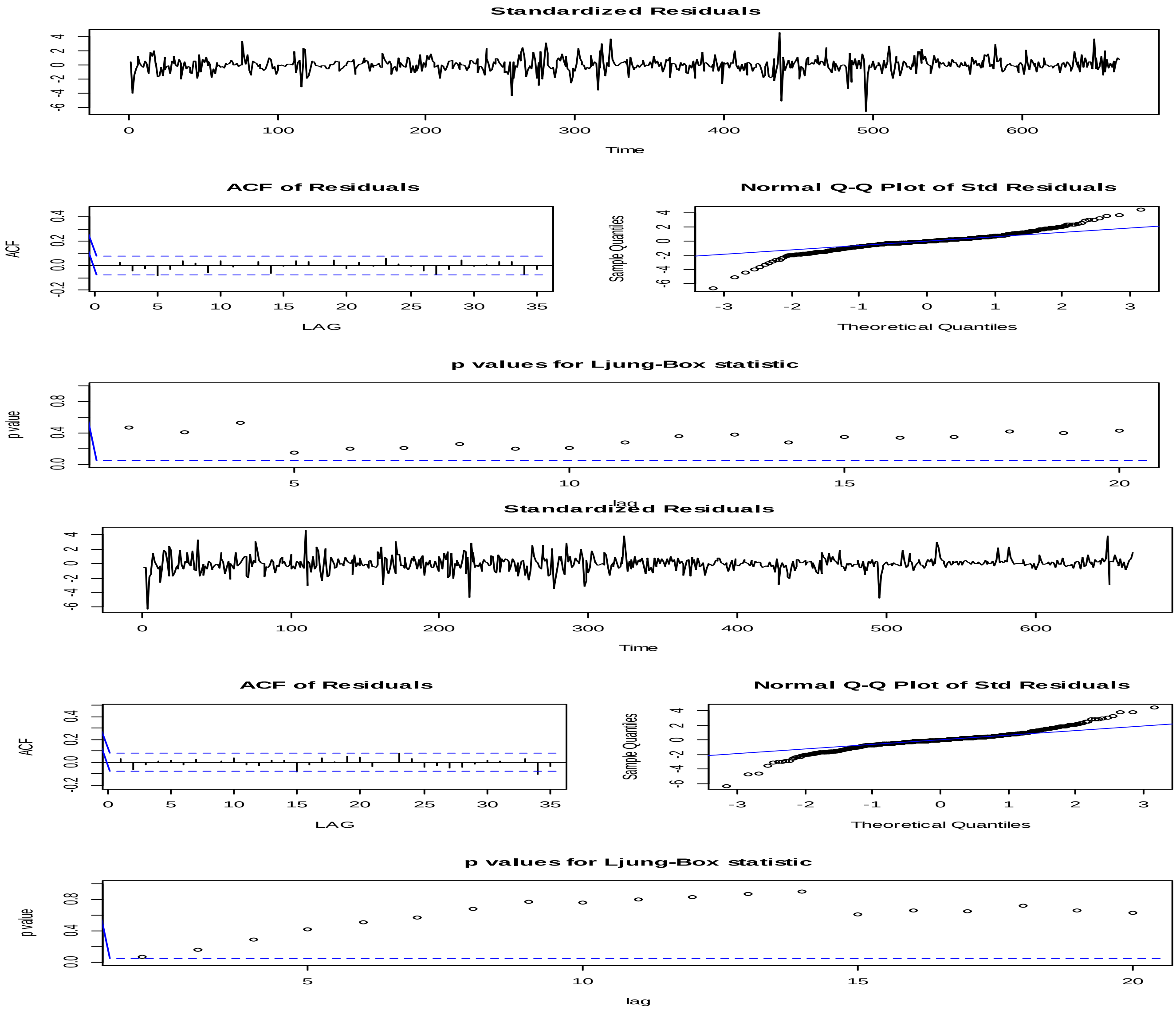


Pair 9: ARCH affect test result for bond and sukuk (respectively)

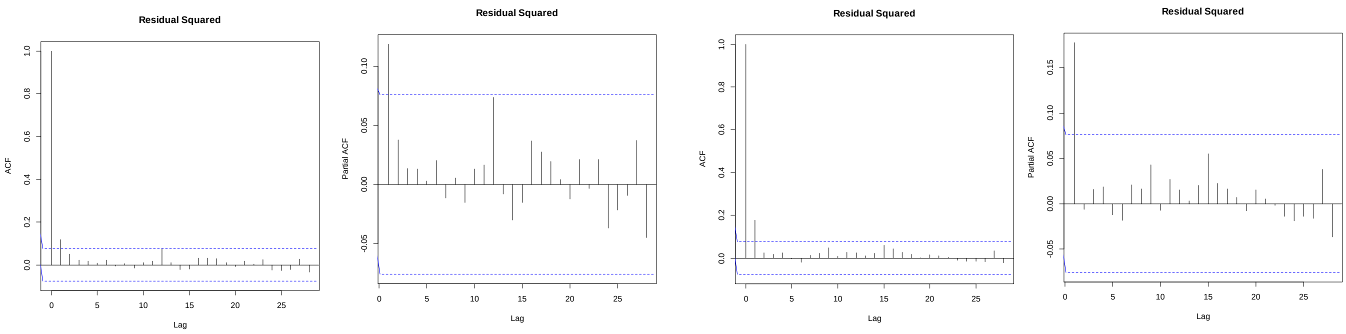


7.3.3 Diagnostic tests for each Pair (continued)

Pair 10: Autoregressive test result for bond and sukuk (respectively)

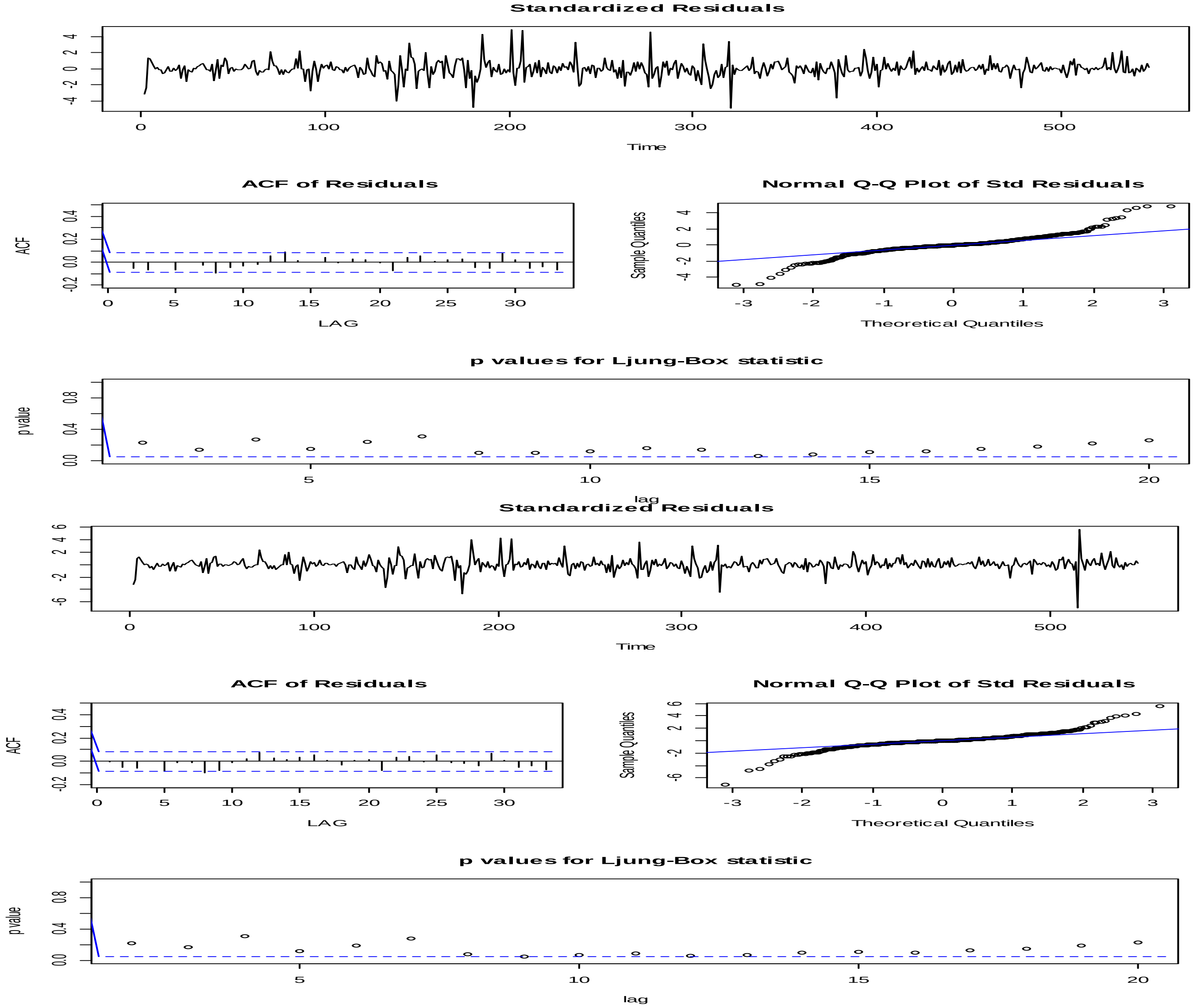


Pair 10: ARCH affect test result for bond and sukuk (respectively)

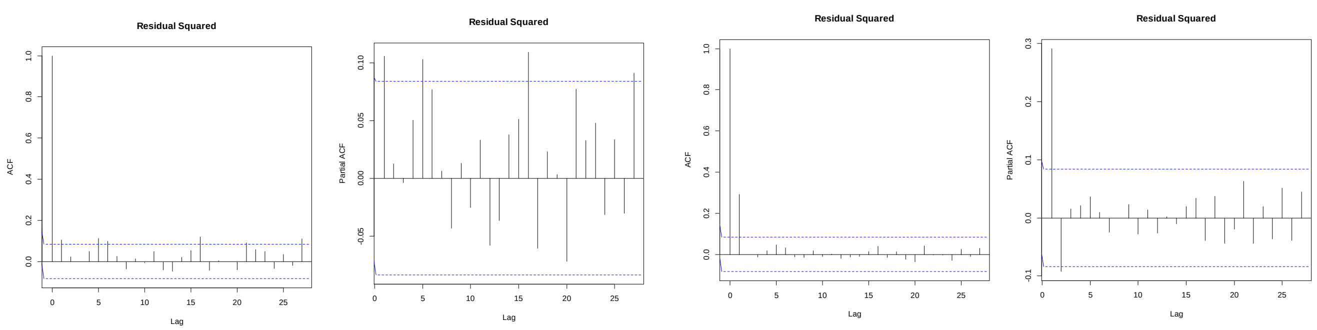


7.3.3 Diagnostic tests for each Pair (continued)

Pair 11: Autoregressive test result for bond and sukuk (respectively)

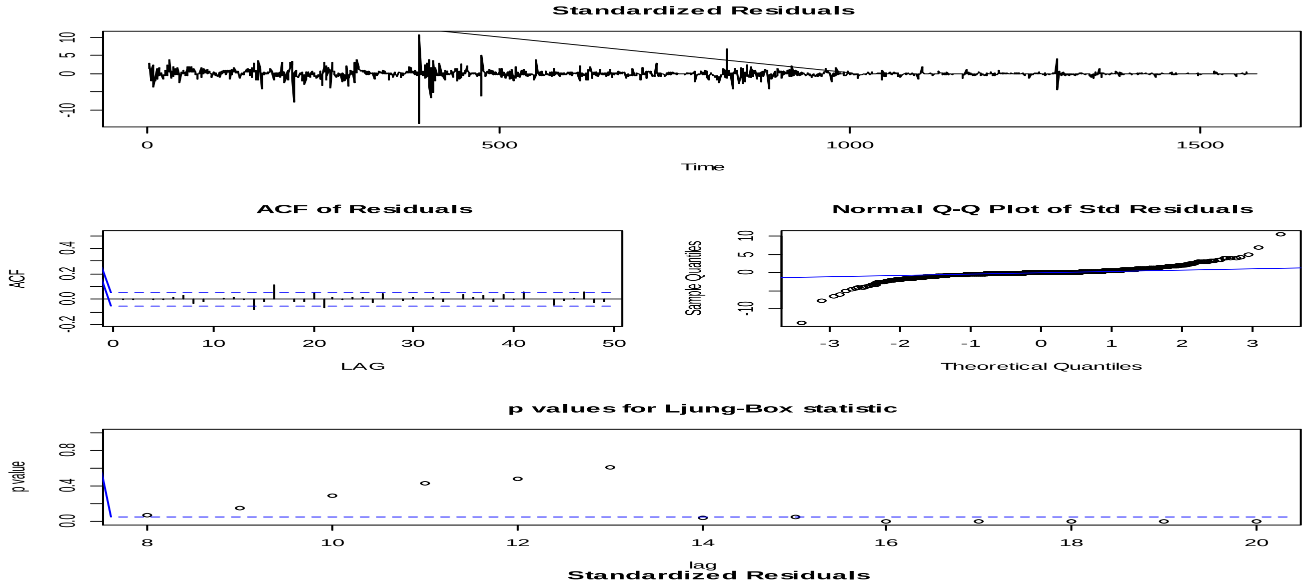


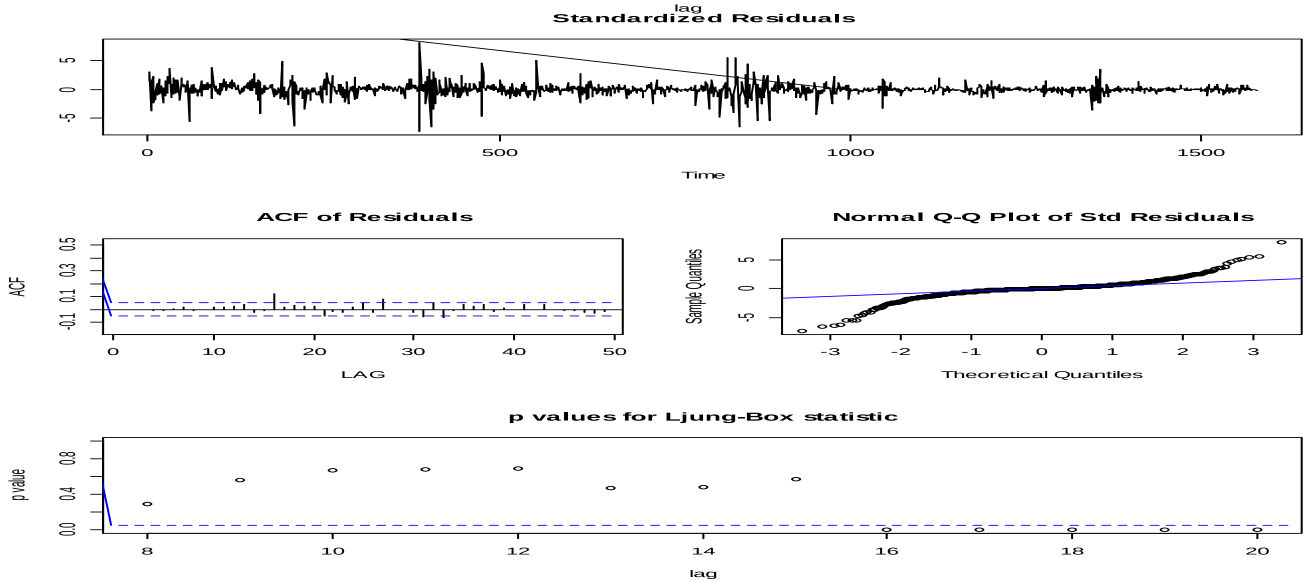
Pair 11: ARCH affect test result for bond and sukuk (respectively)



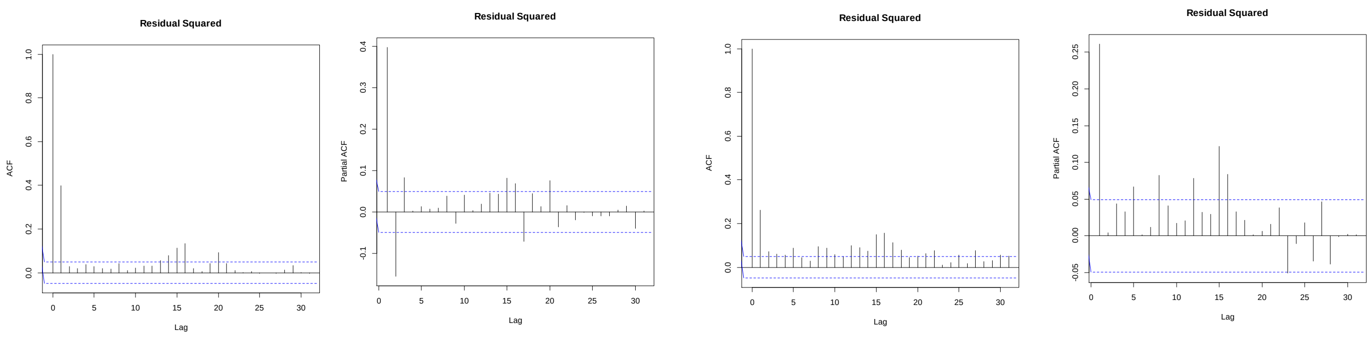
7.3.3 Diagnostic tests for each Pair (continued)

Pair 12: Autoregressive test result for bond and sukuk (respectively)



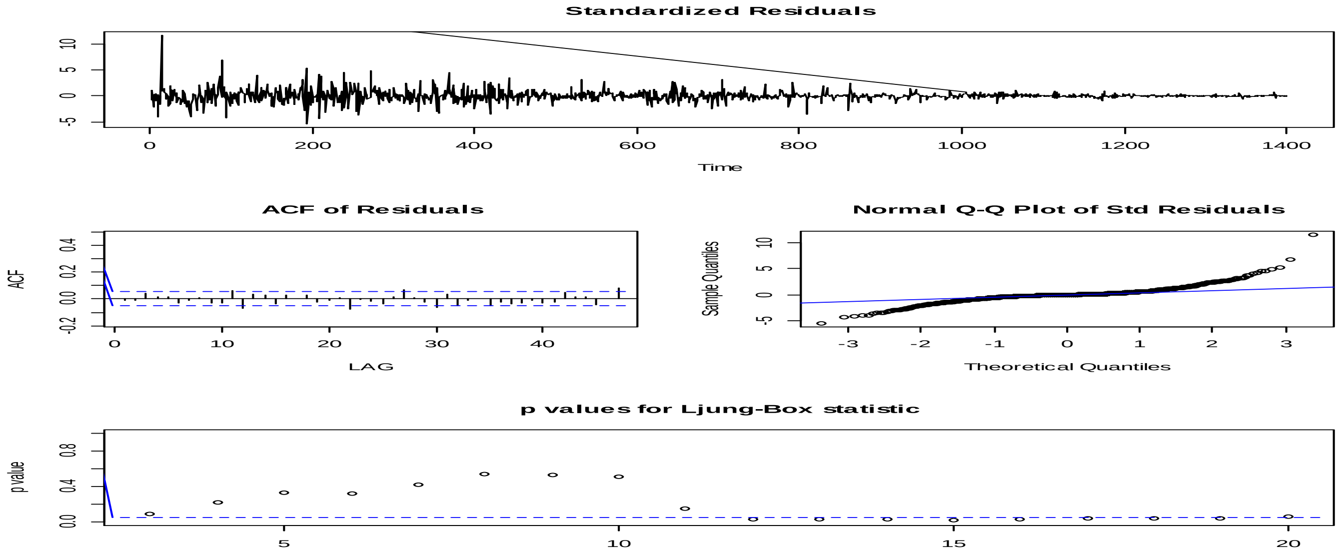


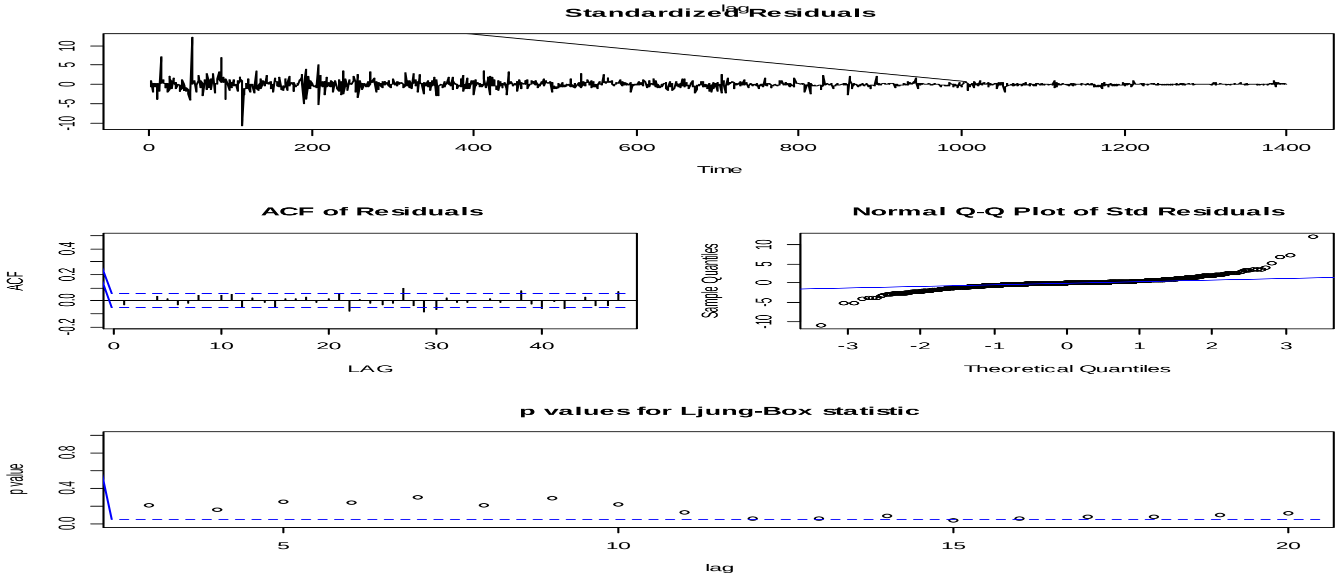
Pair 12: ARCH affect test result for bond and sukuk (respectively)



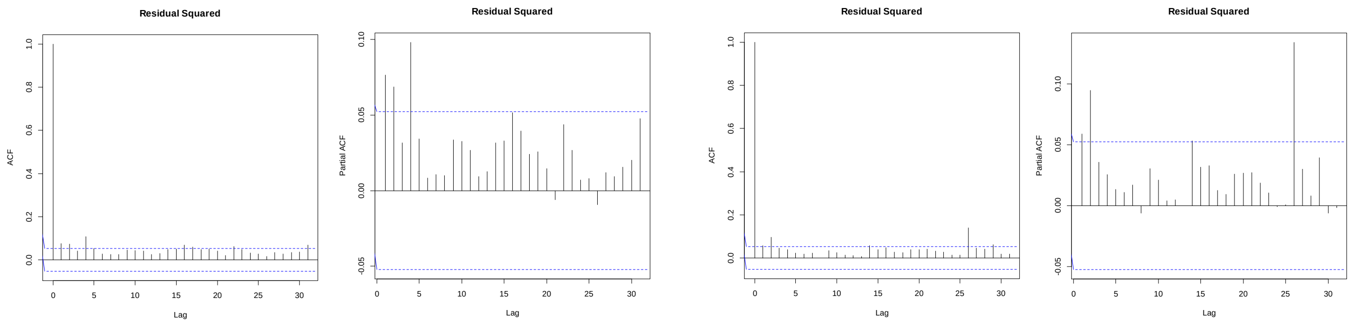
7.3.3 Diagnostic tests for each Pair (continued)

Pair 13: Autoregressive test result for bond and sukuk (respectively)



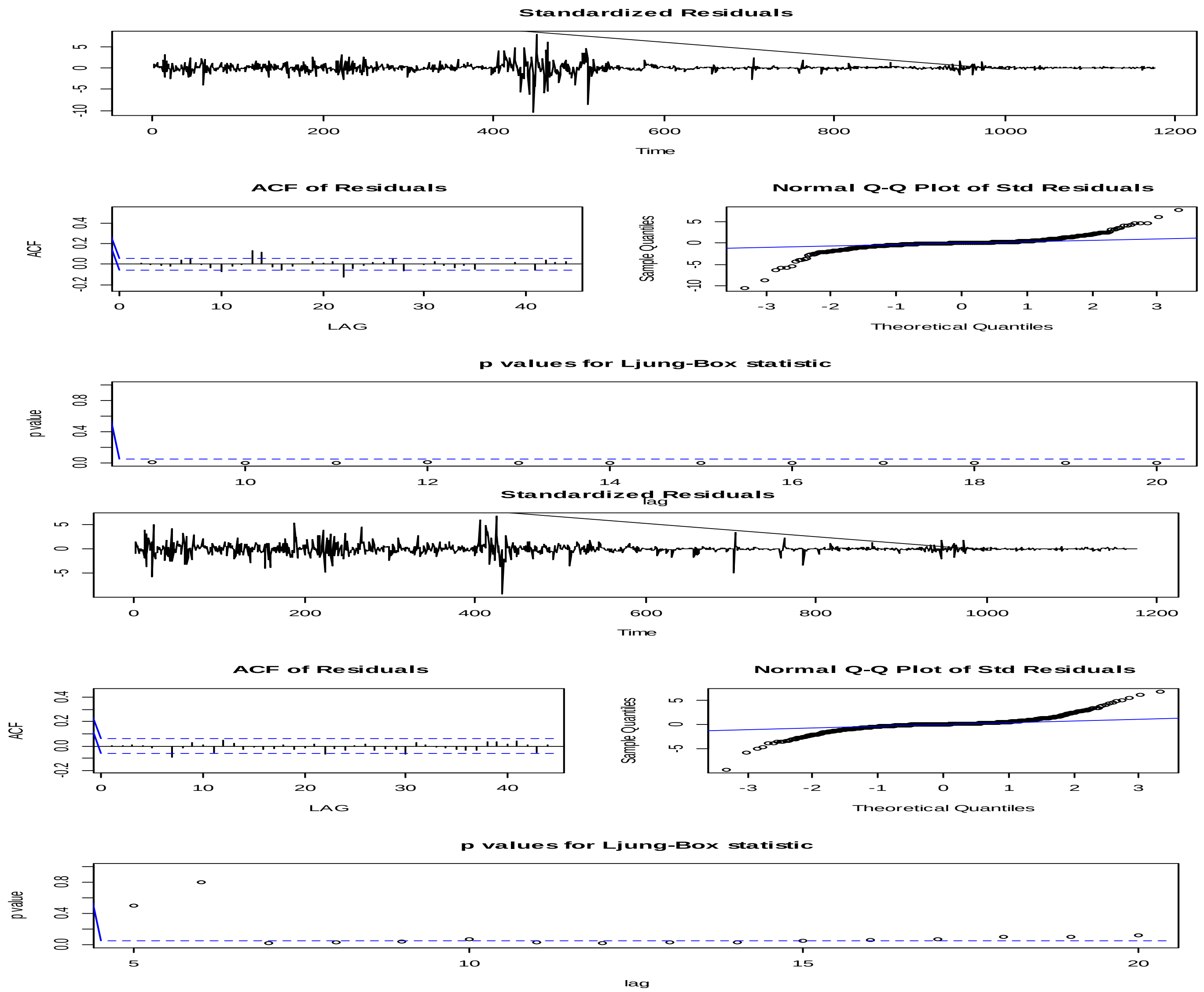


Pair 13: ARCH affect test result for bond and sukuk (respectively)

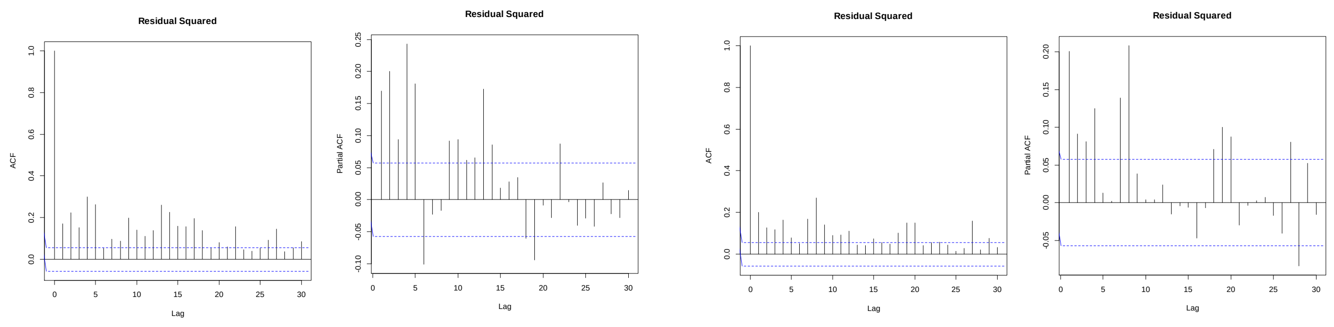


7.3.3 Diagnostic tests for each Pair (continued)

Pair 14: Autoregressive test result for bond and sukuk (respectively)

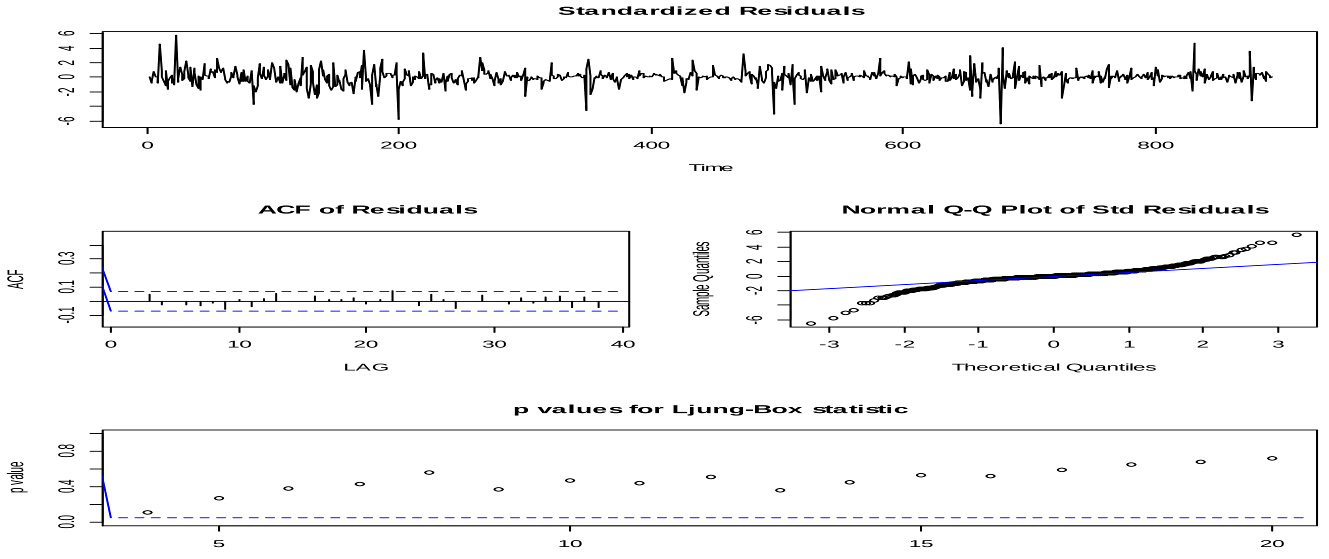


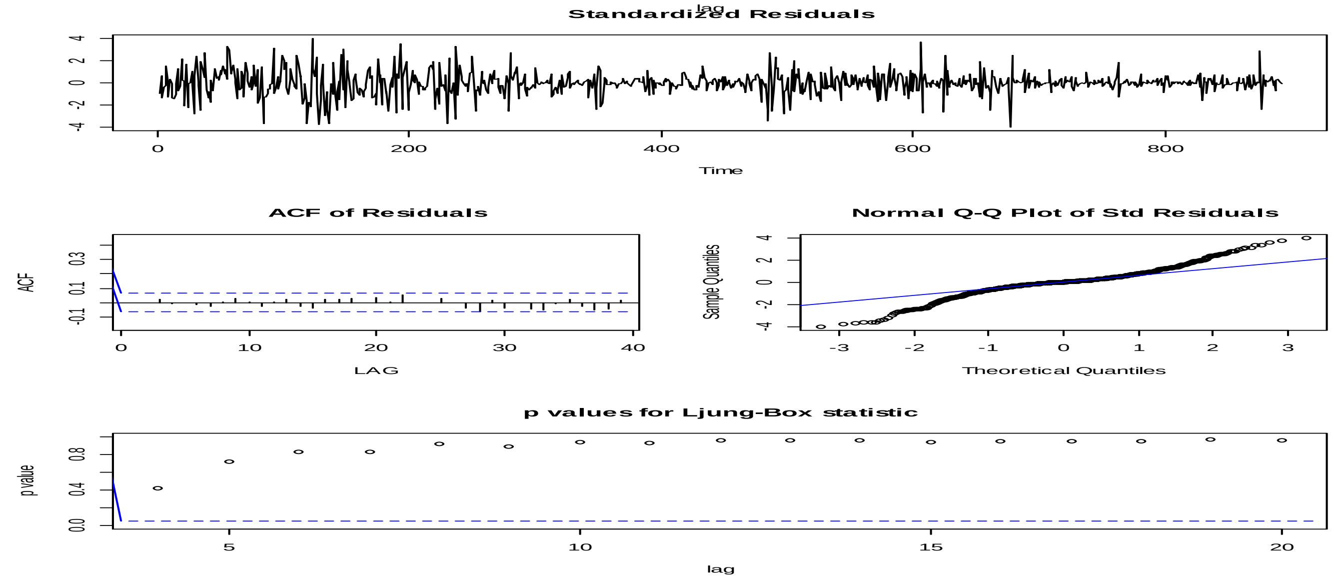
Pair 14: ARCH affect test result for bond and sukuk (respectively)



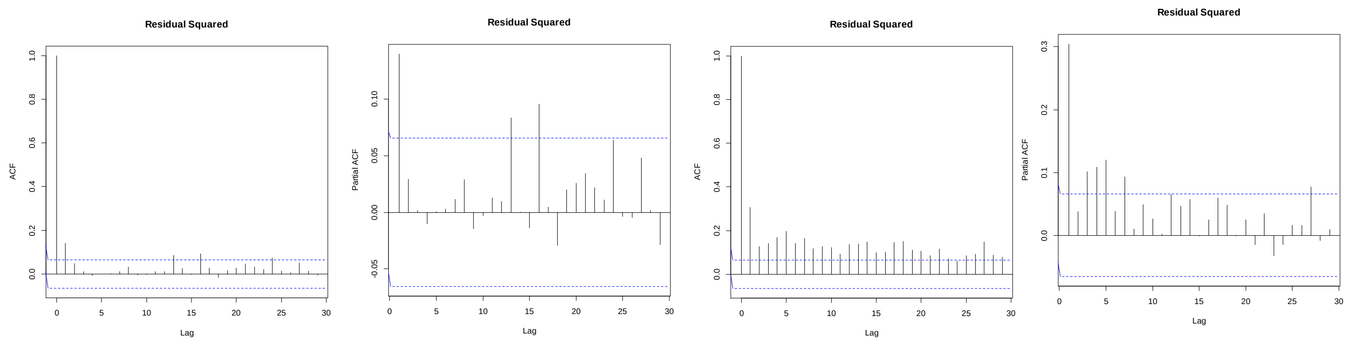
7.3.3 Diagnostic tests for each Pair (continued)

Pair 15: Autoregressive test result for bond and sukuk (respectively)



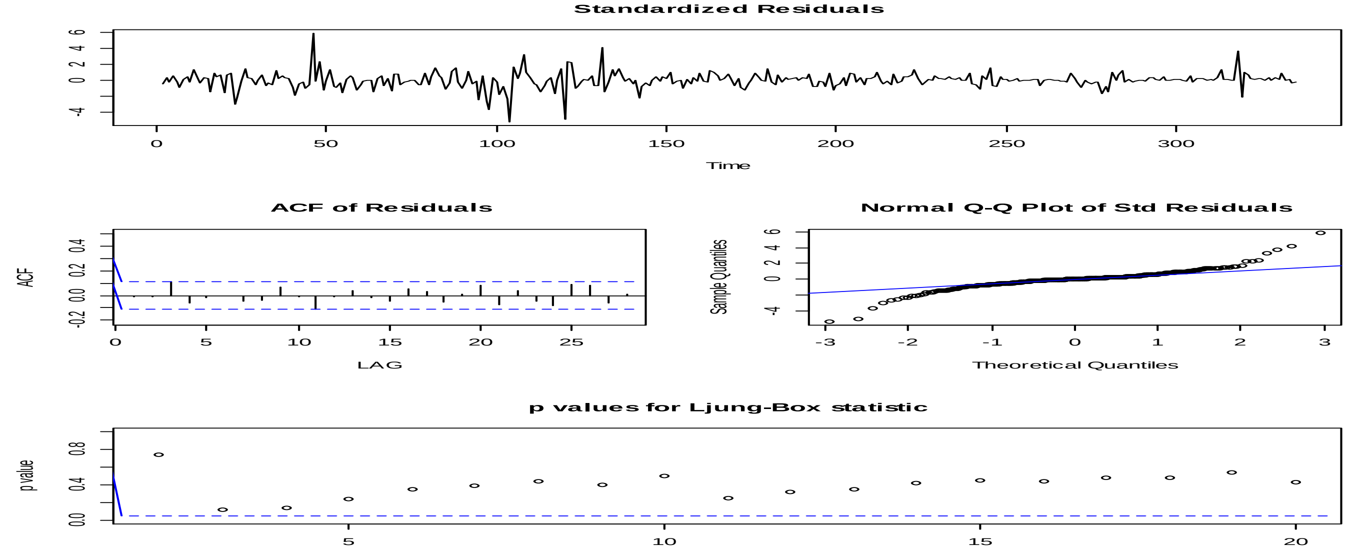


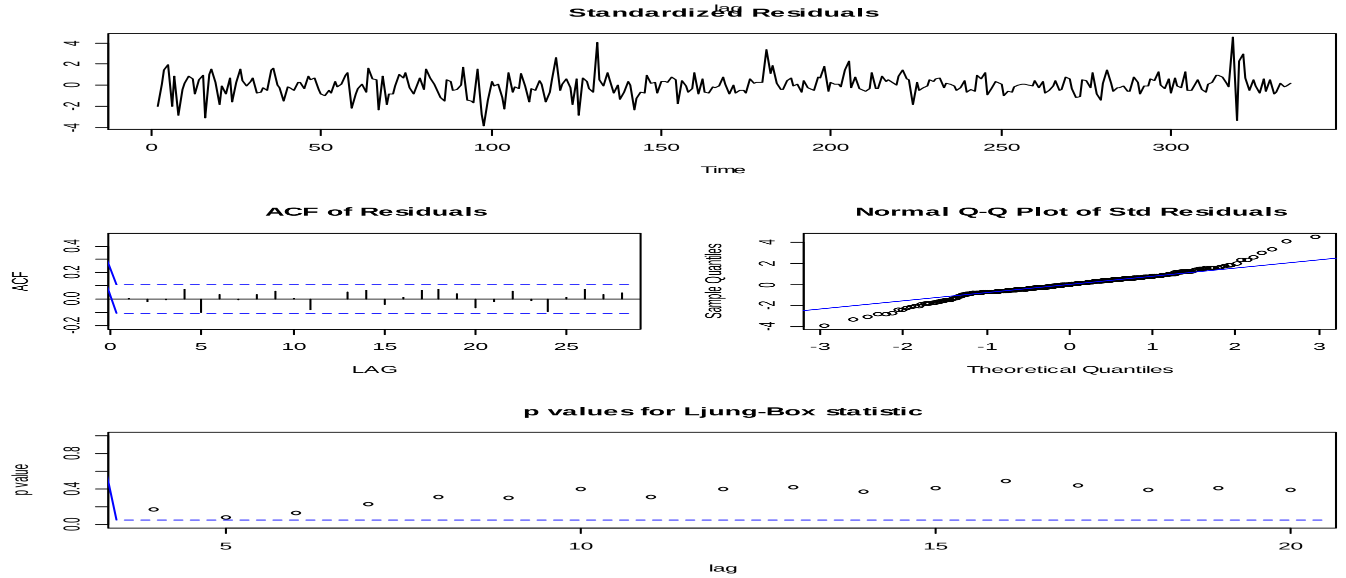
Pair 15: ARCH affect test result for bond and sukuk (respectively)



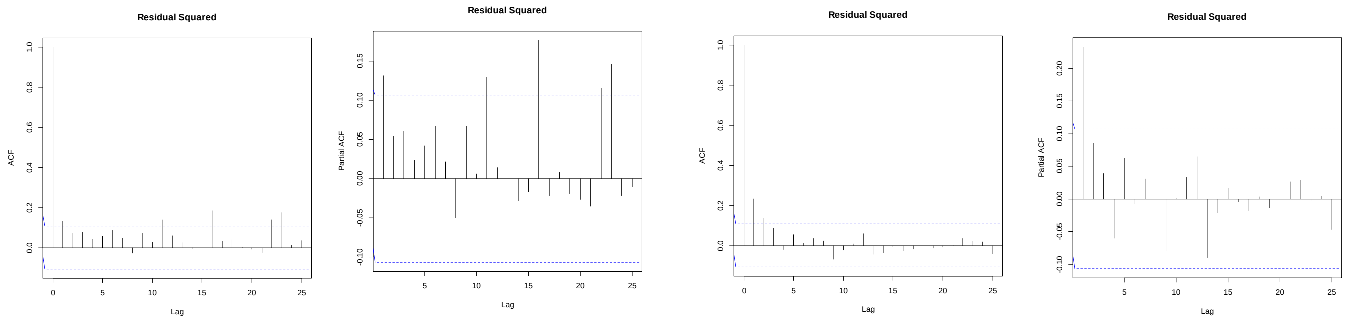
7.3.3 Diagnostic tests for each Pair (continued)

Pair 16: Autoregressive test result for bond and sukuk (respectively)



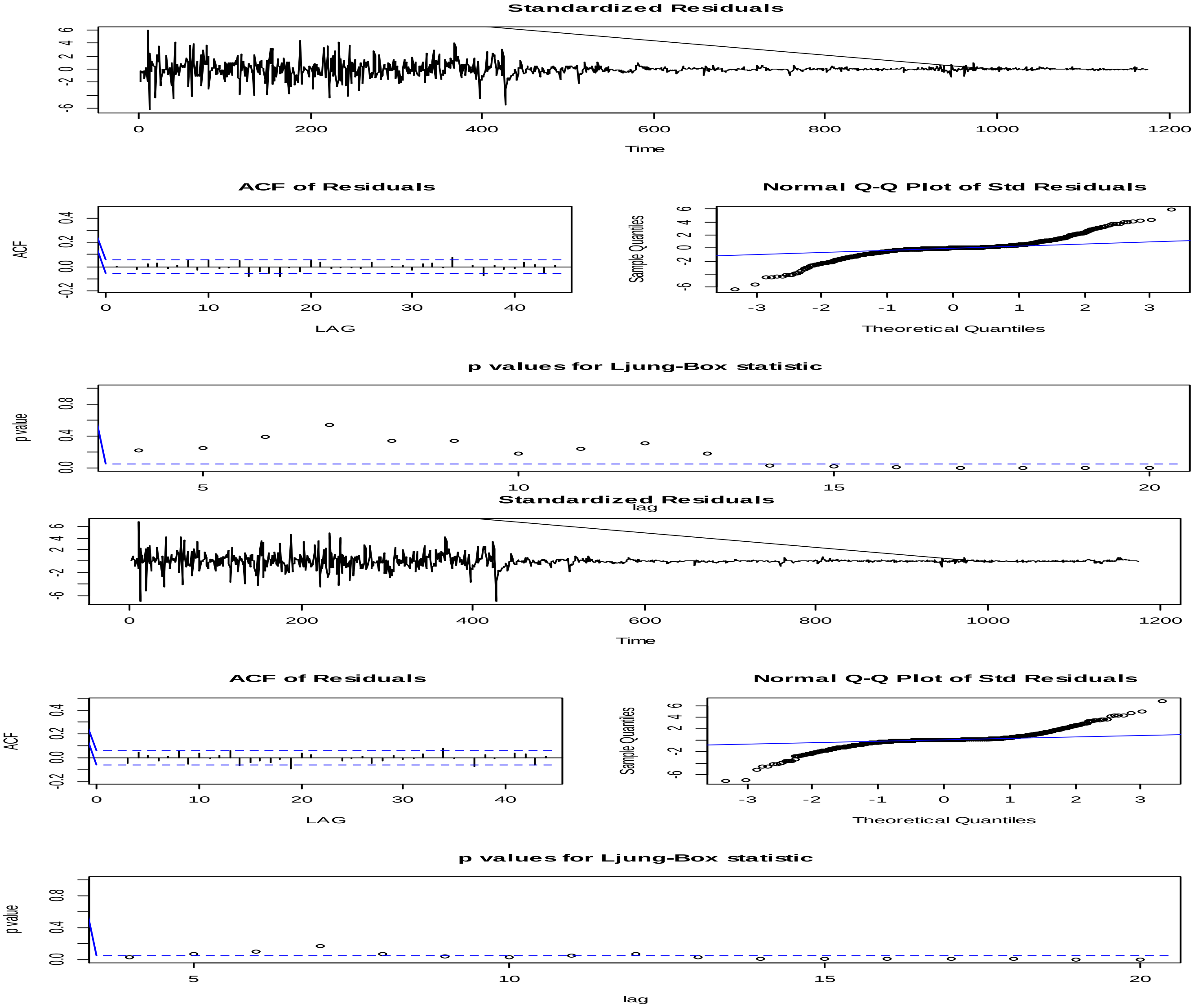


Pair 16: ARCH affect test result for bond and sukuk (respectively)

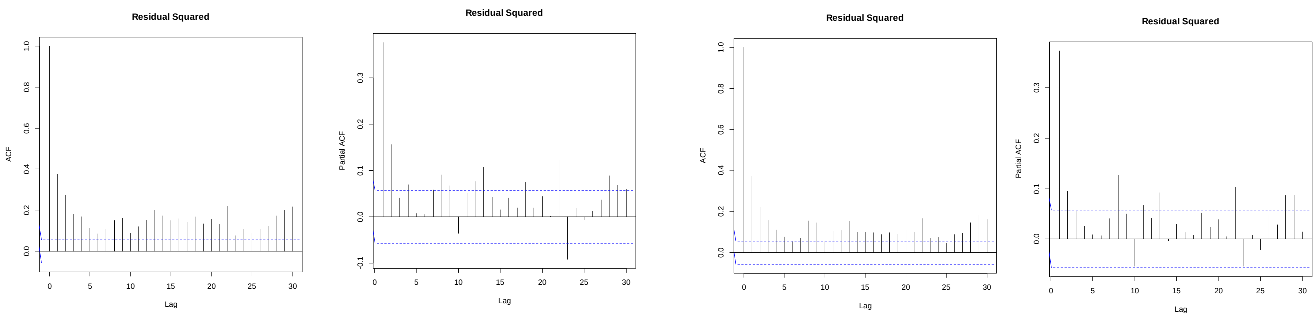


7.3.3 Diagnostic tests for each Pair (continued)

Pair 17: Autoregressive test result for bond and sukuk (respectively)

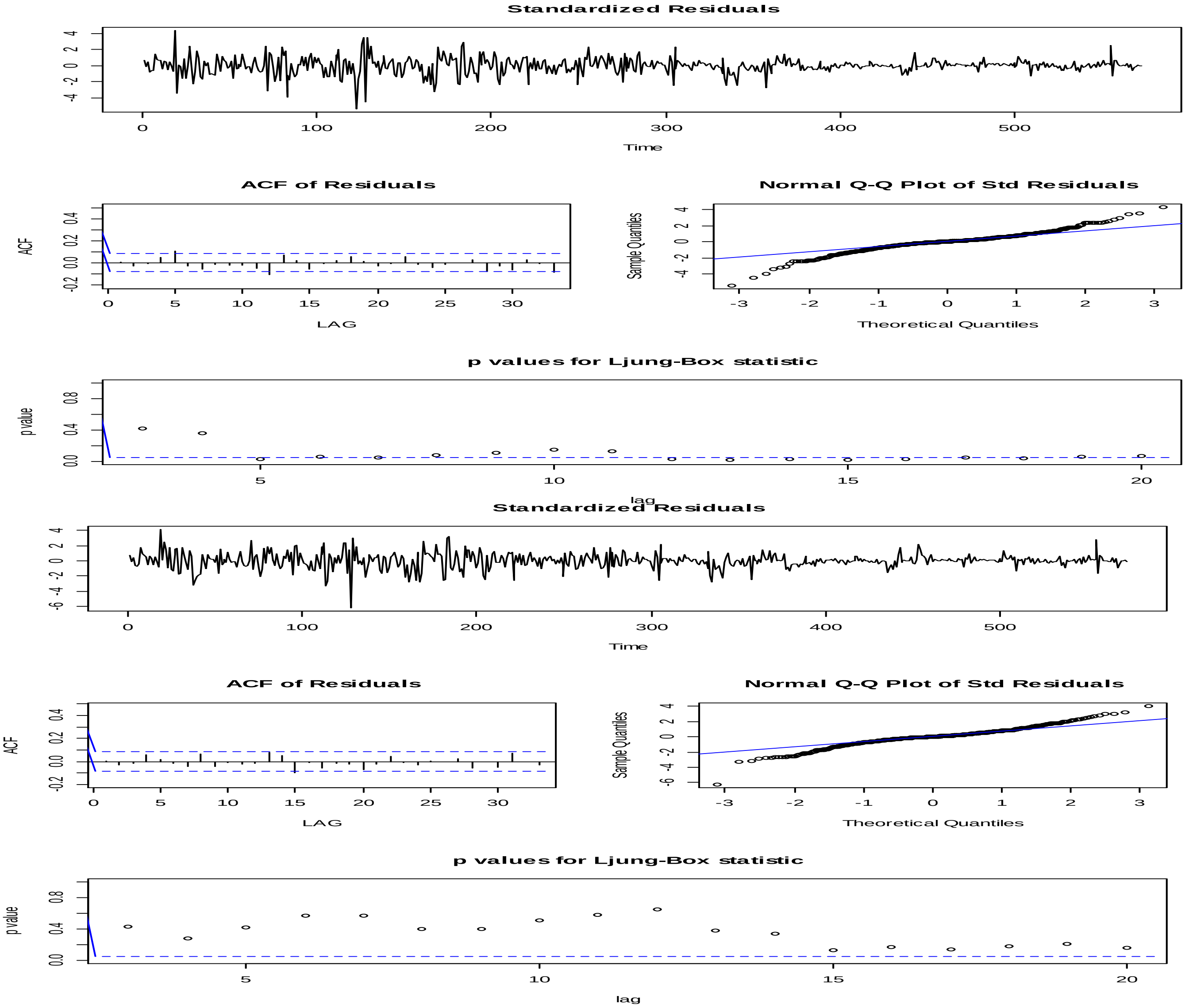


Pair 17: ARCH affect test result for bond and sukuk (respectively)

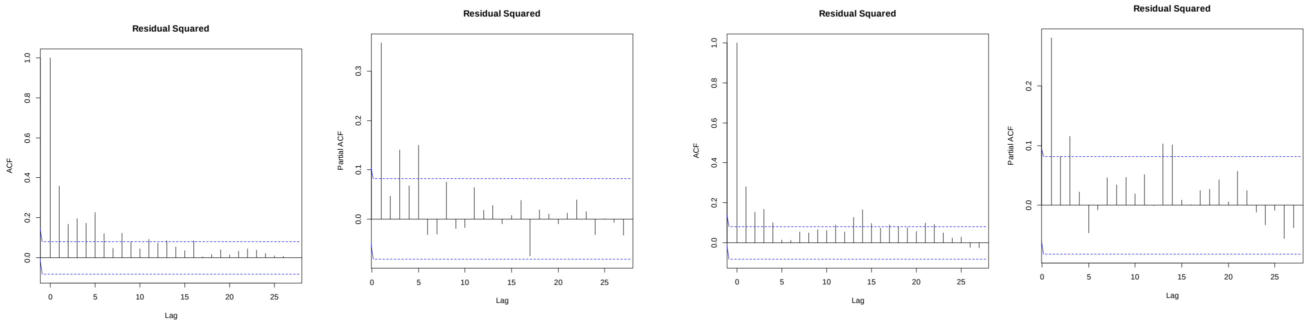


7.3.3 Diagnostic tests for each Pair (continued)

Pair 18: Autoregressive test result for bond and sukuk (respectively)

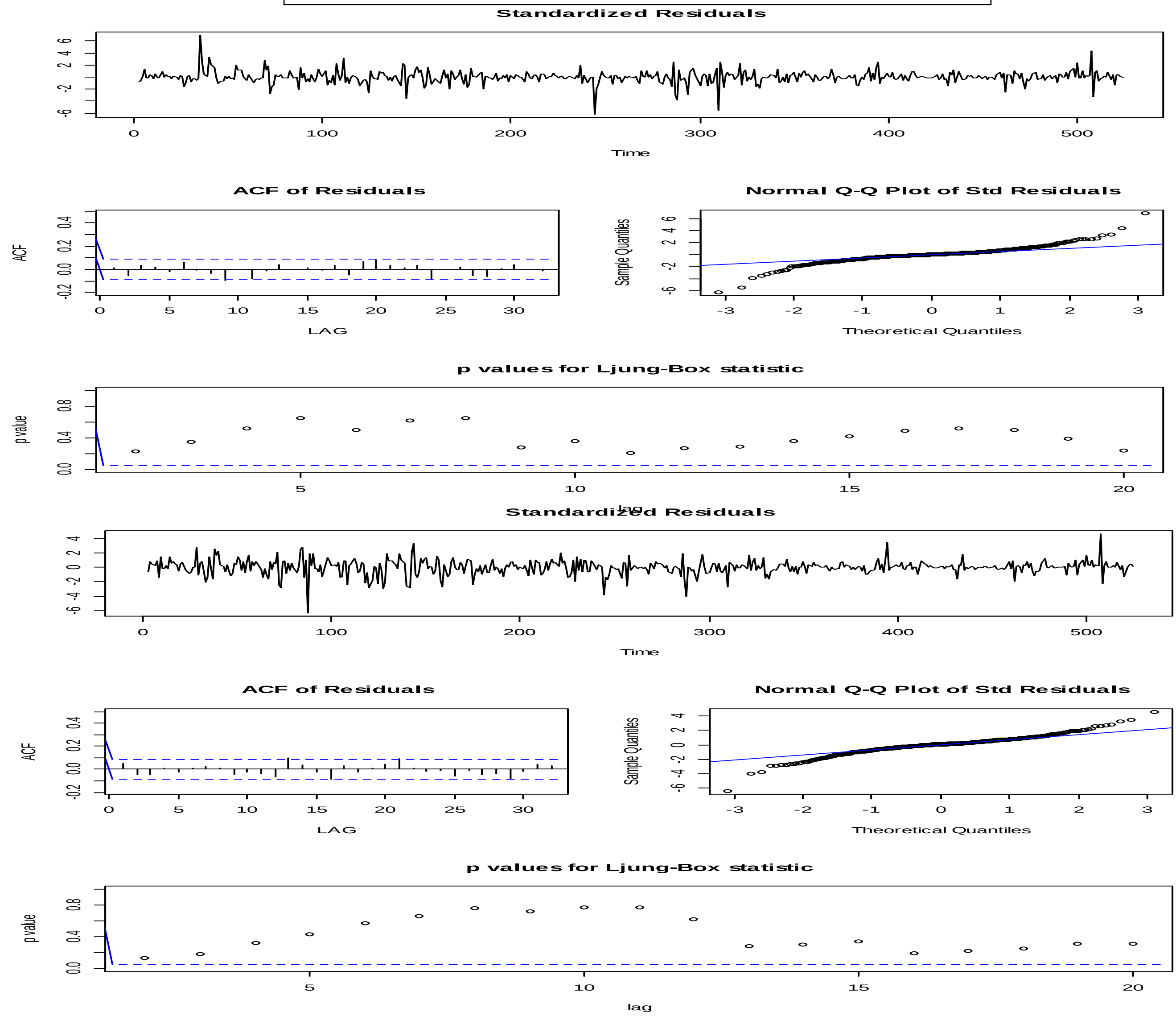


Pair 18: ARCH affect test result for bond and sukuk (respectively)

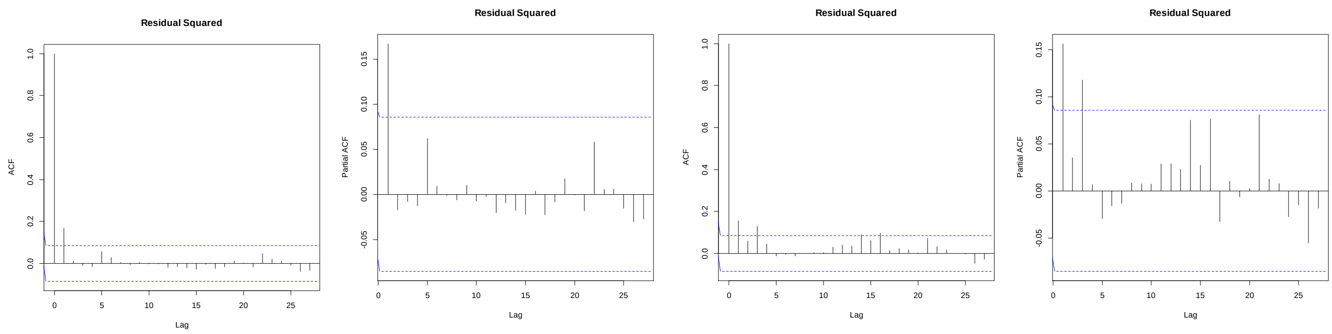


7.3.3 Diagnostic tests for each Pair (continued)

Pair 19: Autoregressive test result for bond and sukuk (respectively)

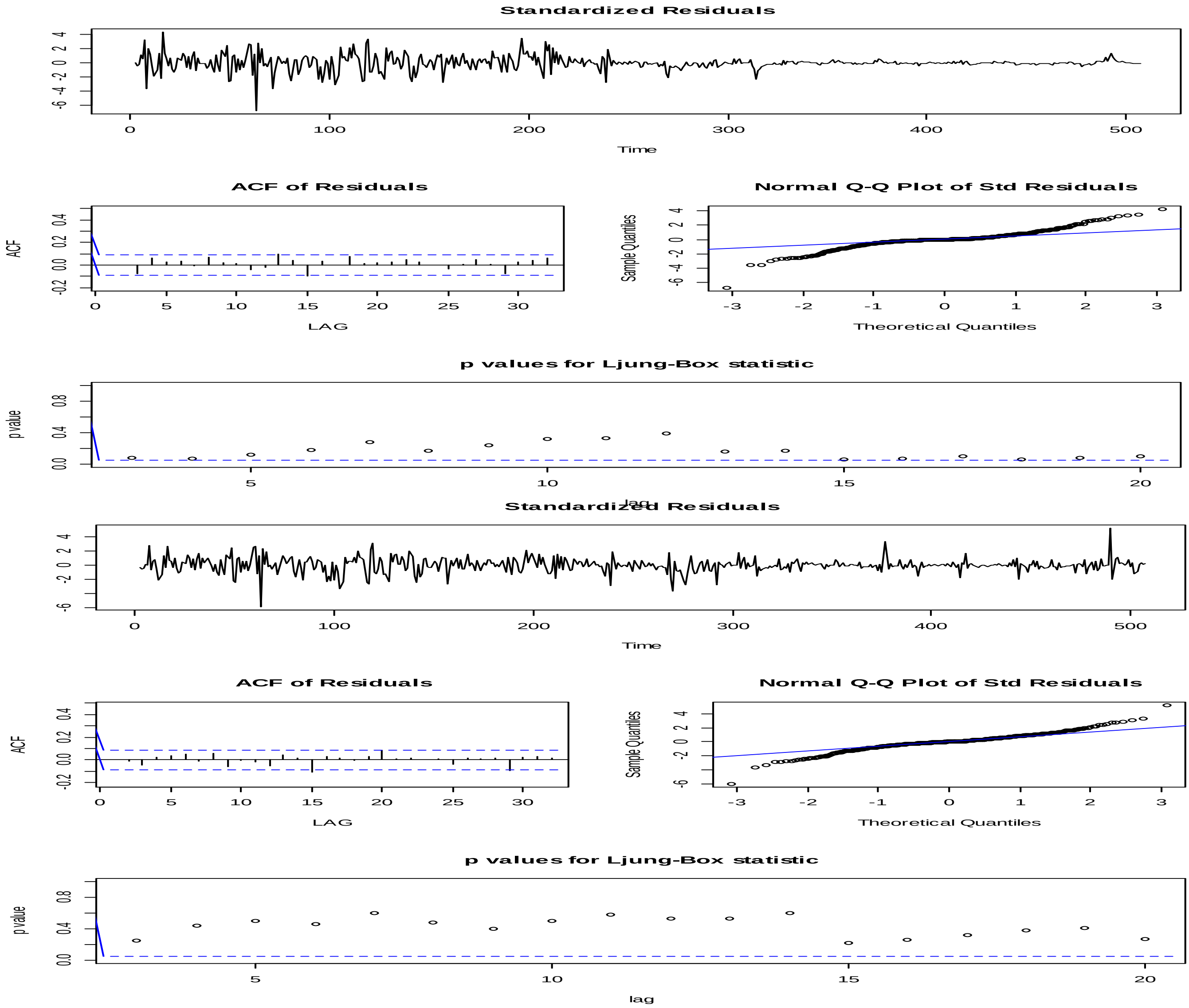


Pair 19: ARCH affect test result for bond and sukuk (respectively)

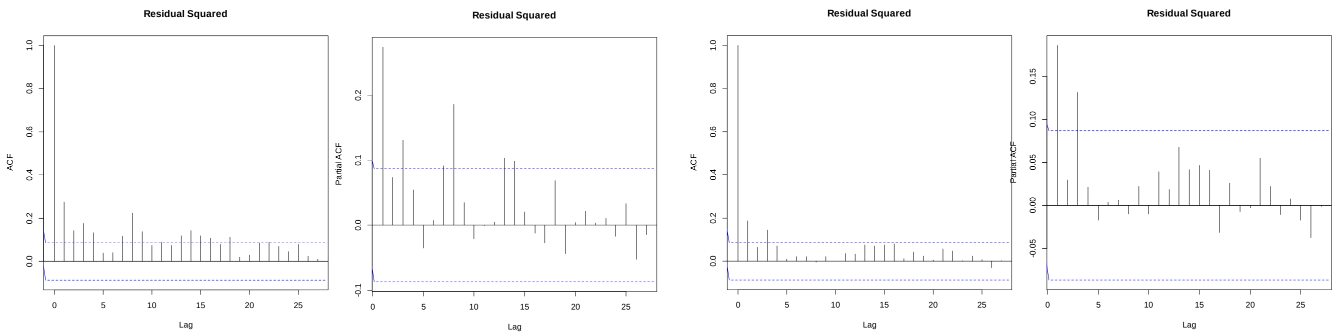


7.3.3 Diagnostic tests for each Pair (continued)

Pair 20: Autoregressive test result for bond and sukuk (respectively)

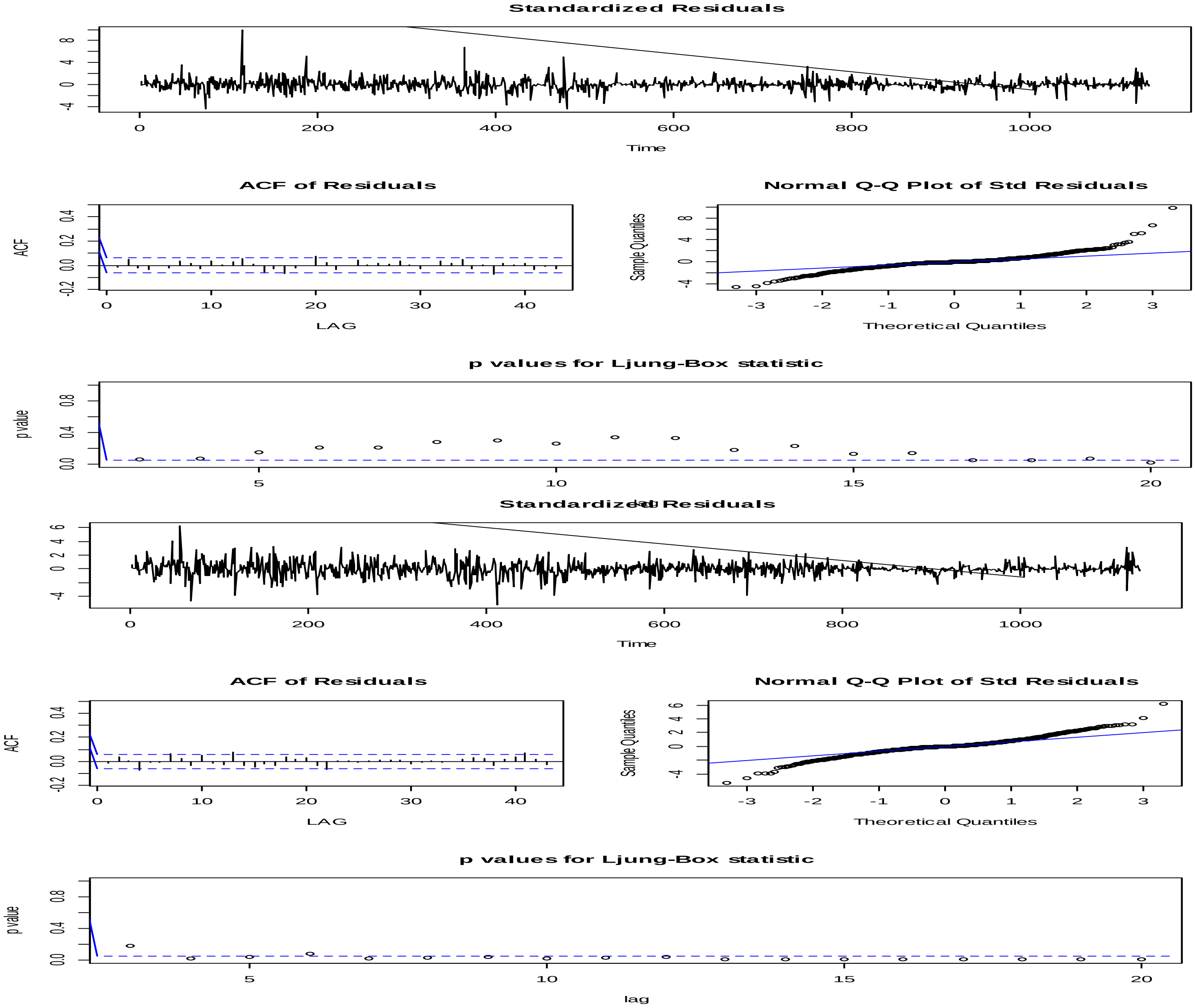


Pair 20: ARCH affect test result for bond and sukuk (respectively)

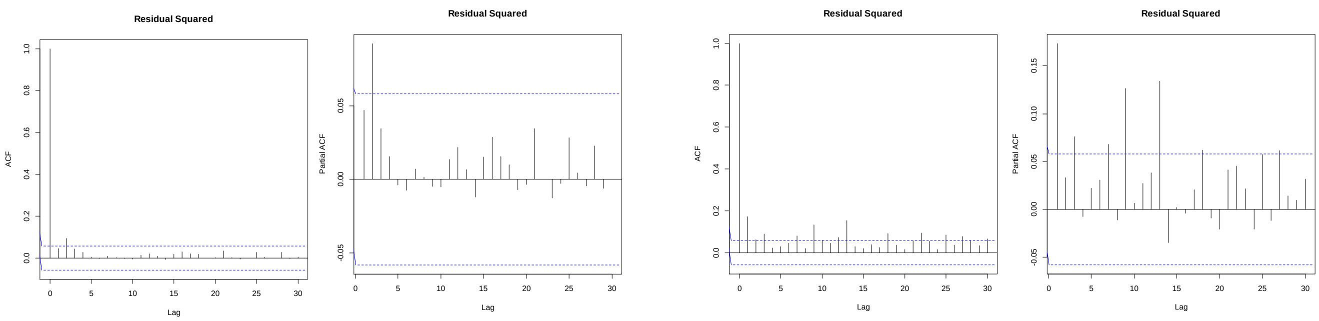


7.3.3 Diagnostic tests for each Pair (continued)

Pair 21: Autoregressive test result for bond and sukuk (respectively)

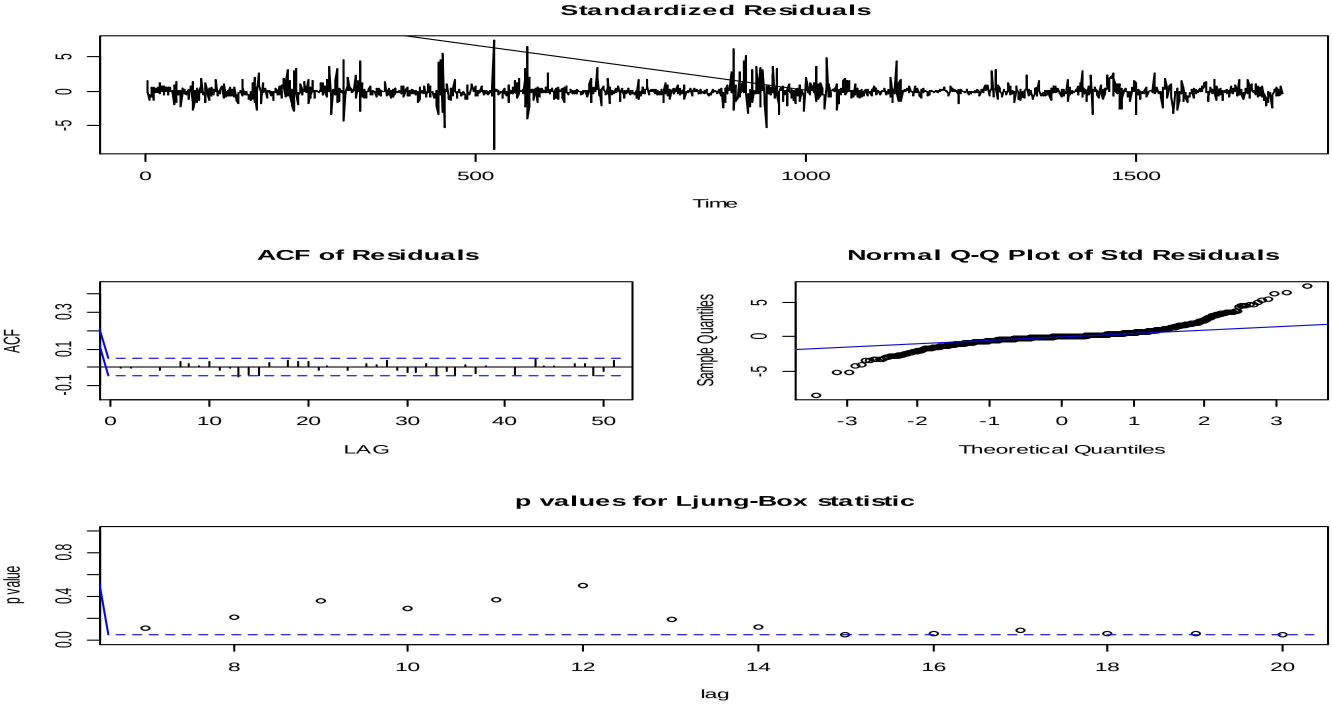


Pair 21: ARCH affect test result for bond and sukuk (respectively)

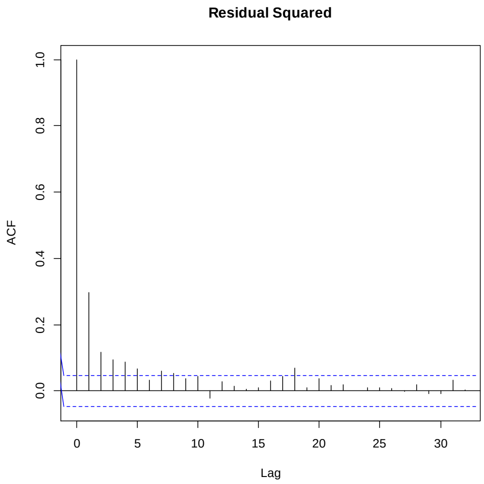


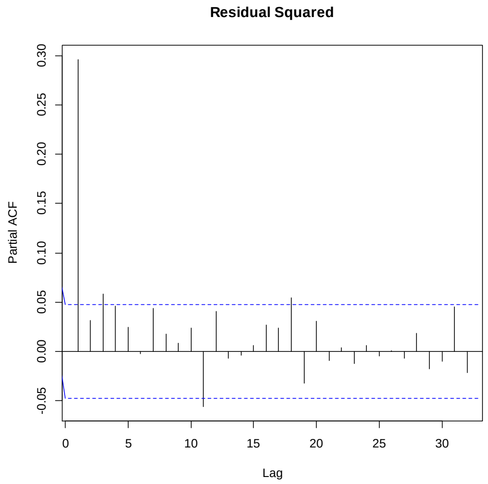
7.3.4 Diagnostic tests for bond index

Bond index: Autoregressive test



Bond index: ARCH affect test result





End of Thesis