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TIME HORIZON VOLATILITY FORECASTING OF MALAYSIAN PROPERTY STOCKS

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TIME HORIZON VOLATILITY FORECASTING OF MALAYSIAN PROPERTY STOCKS

By

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Chair : Choo Wei Chong, PhD
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Reliable and accurate forecasts can provide important input for fund manager and policymakers to make an informed decision. However, volatility forecast research is still bound by several weaknesses such as scarcity in volatility forecasting literature and the lack of knowledge on the contributing factors to poor forecast, i.e. time-varying series characteristic or model specification. As a result of inaccuracy in forecasting, fund managers could face catastrophic consequences. The first contribution is to prove there are 'parameter changes (time-varying) in Generalized autoregressive conditional heteroskedasticity (GARCH) model before and during the GFC in Malaysian property stocks. News impact curve (NIC) is adopted to show how the good news and bad news impact (news shock) on the next period's volatility forecast in these two periods. Findings show that parameters and NICs are changes in both periods, this may incur poor forecast. To further validate the parameter changes in different periods. Second contribution adopted and adapted news impact curve (NIC) for different models in different periods. Adaptive asymmetric Smooth Transition Exponential Smoothing (STES) is reported to be more pragmatic and superior to symmetric model in volatility forecasting. Overall, NIC for the symmetric GARCH model shows the news shock on next volatility estimates during crisis is the highest. NICs for the asymmetric GJR GARCH model and STES-E+AE indicate bad news has higher impact on next period's volatility forecast during crisis period. The study furthered on the volatility forecasting of STES method (the models are STES-E, STES-SE, STES-ESE, STES-AbsE and STES-E+AE) as compared with other models (total thirteen models) in short-time horizon. The third contribution is to study the performance of STES methods in forecasting the Malaysian property stocks volatility compared to various forecasting methods before, during and after global financial crisis (GFC). Surprisingly, the performance of STES is very encouraging. A model performs well in short-time horizon data may not perform well in long-time horizon data. The fourth contribution is to further investigate the performance of STES method in the long-time horizon. Compared to 18 months data used in the previous section, study employed 2000 daily returns (8 years data) of 33 Malaysian property stocks in this study. The result shows that STES method

is still the best method as compared with its competitors such as GARCH family models. Hence, study concludes that STES method outperforms other forecasting methods in forecasting the short and long-time horizon volatility of Malaysian property stocks. Time series data often sampled at a different frequency. It is a dilemma (regression must be at the same frequency) faced by many researchers. MIDAS methods enable different frequency data being used to estimate together. The fifth contribution is investigating the relationship between the house price index (HPI) volatility (quarterly data) and property stock index (PI) volatility (daily data) using MIDAS approach. Modelling and forecasting performance of MIDAS with different weighting functions. The results show there is a negative relationship between HPI volatility and PI volatility indicating that investors can reduce their portfolio's risk by pairing these assets.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

VOLATILITI HORIZON MASA PERAMALAN SAHAM HARTA TANAH MALAYSIA

Oleh

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Ramalan yang boleh dipercayai dan tepat boleh memberikan input yang penting kepada pengurus dana dan pembuat dasar untuk membuat keputusan yang tepat. Walau bagaimanapun, penyelidikan ramalan volatiliti masih terikat kepada beberapa kelemahan seperti kekurangan pengetahuan dalam ramalan dan kekurangan pengetahuan mengenai faktor penyumbang kepada ramalan yang kurang baik, seperti ciri-ciri siri masa yang berlainan atau spesifikasi model. Akibat daripada ketidaktepatan dalam peramalan, pengurus dana mungkin menghadapi bencana yang besar. Sumbangan pertama adalah membuktikan terdapat perubahan parameter (masa yang berbeza-beza) dalam model heteroskedasticity bersyarat autoregressive General (GARCH) sebelum dan semasa GFC dalam stok harta Malaysia. Kurva kesan berita (NIC) digunakan untuk menunjukkan bagaimana berita baik dan impak berita buruk (kejutan berita) kepada ramalan volatiliti tempoh seterusnya dalam kedua-dua tempoh tersebut. Penemuan menunjukkan bahawa. parameter dan NIC adalah berubah dalam kedua-dua tempoh. Ini boleh menimbulkan ramalan yang lemah. Untuk mengesahkan perubahan parameter dalam tempoh yang berbeza. Sumbangan kedua mengadopsi dan menyesuaikan lengkung impak berita (NIC) untuk model yang berlainan dalam tempoh yang berbeza. Pelarasan Eksponen Transisi Smooth Asymmetric Smoothy (STES) adalah didapati lebih pragmatik dan unggul kepada model simetri dalam ramalan volatiliti. Secara keseluruhannya, NIC untuk model GARCH simetri menunjukkan kejutan berita mengenai anggaran volatiliti semasa krisis adalah yang tertinggi. NIC untuk model GJR GARCH asimetri dan STES-E + AE menunjukkan berita buruk mempunyai kesan yang lebih tinggi terhadap ramalan volatiliti tempoh dalam tempoh krisis. Kajian seterusnya membandingkan ramalan volatiliti kaedah STES (model STES-E, STES-E, STES-ESE, STES-AbsE dan STES-E + AE) dengan model lain (tiga belas model) dalam masa yang singkat ufuk. Sumbangan ketiga adalah mengkaji prestasi kaedah STES dalam meramalkan ketidakstabilan stok harta Malaysia berbanding dengan pelbagai kaedah ramalan sebelum, semasa dan selepas krisis kewangan global (GFC). Yang menghairankan, prestasi STES sangat menggalakkan. Model yang baik dalam data cakrawala masa pendek mungkin tidak

berfungsi dengan baik dalam data panjang cakrawala. Sumbangan keempat adalah untuk menyiasat lagi prestasi kaedah STES dalam ufuk lama. Berbanding dengan data 18 bulan yang digunakan pada bahagian sebelum ini, kajian menggunakan 2000 pulangan harian (8 tahun data) daripada 33 saham harta Malaysia dalam kajian ini. Hasilnya menunjukkan bahawa kaedah STES masih merupakan kaedah terbaik dibandingkan pesaingnya seperti model keluarga GARCH. Oleh itu, kajian menyimpulkan bahawa kaedah STES mengatasi kaedah peramalan lain dalam meramalkan ketidaktentuan cakerawala jangka pendek dan jangka panjang saham harta Malaysia. Data siri masa sering dicontohi pada frekuensi yang berbeza. Ia adalah dilema (regresi mestilah pada kekerapan yang sama) yang dihadapi oleh banyak penyelidik. Kaedah MIDAS membolehkan data kekerapan yang berbeza digunakan untuk menganggar bersama. Sumbangan kelima adalah menyiasat hubungan antara turun naik indeks harga rumah (HPI) dan data kemunduran indeks saham (PI) (data harian) menggunakan pendekatan MIDAS. Mempamerkan dan memprediksi prestasi MIDAS dengan fungsi penimbang yang berlainan. Keputusan menunjukkan terdapat hubungan negatif antara volatiliti HPI dan volatiliti PI, ini menunjukkan bahawa pelabur dapat mengurangkan risiko portfolio mereka dengan memasangkan aset tersebut.

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I certify that a Thesis Examination Committee has met on (20/12/2019) to conduct the final examination of (Leong-Mow Gooi) on his thesis entitled ("Time Horizon Volatility Forecasting of Malaysian Property Stocks") in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the (Doctor of Philosophy).

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This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

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LIST OF ABBREVIATIONS

AIC	Akaike's information criterion
AP	Average Price
C	Contribution
Cont	Continue
EGARCH	Exponential GARCH
EWMA	Exponential Weighted Moving Average
GARCH	General Auto Regressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GJR-GARCH (GJR)	Glosten-Jagannathan-Runkle-GARCH
H	Hypotheses
HPI	House Price Index
IGARCH	Integrated GARCH
Log L	Loglikelihood
PI	Property Index
REIT	Real Estate Investment Trust
RO	Research Objective
RQ	Research Question
SBC	Schwarz's Bayesian information criterion
Std. Dev	Standard Deviation
STES	Adaptive Smooth Transition Exponential Smoothing

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter elaborates and justifies on the reasons for focusing on volatility forecasting using smooth transition exponential smoothing (STES methods) in property stocks Malaysia with an aim to learn more on the real estate market. Then it proceeds to highlight the problems statement in volatility forecasting in property stocks and house price index (HPI). Subsequently, this chapter lists the research questions, research objectives, research hypotheses and significance of research aims to be achieved from this thesis. Finally, the organization of the thesis and the summary of this thesis will be presented.

1.2 The "Danger Report" and Potential Effects of Real Estate Market

Real estate market stability is one of the pillars that could cause an economic crisis and has impacts to the economic stability (Gupta, Kabundi, & Miller, 2011; Plakandaras, Gupta, Gogas, & Papadimitriou, 2015; Rapach & Strauss, 2007). Real estate "bubble" burst could lead to economic recession which eventually affect the living standard of the citizen. The real estate booms are because the results of rapid credit growth and leverage (benign neglect factor) while the bubble would burst as a result of debt overhang and deleveraging spirals. Both of these scenarios can affect the financial and macroeconomic stability(Crowe, Ariccia, Igan, & Rabanal, 2013).

In year 2007, the burst of U.S real estate "bubble" had caused economic recession in U.S which then resulted in the occurrence of Global Financial Crisis (GFC) in the world. This crisis clearly illustrates that the sharp increase in the housing prices could lead to the "over-heating" of the economy, and vice versa (Leamer, 2007qtd in (Crowe et al., 2013)).

The crash of the U.S real estate market has significant impact on the U.S. economic crisis 2008. With the crash of U.S real estate market, the financial market was also adversely impacted by the sub-prime mortgage, which caused the market crisis to begin in August 2007. This crisis has affected other sectors in U.S. and ultimately, ignited the Global Financial Crisis (Liow, Huang, & Song, 2019b; Liow, Zhou, Li, & Huang, 2019). This crisis clearly illustrates the adverse impact of the sharp increase in the housing prices, i.e. "overheating" of the economy, and vice versa (Leamer, 2007 qtd in (Crowe et al., 2013)). The recent global financial crisis is a glaring testimony to this.

Not only that, the real estate "boom" and "bubble" burst also impacted the society. The real estate "bubble" is a threat to the society as well as economy. The cost of living may increase due to higher real estate price and rental. These welfare consequences have been mentioned in some studies (Bianconi & Yoshino, 2012; Christensen, 2017; Glaeser,

Gyourko, & Saiz, 2008; Ott, 2016).Without proper monitoring on the real estate (property) price, the cost of living would increase while the productivity and innovation of people would decrease.

A chain of issues would also be noted, e.g. when the owner of the real estate property purchased his or her property at a higher price/cost (Carrick, 2016), he or she would demand a higher rental from his or her tenants to cover the higher cost incurred by him for owning the property.

In the tenant's perspective, the tenant of a residential property would need a higher household budget for his or her higher rental to stay in the property. If the property is used for commercial activities such as retail shop, the tenants would have to sell their goods at a higher price in order to cover the high amount of rental paid for renting the property. Consequently, the aggregate product price will increase, which in turn, cause the increase in the cost of living. Thus, the higher the rental, the higher the goods' selling price and the higher the cost of living.

When the real estate market "bubble" burst, the local economy is likely to turn into a local recession. During an economy recession, there would be lots of people who lost their jobs, which caused the increase in the country's unemployment rate. At these times, many people will not be able to earn their living causing their standard of living to decrease. Relatively, the poverty rate would increase due to the increase in the expenditure during the economic recession (inflation). Hence, the population poverty rate could increase simultaneously(Mărcuţă, Mărcuţă, & Angelescu, 2013).

Besides, the burst of real estate bubble would also bring a number of welfare consequences. (Bianconi & Yoshino, 2012; Christensen, 2017; Glaeser et al., 2008; Ott, 2016). Without enough income to support the daily expenses, the domestic demand (firm's products and services) will be affected. The situation would continue until it affected the whole supply and demand chain in more and more sectors. The consequences could be catastrophic in nature.

1.3 Property (Real Estate Fixed Assets) Market Investment and Property Stock Market (Non-Fixed assets) Investment and REITs

The Cambridge dictionary defines the property (real estate) market as an activity that involves in buying or selling of lands and buildings. The right of ownership on a physical real estate or land with all the facilities or improvements on it, which are permanently affixed to it, is called real estate property (Pagourtzi, Assimakopoulos, Hatzichristos, & French, 2003).

The property (real estate) stock market represents the shares of real estate companies which are traded in Bursa Malaysia. The main business activity of the real estate companies is to involve in real estate development projects (developers). Investing in

real estate (property) stock market shares the same traits of investing in the physical real estate market and the stock market but not in the real estate investment trust (REITs), which is similar to mutual funds. Those mutual fund companies normally own or finance those income-producing real estate (Investopedia, 2019) properties (e.g rental or value appreciation from the property).

The strong performance of the real estate market in Singapore has transformed into better return performance (higher profit) to most of the real estate stocks traded in the Stock Exchange of Singapore (SES)(Liow, 1997). The returns and volatilities profiles are belong to property (real estate) stock price itself (Liow et al., 2006). Considering these, a more-in-depth understanding is important to know whether property stock market could provide another representative alternative (proxy) way to forecast the volatility in real estate market.

The real estate (property) investment is a good hedging tool (R. J. Shiller, 1995) to hedge against inflation (Hoesli, 1994). Many investors have started to include real estate sector to their portfolio allocation (Hudson-Wilson, Gordon, Fabozzi, Anson, & Giliberto, 2005). Yunus (2009) stated that, real estate investment has low correlation with traditional assets investment such as stocks and bonds across the countries qtd in (Abdulnasser, Roca, & Al-shayeb, 2014).

However, direct real estate investment (fixed asset) is not as liquid as stock market transaction. Hwang (2004) stated that, the transaction process of real estate (property) would take six to twelve (6-12) months, and this does not include the selling period (qtd. in (Abdulnasser et al., 2014)). Hence, investment in property stock market could be one of the good options to hedge against inflation and reduce the real estate transaction process risk.

1.4 Malaysian property Stock Market

With reference to Table 1.1: Property Stocks Malaysia and Market Cap, as at January 2020, there are ninety-seven (97) property stocks in the list of Bursa Malaysia property sector. The main developers in this sector are IOI Properties, SP Setia, Mahsing, IGB, Eco world, Eastern & Oriental (E&O), LBS Bina and more. The market capital of property stock market is equivalent to 13% of the total market capital of Bursa Malaysia.

Table 1.1: Property Stocks Malaysia and Market Cap

No	Listed Company Name	Market Cap (RM)	No	Listed Company Name	Market Cap (RM)
1	IOI Properties	6,830,000,000	51	M K Land	198,760,000
2	SP Setia	6,440,000,000	52	Asian Pac	193,550,000
3	Sime Darby Property	5,950,000,000	53	PLB Engineering	174,210,000
4	UOA Development	3,970,000,000	54	JKG Land	170,620,000
5	Malaysian Resources	3,220,000,000	55	Y&G Corp	163,860,000
6	UEM Sunrise	3,150,000,000	56	Enra Group	161,900,000
7	IGB	2,370,000,000	57	Ewein	157,390,000
8	Eco World Intl	2,230,000,000	58	Menang Corp	151,450,000
9	Eco World Develop	2,110,000,000	59	Talam Transform	150,330,000
10	OSK	2,080,000,000	60	Country View	149,000,000
11	Mah Sing	1,700,000,000	61	Tiger Synergy Bhd	139,850,000
12	Matrix Concepts	1,580,000,000	62	Yong Tai	138,840,000
13	YNH Property	1,460,000,000	63	Hua Yang	137,280,000
14	TA Global	1,370,000,000	64	MUI Properties	133,360,000
15	Tropicana Corp	1,280,000,000	65	Damansara Realty	132,120,000
16	MKH	1,010,000,000	66	Pasdec	128,120,000
17	Eastern & Oriental	852,370,000	67	BCB	123,880,000
18	Paramount Corp	812,950,000	68	Bina Darulaman	113,950,000
19	KSL	768,000,000	69	Gromutual	112,680,000
20	Ideal United Bintang	756,730,000	70	Thriven Global	112,120,000
21	Berjaya Assets	741,900,000	71	SBC Corp	108,390,000
22	LBS Bina	738,880,000	72	Global Oriental	102,300,000
23	Iskandar Waterfront City	703,410,000	73	Ken	98,640,000
24	Rapid Synergy Bhd	633,890,000	74	Majuperak	97,680,000
25	SHL Consolidated	559,310,000	75	GSB	96,680,000
26	Naim	525,780,000	76	Sentoria	94,810,000
27	Sunsuria Bhd	524,110,000	77	Encorp	88,770,000
28	HCK Capital	521,240,000	78	Ivory Properties	85,760,000
29	Plenitude	480,730,000	79	Eupe Corp	83,200,000
30	GuocoLand	479,810,000	80	Lien Hoe Corp	81,440,000
31	Gw Plastics	458,950,000	81	SEAL Incorporated Bhd	74,670,000
32	Amverton	438,080,000	82	Sapura Resources	73,990,000
33	Land General	401,370,000	83	Naim Indah	71,960,000
34	Titijaya Land	362,060,000	84	Acme	65,990,000
35	Crescendo Corp	343,680,000	85	LBI Capital	58,920,000
36	Amcorp Properties	343,100,000	86	Jiankun Int	54,220,000
37	AYER	333,100,000	87	Farlim	53,130,000
38	Oriental Interest	312,810,000	88	Bertam Alliance	51,690,000
39	Country Heights	311,860,000	89	DPS Resources	47,020,000
40	Tambun Indah Land	305,590,000	90	Tekala	44,750,000
41	Ibraco	292,880,000	91	Tanco	37,370,000
42	Glomac	291,980,000	92	Meridian	34,780,000
43	EcoFirst Cons	275,490,000	93	South Malaysia Ind	32,540,000
44	Magna Prima	274,420,000	94	Malaysia Pacific Corp	30,200,000
45	I-Berhad	260,890,000	95	Multi Usage Holdings Bhd	18,900,000
46	Selangor Dredging	251,420,000	96	Grand Hoover	16,400,000
47	Malton	242,940,000	97	ARK Resources	14,600,000
48	Symphony Life	237,050,000		Total	66,701,090,000
49	MB World Group	232,920,000			
50	Tadmax Resources Bhd	219,320,000			

1.5 Malaysian Real Estate Market Recent Trends

Malaysia is an emerging (developing) country, which has characterized by strong economic growth (Demirguc-Kunt, 2005). Malaysia is favored by foreign investor due to its potential in generating higher return on investment. Furthermore, with stabilization

in politics and less natural disasters, Malaysia is a good option for property investment (Razali, 2015). Since 1980s, many investors have included investments in emerging markets in their international portfolio management especially in Asian property market because of their sustainable economy during Global Financial Crisis (GFC) (Razali, Hamid, & Zekri, 2019). As compared to matured (developed) market, emerging markets have more potential to grow, thus, could have higher rates of return on investment.

Conversely, the assets of emerging market are more volatile (risky). According to World Bank, the biggest four emerging markets nowadays are China, India, Indonesia and Brazil. In recent decades, the tremendous development of Malaysia has attracted numerous foreign investors to invest in various types of Malaysia's economy sector, especially in real estate sector due to high investment return opportunity.

The real estate market is considered as one of the good investments in the emerging market because of its high growth since year 2009 (after global financial crisis) and its diversification benefits (Karl E. Case, Robert, & N. Weiss, 1991; Liow, Ho, Ibrahim, & Chen, 2009). The real estate market in emerging markets had brought a high return on investment to most of the real estate investors from year 2009 to 2013. In Malaysia, the overwhelming increase in house price is not a new topic in the newspaper, magazines, television, and financial press. After the global financial crisis in year 2008 and 2009, the real estate market in Malaysia had increased dramatically. The house price in some areas has even flipped over in just one year. The same situation had happened to the land price in Malaysia, where some of the agriculture lands market price had folded over several times from year 2009 to 2013.

In year 2009, the Malaysia's economy growth was at 7.3%. The tremendous economy growth result was contributed by the service, agriculture and mining sector in Malaysia. The rapid growth of these industries could increase the real estate (property) demand in Malaysia. The high demand would have made the real estate prices increase. Eventually, this phenomenon would cause the real estate (property market) to become a profitable investment tool.

The real estate market of Malaysia has been experiencing a long appreciation and real estate market boom since year 2009. Figure 1.1 shows that the Malaysia's house price index had increased approximately 60 points or almost 50% in 3 years' time from year 2009 until 2013. In year 2014, the real estate (property) price in Malaysia still in upward trend. However, there were still statements stating that the Malaysia's real estate market still affordable for the Malaysian and it is undervalued as compared to neighboring countries.

Malaysia house price index had a sharper increase from year 2009-2013 as compared to year 2001-2008, where the latter growth of the house price index was relatively steadier. In year 2013, it was reported that, the residential property had declined in the transaction volume by 9.75% but the transaction value still rose by 6.3% to RM 72.06 billion. Kuala Lumpur continued to be the market leader with sharper house price index, rising by 14.4%

(nominal). Figure 1.3 indicates the performance of Kuala Lumpur house price index from year 2005 to 2012.

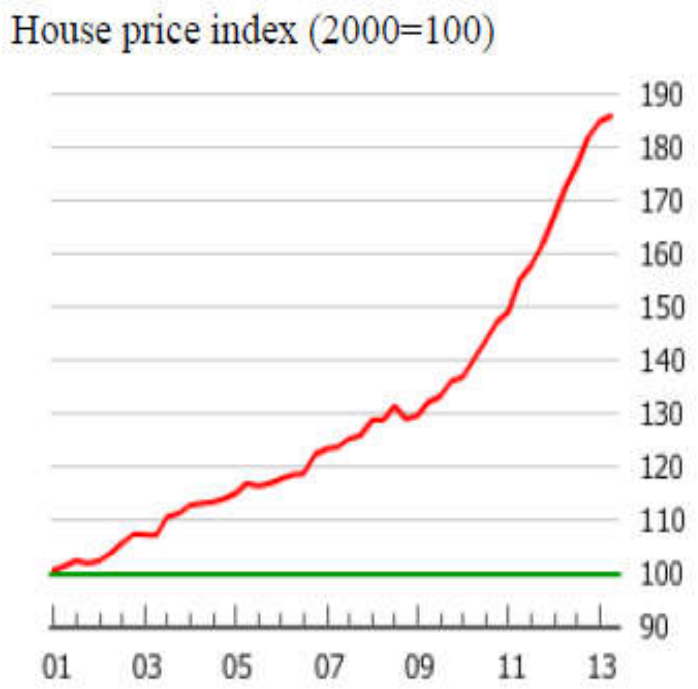

Figure 1.1: Malaysia House Price Index from Year 2001-2013 (Yearly Data)

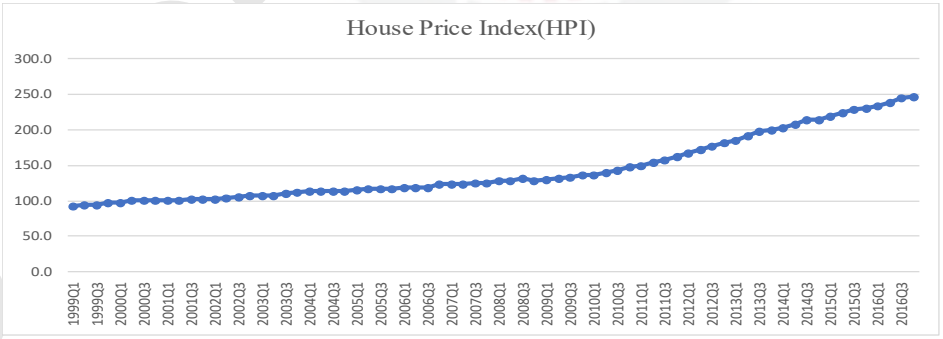

Figure 1.2: Malaysia House Price Index from the Year 1999-2016 (Quarterly Data)
(Source: JPPH Malaysia)

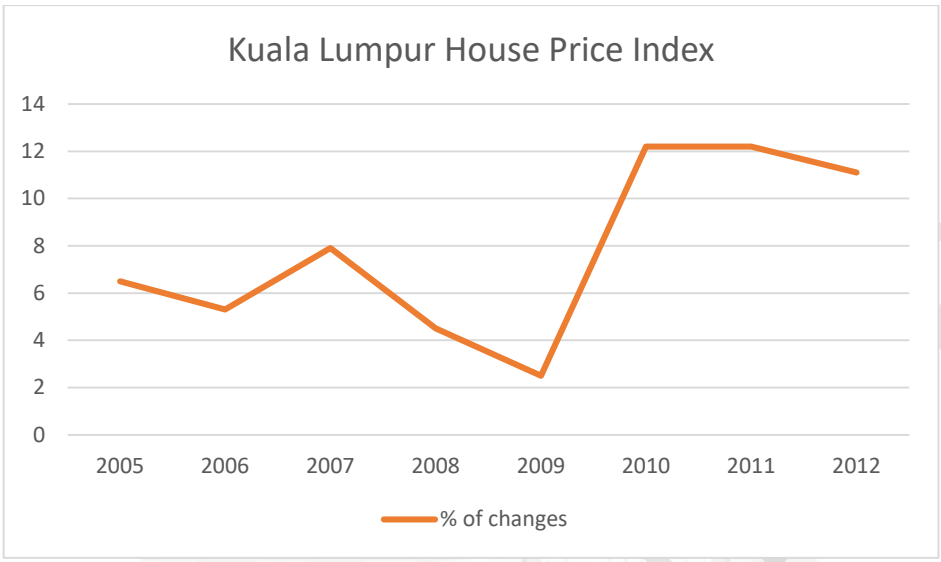

Figure 1.3: Kuala Lumpur House Price Index Return from Year 2005-2012

With reference to Figure 1.2: Malaysia House Price Index from the Year 1999-2016 (Quarterly Data), the figure shows that, from year 2014 to 2016, although the real estate market was still in upward trend but the growth rate was slowed down in year 2016. The real estate transaction volume in Malaysia has declined but the real estate market price (especially housing price) is still in an increasing trend but steadier. According to JPPH ("Jabatan Penilaian Dan Perkhidmatan Harta/Valuation and Property Service Department") in the first quarter of year 2014, Malaysia house prices have increased by 1.65% (0.73% inflation-adjusted). The accumulated value of residential property transactions rose by 6.3% to MYR72.06 billion (US$22.4 billion) but the total volume of residential property transactions has declined by 9.7% to 246,225 unit. Malaysia's residential construction activities have declined since year 2013.

The new residential building plan approvals have declined by 13.5% year-to-year basis to 33,859 units in the fourth quarter of year 2013. Similarly, the new housing construction projects have dropped by 13.6% whereas the project completions have plunged by 15.8% over the same period. Consequently, the newly launched residential units totaled up to 48,617 units in year 2013 and the total housing available positioned at 4,725,109 units by the end of year 2013, which believed to be over supplied.

The real estate (property) sector serves as one of the major contributors to gross domestic production (GDP), nation's economic development and prosperity. Hence the real estate sector must be well monitored (Plakandaras et al., 2015). Real estate sector has contributed a lot to the GDP of a nation. According to Savills, a UK-based real estate service firm, the global real estate assets, which included commercial, residential property and agricultural land, are valued at US217 trillion in year 2016. This value is equivalent to 2.7 times of global gross domestic production (GDP), more than 12 times

of the US GDP, 21 times of China GDP, 3.9 times of all equities value and 36 times of mined gold value up to date (Grandhi, 2016).

The global real estate assets are the world's biggest business, which has been valued at US50 trillion (15 percent of the global GDP) (qtd. in ((Liow et al., 2006)). In short, real estate sector is an important sector not only to a country, but also to the world as a whole. The aggregate value of real estate market is huge, and it contributes a great deal to a nation's GDP. Local government has to exercise government intervention in real estate sector as this is imperative to maintain the national economic condition.

1.6 Portion of Real Estate Sector in GDP Malaysia

Table 1.2: GDP by Economic Activity and Annual Changes (%)

GDP by Economic Activity (at constant 2010 prices)

	Share 2014 (%)	2014			2015
		1Q	4Q	Year	1Q
		Annual change (%)			
Agriculture	9.2	2.6	-3.7	2.1	-4.7
Mining	9.0	-0.1	9.5	3.3	9.6
Manufacturing	23.0	7.0	5.4	6.2	5.6
Construction	4.3	19.3	8.8	11.8	9.7
Services	53.5	6.7	6.6	6.5	6.4
Real GDP	**100.0[1]**	**6.3**	**5.7**	**6.0**	**5.6**
Real GDP (q-o-q seasonally adjusted)	-	**1.4**	**1.8**	-	**1.2**

[1] Numbers do not add up due to rounding and exclusion of import duties component

Source: Department of Statistics, Malaysia

Table 1.3: Performance of the Services Sector

Performance of the Services Sector (value added at constant 2010 prices)

	Share 2014 (%)	2014			2015
		1Q	4Q	Year	1Q
		Annual change (%)			
Intermediate Services	**38.4**	**6.1**	**6.1**	**5.9**	**5.7**
Finance & insurance	13.7	2.7	2.4	2.3	1.9
Real estate & business services	7.9	8.2	8.3	8.0	7.6
Transport & storage	6.5	4.8	6.0	5.2	5.7
Information & communication	10.2	10.1	9.7	9.7	9.6
Final Services	**61.6**	**7.2**	**6.9**	**7.0**	**6.8**
Wholesale & retail trade	26.9	8.5	9.4	8.9	9.8
Food & beverages and accommodation	5.1	6.3	7.5	6.5	7.3
Utilities	4.8	3.2	3.9	3.8	3.7
Government services	16.5	7.6	4.7	6.1	3.9
Other services	8.2	5.3	4.7	4.8	4.6
Total Services	**100.0**[1]	**6.7**	**6.6**	**6.5**	**6.4**

[1] Numbers do not add up due to rounding

Source: Department of Statistics, Malaysia

The Table 1.2: GDP by Economic Activity and Annual Changes (%) and the Table 1.3: Performance of the Services Sector show that, the real estate (property) market, i.e. construction, contributes a totaled 12.82% of the GDP (4.3% as shown in Table 1.2 and 8.52% in Table 1.3 (real estate and business services at 7.9% from the 53.5% services sector). Hence, the real estate sector is one of the major economy contributors to Malaysia's GDP. Similarly, the US real estate market with a combination of residential investment and consumption of housing service contributed an average of 15-18% to US GDP (National Association of Home Builders, 2016).

The real estate market is an important sector to most of the countries. Staying in a house is an essential need as people need to have a roof on the top to provide shelter and comfort. People must afford to own a house (desired by them) and live in it for at least 7 years (Diewert, Nakamura, & Nakamura, 2009; Glaeser et al., 2008). Houses provide shelters to us so that we can sleep, live and maintain a family peacefully. The common objective in real estate industry is to build a "green building" to take care on the return of investment for investors and ensure that there is low risk in real estate market besides creating important Key Performance Indicators (KPIs) for the investors (Christensen, 2017).

The long run appreciation in real estate market price could adversely impact the people's standard of living. Figure 1.3 shows that Malaysia real estate market has gone through a long-run appreciation in the past 12 years from year 2000-2012. This long-run appreciation of the Malaysian property market may cause housing issue that in turn impact on the citizens' standard of living. The affordability of Malaysian to own their own house are now questionable. The long run appreciation of housing price could become a huge burden to citizens.

According to the OECD index, most of the spending, which is about 18% gross adjusted disposable income in Korea is for their house. In Czech Republic and Greece, the household spending on housing is varying from 26% to less than 16%. The condition is better in the Russian Federation which is around 11% (OECD Better Life Index, 2016).

The higher rate on disposable income spending for houses could increase the cost of living in a country. The future generations would no longer afford to own a house for their own family. It is crucial for the present government to ensure that the next generation could afford to have their own house to stay. Thus, a stringent monitoring on the real estate market is necessary for the welfare of a nation's society.

1.6.1 Government Intervention

Government intervention can affect real estate market performance (Floetotto, Kirker, & Stroebel, 2016; Hongyu, 1998). To overcome the GFC (global financial crisis) 2008, Malaysian government had implemented appropriate policies such as monetary policies in the real estate market. The policies were implemented with an aim to control the house price inflation (Das, Gupta, & Kabundi, 2009) and determine the appreciation of the real estate market (Crowe et al., 2013; Eleanor & Chen, 2012; Koh et al., 2005). Given this, forecasting in real estate sector can give policy-makers better ideas on designing appropriate policies at the right timing.

Macro-economic variables are found significant in affecting the volatility increases in the real estate market (Dolde & Tirtiroglu, 2002). The unusual real estate market boom in Malaysia is not occasional but with reasons. According to Global Property Guide, after the global financial crisis (economic crisis) from year 2008-2009, the real estate market was back to normal with the assistance of the Greater Kuala Lumpur Plan and prime locations targeted development such as the "The MRT Project", DIBS (Developer Interest Bearing Scheme) scheme, zero down payment and low interest scheme in purchasing the direct real estate property (Guide, 2016).

The Malaysian government has succeeded in overcoming the global financial crisis impacts (GFC) in Malaysia's economic performance. The real estate market prices in certain locations of Malaysia have been doubled within few years and the GDP of Malaysia has starting to turn into growth. Beyond that, the appreciation of the real estate market in Malaysia has generated a considerable income through the Property Transfer Tax (which is also known as Stamp Duty) to Malaysia government. This phenomenon was a rare occurrence in Malaysia's property history.

1.7 "Bubble" and Risk

The over booming in the real estate market could create risk to the financial market and the economic stability of a country. The real estate boom normally followed by the increase in leverage, which means the household are highly leveraged. In the report

issued by Moody's Investor Service, the Malaysia household debt was 88.4% in year 2016 but has improved to 84.6% in year 2017. Moody's rated Malaysia with an A3 rating and a "stable" outlook and a high vulnerability indicator of 139.7%. (Moody's, 2017). The vulnerability indicator is used to measure sovereigns' exposure to a sudden stop in capital flows with 139.7%.

Monetary policy approach is the "benign neglect" to the real estate boom for most of the countries. In year 1986, Japanese government had reduced their interest rate from 5% to 2.5% to stimulate the economic growth. This had caused a boom in the Japanese real estate market. In order to confront with the situation, in year 1990, the Japanese government raised the interest rate which at last resulted in a long term economic recession in Japan(Calvin & Lin, 2011).

It is hard to identify unsustainable real estate "boom" or "bubbles" (sharp increase of price which is not supported by fundamental factors). The imbalance is not monitored well by the bank regulations which are not equipped well to deal with the risks originated from the aggregate credit dynamic (Crowe et al., 2013). Thus, the real estate boom may be followed by the burst of the real estate "bubbles". One of the most recent real estate bubble bursts happened in the U.S real estate market in year 2007. The burst has resulted in the recession to the U.S overall economic, which quickly spread to other countries.

1.8 Real Estate and Economic Conditions

Real estate market is important to overall economic performance hence the real estate market risk should be monitored well. Since there is a lack of quality (C. L. Lee, 2009) and quantity data in the real estate market, the listed property stock market performance could be the proxy for the real estate market. Reliable and accurate volatility (risk) forecast on the property/real estate stock market is important and useful for investors and policymakers.

By having a more accurate volatility forecast in the property stock market, the daily forecast volatility/risk of the property stock market will be available to us. It could be treated as one of the financial risk indicators (early warning system) for the economy.

Secondly, policy makers or investors can plan effectively and resourcefully by using the volatility forecast. Modelling and forecasting the volatility of property stock market in different time periods could be a prime requirement to assist the policy makers in the capital allocation decision-making process. Knowing the risk in the worst situation (economic crisis period) and the risk in the best situation (economic boom period) helps the practitioners to differentiate the guideline risk in different periods.

Thirdly, the newly proposed adaptive STES methods could be tested to determine if it can provide a higher volatility forecasting accuracy and able to deal with outlier problems by using a lower number (GARCH models need high number of observations to produce

appropriate parameters estimate) of observations (sample sized, at here daily return). With lower observations requirement, the model can provide a set of more timely and accurate information of the market.

1.9 Disadvantage in Direct Real Estate Investment VS Property Stock Investment

Although the real estate markets are interdependent, the lagged values of the real estate markets themselves are the most significant influence factor (Brooks & Tsolacos, 2010). The disadvantage of investing in direct real estate market (fixed assets) is illiquid and it could cause an increase in the aggregate housing price. The purpose of this study is to provide another alternative investment option for the investors to invest in the Malaysian property stock market by providing a more accurate volatility/risk forecast on the property stock market and at the same time reducing their risk of investment.

Though investing in the real estate market at the right timing could promise a fruitful return, there are still disadvantages in investing in the real estate market. The disadvantages of investing in the direct real estate market (fixed assets) is the liquidity risk; the investment is illiquid and it could cause an increase in the aggregate housing price. Two-way causal effects are found between the real estate stock market data and the direct property (real estate) market (Lizieri & Satchell, 1997).

As discussed by Liow(1997), many public listed property companies of Singapore have built up their land banks not only in local but in neighboring Asian countries such as China, Indian and Vietnam. These companies have engaged in major property developments of these countries (Liow, 1997). Therefore, investing in the real estate (property) stock market could be more profitable if they can manage their risk better due to the prospect of the company's future.

This study is to identify an accurate volatility forecasting model for the Malaysian real estate stock market in order to encourage investor to invest in property stock market instead of direct real estate market. Knowing the future risk and the difference of risk between the direct real estate market and the property stock market are crucial for investors. It is believed that, the Malaysian property stock market volatility forecast or risk forecast could provide a good guideline for the relevant parties such as house market participants, investors, developers, mortgage financial institutions, and policy makers as well as a guideline for other countries (Gogas & Pragidis, 2011) in learning the real estate risk of a country.

1.10 Prevention Policy on Overheating Real Estate Market with Property Stocks

The prevention policy against the real estate boom issue has been discussed by the academicians(Coleman IV, LaCour-Little, & Vandell, 2008). Yet, the preventive policy has resulted in a lot of questions, e.g what indicators should be used and how the indicator

tells us when to trigger the intervention of prevention action in order to slow down or ceased the real estate boom. Macroprudential measures (such as risk on excessive leverage) are believed to have some advantages especially when coordinating with different location and time. However, the fact so far suggested that, these measures are not always effective especially on the lax monetary policy stance and external demand. Monetary policy should play a complimentary role to overcome the situation(Crowe et al., 2013).

To overcome this potential issue (threat), innovation measures have been urged (as the indicator to trigger the policy intervention when there is real estate boom or "bubble burst") especially after the recent global financial crisis (GFC) in year 2008. Misprice of the real estate investment will have negative impact on other sectors in the economy and the negative impact will spill over internationally (Abdulnasser et al., 2014). New or innovation ways are being demanded as macroprudential measures are not always effective in slowing down or stopping the real estate boom and "bubble burst".

In order to find an effective policy or toolkit to confront with the real estate boom, it is suggested that the policy perspective should be widen to recognize the imbalance between inflation and output gaps. These include complementary measure in reducing the risk of the real estate "bubbles" and increasing the housing supply aggregate to reduce the impact of the housing demand shock (Crowe et al., 2013).

Besides, one of the complementary measures is real estate volatility forecasting. It could become one of the good measures in reducing the real estate market risk of a country. The strong performance in the real estate market in Singapore has transformed into better return performance (higher profit) to most of the real estate stocks traded in the Stock Exchange of Singapore (SES) (Liow, 1997). Hence, the real estate stock market could become a proxy for investors to forecast the real estate market volatility when the returns and volatilities profiles belong to the real estate stock price itself (Liow et al., 2006).

Following the suggestion of Newell (2019), to prevent the collapse of the real estate market, introduction of preventive policy action are encouraged. (Coleman IV et al., 2008). One of the solutions is volatility forecasting. The risk of the European real estate/property stock markets is interdependent (Liow, 2013). Therefore, the property/real estate stock market volatility forecasts could become one of the good indicators in minimizing the volatility (risk) in the property/real estate stock market of a country.

The global financial crisis (GFC) happened from the year 2008 to 2009, but there are limited studies that discussed on the impact of GFC to the parameter of the GARCH model in Malaysian property stock market. It is useful to outline some sources of potential insight (information) from GARCH model parameters and summarize of extract some information from the models in different time periods as these could be used to explain the poor performance of the model in forecasting.

Considering the increasing contribution of developing countries to the world economy over time and moving in tandem with rapid property market (physical) growth, the Malaysian property market value has experienced a sharp rise in both the residential and commercial sectors in the last few years. By considering indirect property investment vehicle as substitutes for the direct real estate investments, this study is to analyze the volatility (risk) forecasting performance of *ad-hoc* methods, generalized autoregressive conditional heteroscedasticity (GARCH) models, Integrated GARCH (IGARCH), Exponential GARCH (EGARCH), GJR-GARCH (GJR) and newly purposed Smooth Transition Exponential Smoothing (STES) method in Malaysian property (real estate) stock market.

1.11 Forecasting in Property Stock Market

A large part of a forecaster's job is to explain the reason for seeing a particular set of future events. This thesis concerned with methods of forecasting volatility time series. Studies will be conducted in an attempt to find out the possible reasons behind the failure in forecasting and highlight the difficulties in forecasting the real estate market future. The accuracy in forecasting depends almost entirely on the model that is being used. A technique capable of producing a reliable model is always necessary (adoption of STES method). Meanwhile, these are a body of methods that rely primarily on the statistical properties (characteristic and time horizon) of the data (Christoffersen & Diebold, 2000; Christoffersen, Diebold, & Schuermann, 1998).

The objective of this study is to learn different specification of forecasting models in capturing the time series behavior of the data and may be used to predict the data's general performance. It also tries to find out whether property stock index (PI) variance can be used as a proxy for house price index (HPI) variance which can provide timely information. This thesis will discuss the detailed forecasting performance of different specification forecasting models, statistical issues of estimation and inference by using Malaysian property stocks (Fama, 1970; Timmermann & Granger, 2004).

Forecasting is important as it can provide essential guidelines to decision-makers in many aspects., Forecasting can act as an earlier warning system of economic crisis and helps in the decision-making processes which includes decision making in stock demand, capital budget, weather, risk management (option pricing and portfolio analysis) and more. Most of the academicians and practitioners found forecast accuracy, changing variance (time series), different characteristic of in-sample observations and out-of-sample observations (Ghysels, Sinko, & Valkanov, 2007; Taylor, 2004b), and failure in forecasting are those important problems in the forecasting literature.

To have a good prediction, the model of conditional volatility is what most researchers would agree on. However, the question of what model to be used remained unresolved. Previous forecast studies cannot conclude which forecasting model can work well in all the datasets. R. F. Engle, (1982) started the conditional volatility literature with autoregressive conditional heteroscedasticity (ARCH)-class of models. ARCH has

successfully captured the dynamics of return variance using simple parametric models and modified ARCH models such as symmetric GARCH (R. F. Engle & Bollerslev, 1986), asymmetric EGARCH(Nelson, 1991) have been developed over time.

The forecasting performance is affected by many reasons and often few of them could be due to the forecasting models, terms of regressors, and different economic conditions (return histories) (Ghysels, Santa-Clara, & Valkanov, 2006; Ghysels et al., 2007). Other than the new methods/models, one alternative is to look for variables (squared returns or absolute returns) (Ghysels et al., 2006, 2007) that could be good predictors of volatility. Furthermore, the returns distribution, returns mean value, and returns standard deviation of a series could be different in different economic conditions.

Although the robustness and consistency in the performance of a forecasting model is important, it could be affected by changing series' characteristic (Taylor, 2004a). There are several advantages of using STES regressions as it allows level shift and different optimization value.

Some important information on why poor forecast happens could be outlined from GARCH (General Auto Regressive Conditional Heteroskedasticity) model's parameter (F. Engle & K.Ng, 1993; Fukuda, 2010; Hillebrand, 2005). Meanwhile, the short-time and long-time horizon data could affect the forecast accuracy. The news impact curve can be used to reflect how the news shock impact on the volatility of different market/economic condition. Last but not least, MIDAS (Ghysels, Santa-Clara, & Vlkanov, 2004; Ghysels et al., 2007) can help in identifying the variance relationship between the two data sampled at different frequency.

This thesis employs two different property stock return data, one for 2005 to 2010 (5 years data separated into short-time horizon for periods before, during and after GFC.) and the other data from year 2009 to 2016 (7 years long-time horizon after GFC period) to provide a full picture regarding the impact of short-time horizon changing dynamics of the Malaysian property stock return before, during and after GFC to the return volatility forecasting performance of different forecasting models and long-time horizon after GFC (Razali, 2015; Zekri & Razali, 2019). This is to compare the robustness in volatility forecasting performance of the models. Besides, the house price index (HPI) and property index (PI) (different frequency data, details provided in each chapter) have been used to learn their variance relationship.

1.12 Problem Statements and Research Gaps

According to forecasters, the year 2008 should be a prosperous year for the financial market. The failure of economists fails to forecast the crash was not something special. This has lead to the financiers to focus on quantitative mathematical models when calculating risk. Hence, even they cannot forecast what would happen in the future, they could at least be able to calculate risk (Orrell, 2010). In response to this problem, this thesis proposes to investigate in depth by comparing the empirical findings of different

quantitative mathematical models on the volatility level including the volatility forecasting performance in different periods, how it changes, and what it implies by using Malaysian property stocks, average price of the selected property stocks(AP), and property index(PI).

There are five gaps in this thesis. First, to clarify when is the crisis period and how did the volatility behaved during the crisis period as compared with before crisis period. The study on changing parameters of GARCH's model in different economic conditions (time periods) allow us to learn the volatility term structure of Malaysian property stocks in different period. In other words, it helps us to differentiate the volatility status of Malaysian property stocks in before and after GFC period. With the other point of views, this explains one of the reasons of poor forecasting. Through this volatility level identification, decision makers could choose the right timing for their investment and the policies objective development.

Second, in different economic conditions, the policy makers in property sector might make decision based on property index performance while practitioners might make decision based on individual stock. The academician should provide literature knowledge on the differences in using different time series data and models. This study further studies in depth on NIC built on different model such as symmetric GARCH model, asymmetric GJR-GARCH and STES methods in different periods using property index (PI), Malaysian property stocks average price (AP), and individual stock (pattern of NIC of different models, different period, their implication and more), providing the differences in between and its implications.

Third, the method to identify a crisis period is essential and model to be employed in different period is equally critical and essential. Selecting the most accurate models in calculating risk in different time period could help in better decision-making overtime. Distinguish timely volatility level of the current market in different period is important as it could help in preventing the hidden coming crisis. Analyzing on the volatility performance in different periods (economic conditions) might provide better picture on the time-varying conditional volatility level and might able to indicate the change in the market condition. Meanwhile, the performance of different quantitative mathematical models in different periods in-sample and out-of-sample performance might further solve the question "why poor forecast" in forecasting literature (Hendry & Doornik, 2014; Orrell, 2010). Furthermore, there is a lack of empirical findings of volatility forecasting literature focusing in developing country property stock market such as Malaysian property stock market volatility forecasting literature using short sample size (short-time horizon).

Fourth, the forecasting model that can work well in short-time horizon might not work well in long-time horizon. Considering the importance of using the right model at the right timing, identifying the consistent performance of smooth transition exponential smoothing (STES methods) with GARCH family models and its' volatility forecasting performance of Malaysian property stocks in short and long-time horizon must be studied

wisely. Meanwhile, it is interesting to identify if the STES methods forecasting performance would be affected by using different optimization methods.

Fifth, the high frequency daily data of property index (PI) can provide timely information as compared with low frequency quarterly data of house price index (HPI). With some finite or infinite lag polynomial operator, MIDAS (Mixed Data Sampling regression model) regression allows different frequencies data can be regressed together. Hence, using MIDAS allows us to identify the variance relationship between the Malaysian house price index (HPI) and property index (PI) in depth.

1.12.1 GARCH Parameters in Different Economic Conditions (Time Periods)

There is a research gap by comparing the parameter estimates of GARCH model in different economic conditions. This is especially true in the impact of the recent global financial crisis (GFC) to Asian property stock market. There is a strong volatility (time-varying conditional variance) found in the REITs market (developed countries) (Choo, Ahmad, & Abdullah, 1999; Kim Hiang & Qiong, 2006; Liow et al., 2009, 2006). The property (real estate) stock market volatility could be different across different economic conditions such as before and during Global Financial Crisis (GFC). Hence, the GARCH parameter estimates are postulated or hypothesized to vary under different economic conditions.

1.12.2 Volatility Status of Different Time Series Data across Different Economic Conditions

It is widely recognized that the volatility is higher during recessions time, but these effects are not clear (R. F. Engle, 2008). Hamilton & Susmel (1994) concludes that the economic crisis, to some degree, is associated with the high volatility. The decrease in stock price have led to a bigger increase in volatility than an increase in stock price at the same magnitude. Hence, concrete studies in volatility can help in analyzing the market trend and investment portfolio. The news impact curve (NIC) can be used to evaluate and compare the property of volatility estimates in the autoregressive conditional heteroskedasticity (ARCH) class. It is a standard measure of how news can be incorporated into volatility estimates (F. Engle & K.Ng, 1993).

The decrease in stock price could lead to a bigger increase in volatility than an increase in stock price of the same magnitude (Hamilton & Susmel, 1994). One must use parameter estimates that can reflect the changes in current market condition (Carol, 2001). Therefore, a study on GARCH parameter estimates in different time periods (market conditions) could help in understanding the reasons for failure in forecasting as well as reflecting the current market condition and how news impact on volatility in different economic conditions.

1.12.3 Forecasting Models' Performance in Different Economic Conditions (Time Periods)

From previous studies, there is no single and consistent forecasting model that can work best in all the datasets and studies. Many researchers have recommended further investigation using different data, countries, and sectors (Brooks & Tsolacos, 2010; Ken & Brennan, 2010; Y.-H. Lee & Pai, 2010). In a specific point of time, the economic conditions are not necessarily same across the regions, thus it is plausible that a forecasting model performs the best at the national level but not for a specific region. It is also plausible that each forecasting model could only perform better for a specific sector, a specific period or a specific company. Hence, it is important to find out the right measurement tool, adaptive and more accurate forecasting model in forecasting the real estate market volatility(risk).

There is a research gap by studying the volatility forecasting performance of forecasting models in different economic conditions. Strong time-varying conditional volatility was also found in the REITs market (developed countries) (Kim Hiang & Qiong, 2006). The property stock market volatility could be different across different economic conditions such as before, during and after the Global Financial Crisis (GFC). Hence, the forecasting models' performance could be different in different economic conditions. Forecasting performance would be affected if the in-sample characteristic is different from the out-of-sample characteristic (Taylor, 2004b, 2004a). The changing characteristic of the series (return distribution) could incur outlier problem at the same time (Balke & Fomby, 1994; S.-H. Li & Chan, 2005; Park, 2002; Vosseler, 2016). Therefore, as the study in crisis periods are mostly short, shorter time horizon study should be conducted.

There is a lack of studies in volatility forecasting model's performance in different time periods especially before, during and after global financial crisis (GFC) 2007. Considering the fact that omission of the presence of threshold effects can lead to misinterpretations of equilibrium relationship (Gonzalo & Pitarakis, 2006) and different forecasting model's specification (asymmetric models and symmetric models) may perform differently in different market conditions (Stagnant, bear or bull market), the study on the forecasting performance of different forecasting model's specification in different periods should be conducted (Balke & Fomby, 1994; Castle, Doornik, & Hendry, 2012; Castle, Fawcett, & Hendry, 2011; Park, 2002; Vosseler, 2016).

This study intends to examine if the weighting criteria (specification) of forecasting models could forecast better in a different time period (before, during and after GFC). The novelty of this study focuses on daily volatility forecasting of developing countries real estate/property sectoral stocks (which commonly using REITs or property indices (indexes) in research). The property stock market returns volatility as the proxy data (focus on real estate developer company stocks) of real estate market volatility could be more appropriate to instantly indicate the overall real estate sector market performance.

Another gap is to compare the performance of forecasting models in short and long-time horizon datasets (sample size). Various technical forecasting models have been

introduced (Siau & Rossi, 2011) but there are inherent weaknesses within the technique. One of the weaknesses of widely used GARCH model is the minimum sample size which is about 500-1000 observations (Hwang & Valls Pereira, 2006; H. R. Ng & Lam, 2006). In conversion about 252 trading days in a year, it is at least 2 years period. It could be not practical to use 2 years data parameters estimated to forecast tomorrow volatility. Besides, the forecasting model's forecasting performance may not be consistent in short and long-time horizon dataset. Hence, the study for more appropriate forecasting model in each different time period such as STES method in forecasting Malaysian property stock market volatility in short and long-time horizon should be evaluated.

1.12.4 STES Method in Long-Time Horizon

The forecast model that has good forecasting performance in short-time horizon might not work well in long-time horizon (Castle & Hendry, 2014; Ghysels et al., 2007; V. Ng, Engle, & Rothschild, 1992). This study will focus deeply on long-time horizon volatility forecasting model's performance of Malaysian property stocks. This study fills in the gap by applying STES (smooth transition exponential smoothing) methods (a newly proposed model), GARCH models, and *ad hoc* models to generalize the in-sample goodness-of-fit performance and out-of-sample volatility forecasting of Malaysian (developing country) listed property companies individual stock return. Meanwhile, the STES methods would be optimized by using different optimization methods (RMSE and MAE) and the performance of each model will be evaluated in order to find out the most accurate volatility forecasting model for Malaysian property stock market (developing countries) in long-time horizon. Table 2.1 presents that the previous studies done in real estate sector and some are looking for the most accurate forecasting model and mostly are not focusing on volatility forecasting. Besides, most of the previous studies focus on developed countries data instead of developing countries data.

1.12.5 MIDAS in Variance

Considering there is insufficient information on the Malaysian real estate (property) market risk, it is important for us to study and evaluate if we could forecast the Malaysian property stock market volatility and convert it to become a proxy for Malaysian house price index (HPI) volatility. This information is very useful and important because the property stock price index (PI) and the house price index of Singapore are found cointegrated (Liow, 1997). The property stock market volatility forecasting index could be used as an alternative for the real estate (Ong, 1994). By studying the relationship between the real estate market and the property stock market, it allows us to know more about the real estate market (which is sampled in low frequency) through the property stock market (property stocks or property index (PI) which is sampled in high frequency). This information does not only provide useful insights for the investors but also assist the policymakers to judge and evaluate their policy decision outcomes in shorter time frame.

However, some important time-series data are sampled at different frequency (HPI and PI are sampled in different frequency). The MIDAS regression model is one of the

models that can process data sampled at different frequencies. MIDAS regression model is not being used wisely in finding the relationship between house price index (HPI) (low-frequency data) and property stock market index (PI) (high-frequency data). The property stock market index (PI) variance could be a proxy (timely information) for house price index (HPI) variance and it would be interesting if we can identify their variance relationship. This thesis further analyzes the relationship between the House price index (HPI) volatility and Property index (PI) volatility using Mixed data sampling regression model (MIDAS) regression model. To our knowledge, there are no such studies using MIDAS done in Malaysian property stocks before.

1.13 Research Questions

The research questions are as follow:

RQ1: Does the GARCH's parameter different in different economic condition (period)?

RQ2: Are good news and bad news impact on the volatility estimates in different market/economic conditions?

RQ3: Does STES method outperform other comparison forecasting models in short-time horizon (different economic condition period) volatility forecasting of Malaysian property stocks in different time periods?

RQ4: Does STES method outperforms other comparison forecasting models in long-time horizon volatility forecasting of Malaysian property stock market?

RQ5: Can MIDAS explain the variance relationship between Malaysian house price index (HPI) and property index (PI)?

1.14 Research Objectives

Volatility has been one of the important areas of research in time series econometrics and market forecasting. In short, forecast failure could be due to data availability, sample size period, a level shift of the series, and forecasting model's specification (limitation of forecasting model). This study proposed to use adaptive STES methods as compared with GARCH family model (where GARCH has sample size limitation) in volatility forecasting performance of Malaysian property stocks using daily returns, short and long sample period (time horizon) to evaluate the consistency of STES methods. This study aims to outline some potential important theoretical developments and empirical insights on in-sample parameter estimation and how volatility forecasts can be used in practical applications along with applications in the academic literature.

1.14.1 General Objective

The general objective of this research is to study the consistency and whether there are benefits in using the STES methods in one-step-ahead volatility forecasting performance on Malaysian property stocks across different time periods, short and long-time horizon. The consistency of a forecasting model will be formally tested in different economic condition periods. With more appropriate volatility forecasting model, we would have more reliable risk forecasts for Malaysian property stock market which eventually could act as an early warning system to indicate the real estate market risk as well as the economic risk. Meanwhile, NIC is adopted to explain how good and bad news impact on volatility estimates in different market/economic conditions. MIDAS is used to find out the relationship between HPI variance and PI variance for a particular study period.

1.14.2 Specific Objectives

Apart from a formal test on the consistency of STES methods in volatility modelling and forecasting in short and long-time horizon and in different economic conditions, given the growth of interest in housing price fluctuation and the future direction of the real estate market, using Malaysian property stock returns, this study aims to investigate which volatility forecasting model performs the best among the comparison forecasting models especially if the STES methods forecast better than the GARCH family models. Figure: 1.4: Conceptual Framework and Figure 1.5: Hypotheses Correspond to Research Objective shows the overall idea of this thesis.

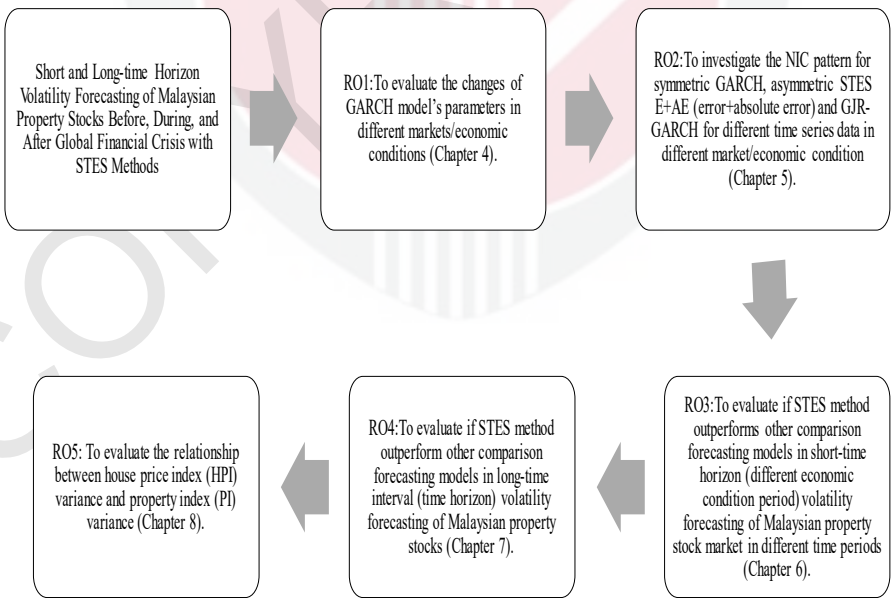

Figure: 1.4: Conceptual Framework

This study will apply varieties of forecasting models such as *ad hoc* models, STES methods and GARCH family models in modelling and forecasting the Malaysian property stock market volatility. The parameters are estimated from the historical time series data of Malaysian listed property companies individual stock returns. A method of decomposing the property stock market volatility into segments in a way to show the significant 'residual' risk-sharing opportunities in the property stock market will be constructed. The risk-sharing opportunities being studied are nonsystematic risk-sharing opportunities. The forecasting model that could consistently perform better in volatility forecasting of the Malaysian property stock market across different time horizons (interval) and time periods (economic conditions) will be evaluated.

The main specific objectives of this study are:

RO1: To evaluate the changes of GARCH model's parameters in different markets/economic conditions (Chapter 4).
RO2: To investigate the NIC pattern for symmetric GARCH, asymmetric STES E+AE (error+absolute error) and GJR-GARCH for different time series data in different market/economic condition (Chapter 5).

RO3: To evaluate if STES method outperforms other comparison forecasting models in short-time horizon (different economic condition period) volatility forecasting of Malaysian property stock market in different time periods (Chapter 6).

RO4: To evaluate if STES method outperform other comparison forecasting models in long-time interval (time horizon) volatility forecasting of Malaysian property stocks (Chapter 7).

RO5: To evaluate the relationship between house price index (HPI) variance and property index (PI) variance (Chapter 8).

1.15 Hypotheses

Hypotheses of this study are:

H1: GARCH model's parameters are not the same in different periods (economic conditions).

H2: NIC for STES-E+AE shows asymmetric effect in different periods.

H3: GARCH effects exist in the short-time horizon before crisis period.

H4: GARCH effects exist in the short-time horizon during crisis period.

H5: GARCH effects exist in the short-time horizon after crisis period.

H6: STES method outperforms other comparison forecasting models such as GARCH family models in short-time horizon one-step-ahead volatility forecasting of Malaysian property stock market before Global Financial Crisis (GFC) 2007 period.

H7: STES method outperforms other comparison forecasting models such as GARCH family models in short-time horizon one-step-ahead volatility forecasting of Malaysian property stock market during Global Financial Crisis (GFC) 2007 period.

H8: STES method outperforms other comparison forecasting models such as GARCH family models in short-time horizon one-step-ahead volatility forecasting of Malaysian property stock market after Global Financial Crisis (GFC) 2007 period.

H9: STES method outperforms other comparison forecasting models such as GARCH family models in long-time horizon one-step-ahead volatility forecasting of Malaysian property stock market after Global Financial Crisis (GFC) 2007 period.

H10: STES method outperforms other comparison forecasting models in short and long-time-interval (time horizon) volatility forecasting of Malaysian property stock market.

H11: There is variance relationship between house price index (HPI) and property index (PI).

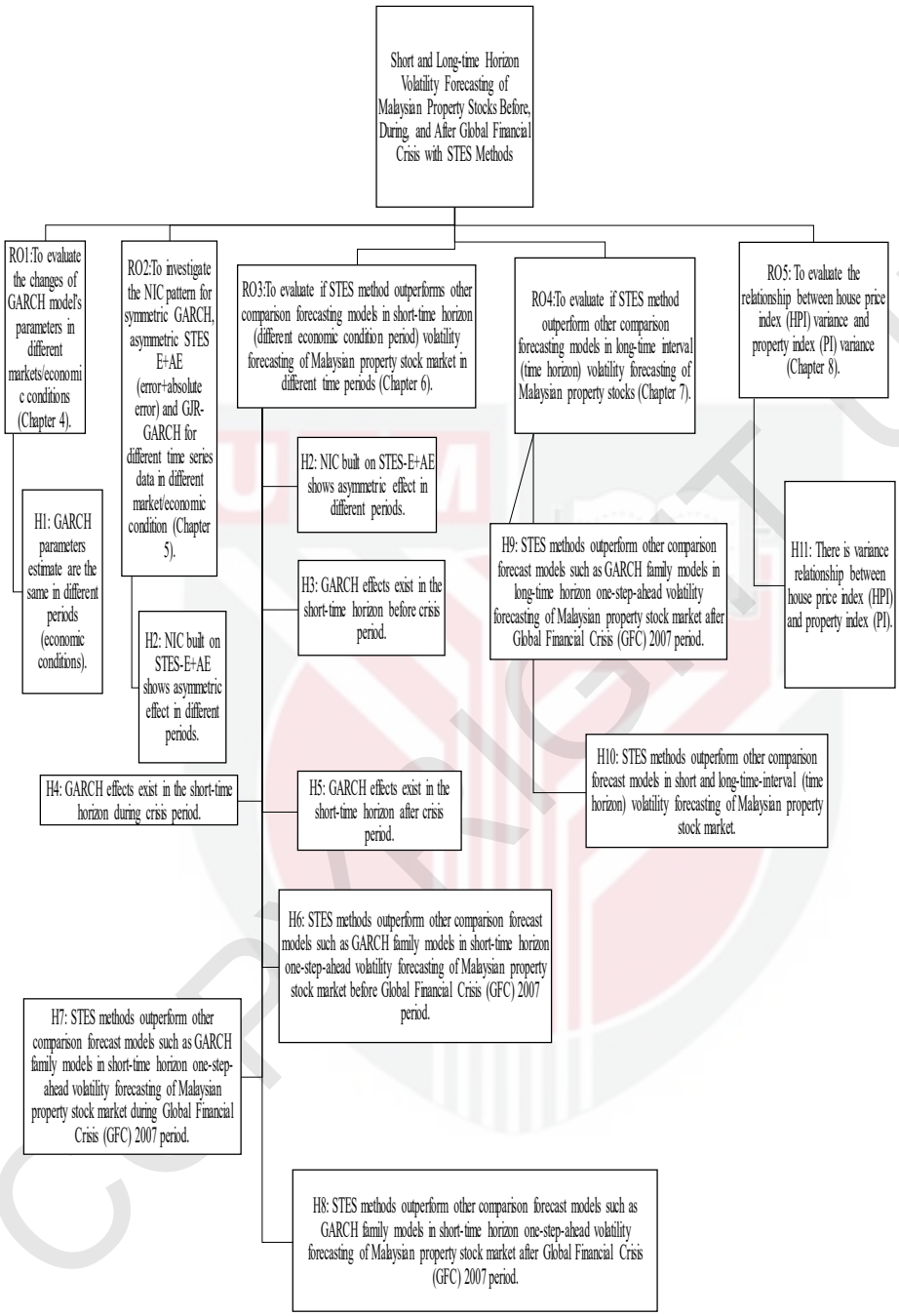

Figure 1.5: Hypotheses Correspond to Research Objective

1.16 Significance of Research

Many studies have been conducted in a search for a good forecasting model to forecast the real estate market (Mcallister, Newell, & Matysiak, 2008; Newell & Macfarlane, 2006) but not the property stock market volatility. More performance measurements on real estate market performance should be developed to give enough information for the practitioners and policymarkers (Geltner & C.Ling, 2006; Geltner & Ling, 2007a) to make sound decision. A reliable forecast on property stock market could become a good indicator (key performance index) on future direction of real estate market. Timely real estate market forecast is a very valuable tool and information not only to policymakers, central bankers, developers and lenders but almost all of us.

However, real estate market forecast is not easy (Mcallister et al., 2008; Newell & Macfarlane, 2006). Hence, volatility forecasting studies on property stock market could be helpful and those studies are rare. Since the strong performance of real estate market in Singapore had transformed into better return performance (higher profit) to most of the property/real estate stocks traded in the Stock Exchange of Singapore (SES) (Liow, 1997) (which concurrent with efficient market theory (EMH) (Fama, 1991)), the volatility forecasts of property stock market could become a proxy to the real estate market volatility. It could reveal the real estate market fluctuation and perhaps can indicate the future direction of the real estate market.

Besides looking for a good volatility forecasting model in different time periods and dataset, the robustness of the forecasting model should not be forgotten. Forecasting performance could be different in different time periods such as before, during and after GFC. Hence, this study uses STES method developed by Taylor (2004a) to investigate its consistency in volatility forecasting of Malaysian property stock return.

Meanwhile, with contracting searches theory (Castle & Hendry, 2014), this study could find out, what "error (transition variables)" could help in improving the volatility forecasting accuracy in different time periods. Furthermore, following Orrell (2010) and Hendry & Doornik (2014), this study will contribute to the forecasting literature on what information can be implied from the "forecast error" through the forecasting performance of different specification models in different time periods.

To our knowledge, this is the first time NIC built for STES E+AE on Malaysian property stocks. NIC pattern built for it could be very unique and whether this uniqueness could make it a better forecast model could be an interesting study. Together with NIC for GARCH model and GJR-GARCH model, it allows us to study on the impact of news shock to the volatility estimates in different economic conditions. Master on the volatility characteristic of real estate market will definitely assist the practitioners and policymakers in risk management.

MIDAS has been used to find out the relationship between HPI variance and PI variance. This finding is very useful in predicting the future HPI (low frequency) variance

according to PI (high frequency or instant information) variance. Furthermore, it helps investors in investment decision making and portfolio construction.

In short, the contributions from this thesis are first, to analyze whether the parameters are the same in different economic period is important and critical. The parameter indicating the characteristic of the time series data. Likewise, the changing parameters means changing characteristic of the time series data. Practitioners and policymakers should not implement previous strategies in new market volatility. Besides, it could affect the forecasting performance of a forecast model too.

Second, NIC is a good indication about the market volatility behavior in different economic conditions. Different strategies should be implemented in different economic conditions. Furthermore, different forecast model will produce different patterns of the NIC. Asymmetric STES E+AE could produce a unique NIC where when the residual is more than a threshold value, the volatility level will change. Other forecast models do not have this unique condition. This information could help practitioners and policymakers to alert whenever threshold value achieved. In other words, it indicates the timing for them to revise their strategy.

Third is to add value on volatility forecasting techniques literature in emerging and developing country especially on the Malaysian property stock market. Previous studies done mostly are using REITs and property index as sample data. Furthermore, those studies more on forecasting the developed country REITs, house price, and house price index but rarely in volatility forecasting. REITs is negatively related to inflation, which make it behave like common stocks than like real estate (Hoesli, 1994).

One difference of this study is focusing on listed property stock development (focus on the developer) companies individual stock return. The main business activity of this listed property development companies is to develop land which has been purchased by them and sell the real estate (property) ownership to the public after developing the land. These data perhaps are more matter (relevant) to the real estate (property) market and perhaps it could reflect the real estate market better. This study is to examine if the property stocks and property index could be used as proxy for real estate market.

Forth, property stock market volatility forecasting studies in developing countries are scarce. More empirical studies are needed in emerging country data. Previous studies done tend to focus more on U.S. Property market or developed countries market data. One study done in developing country data is by Gupta (2013) where he used the South Africa dataset. By comparing the differences between the real estate market of developing and developed countries, it could let us to distinguish and be more familiar with the characteristic of developing and developed countries. Similar to Gupta (2013), this study focusses on Malaysian property stocks volatility forecasting.

Fifth, previous studies focus more on forecasting the return series rather than forecasting the volatility series. This study is to find out if STES method is better than other methods in volatility forecasting of Malaysian property stocks. With a more reliable volatility forecasting on Malaysian property stock market, the forecast volatilities could be used as the proxy for the Malaysian house price index (HPI) volatilities. With this, timely information on Malaysian HPI volatility could be provided for practitioners as well as policymakers.

Sixth, varieties of GARCH family models (symmetric and asymmetric GARCH models) and STES methods will be applied in this study to compare and evaluate their forecasting performance and robustness in different time periods (economic conditions). No single forecasting model can forecast well in different datasets.

This study highlights the volatility forecasting performance of STES methods as compared with symmetric and asymmetric GARCH family models (Andersen, Christoffersen, & Diebold, 2005; Bollerslev, 1986; R. Engle, 2001; Taylor, 2004b) in different short-time horizon especially before, during and after GFC. Following Hendry & Doorni, (2014) and Orrell (2010), the forecasting performance of each forecasting models in different time period would be compared and outline some potential information that could be derived.

Seventh, the real estate market volatility has become an important study after the global financial crisis in the US (Ken & Brennan, 2010). The property stock market volatility forecasting could be an important and useful proxy for the daily real estate market volatility index (a volatility indicator). It allows us to notice the volatility changes in the property stock market timely (instantly) as compared with house price index volatility that could take up to a year to notify the changes.

Reliable volatility forecasts could play an eminent part in the pricing of the derivative securities. It is expected that the findings can outline some sources of important and useful information to us to monitor and manage the real estate market better with the intention to create a more sustainable and healthy economy instead of a high fluctuation "bubble" real estate market. Eventually, it can prevent more urbanization that creates more economically disadvantaged people.

Eighth, this study is to analyze which forecasting model that will performs the best in in-sample long-time horizon volatility modelling (based on goodness-of-fit statistic) and its performance's consistency as compared with short-time horizon performance. All the above findings can assist us in understanding the main factors that are affecting the forecasting model's performance in in-sample modelling and out-of-sample forecasting. Meanwhile, it also tells us about the volatility characteristic about the time series data and timing of the changing variance.

Ninth, this study also contributes to time series forecast technique literature by studying the adaptive STES methods proposed by Taylor (2004a) performance in short and long-time horizon volatility modelling and forecasting of Malaysian property stock market. A reliable forecasting model can assist the policymakers, financial participants and others to formulate their strategies according to reliable volatility forecasts.

Tenth, the property stock market volatility forecasting could be a guideline in the prediction of the property market cycle, business cycle, inflation, CPI and more (Brooks, Katsaris, & Mcgough, 2010; Gupta, Kabundi, & Miller, 2011; Vasilios Plakandaras, Rangan Gupta, Periklis Gogas, 2014; Zietz & Traian, 2014). Reliable volatility forecasting in the short-time horizon (which could not realistic for GARCH model) can indicate the inflation, property or business cycle earlier as compared with traditional ways. In addition of that, if the STES methods are good in volatility forecasting of Malaysian property stock market, the robustness of this methods allows us to adopt these methods in other fields of study such as inflation in the future too.

Eleventh, this study intends to provide a reliable Malaysian property stock market volatility (risk) forecasts for the policymakers and financial participants. This will help them to formulate their strategies according to the forecasted property stocks volatility in different time frames (timing of the market). Knowing the property stocks volatility is important because "the increase of the real estate market volatility is correlated with the home growth rate (or inflation) which then decreases the personal income appreciation rate and the population growth rate" (Miller & Peng, 2006).

Twelfth, the property stock market volatility could be different in different time periods (time frames). The impact of monetary policy shocks on stock markets is lower when the level of uncertainty is higher (Marfatia, 2014). Real estate volatility forecasting can provide an earlier warning system to us so that proper preventive actions could be organized to manage the real estate market fluctuation. With this, it can prevent the property/real estate market risk becoming out of control and cause the real estate market crisis.

Thirteenth, long-time interval time series data sometimes cannot reflect the current market condition timely as short-time-interval time series data does. The relationship of different frequencies data is hard to be justified without a proper regression model. MIDAS approach is used in this study to examine the variance relationship between HPI and PI. This relationship allows us to predict the HPI variance through the PI variance which is timely information. This information is particular important for practitioners.

1.17 Organization of Thesis Chapters

This thesis has 9 chapters. Chapter 4 to 8 is to report the results to answer 5 research questions respectively. Each chapter contents as below:

Chapter 1 introduces the problem statements/research gaps in volatility forecasting, research questions, research objectives, hypotheses and significance of the research.

Chapter 2 reviews the literature on forecasting, volatility, theories, and the Malaysian property market.

Chapter 3 explains the methodology, data, forecasting models, and evaluation criterion used in this thesis.

Chapter 4 analyzes data to answer RQ1. This chapter will show how the GARCH's parameter estimates in different economic condition.

Chapter 5 analyzes data to answer RQ2. This chapter will show how the good news and bad news impact on the volatility estimates in different economic conditions.

Chapter 6 analyzes data to answer RQ3. This chapter will show how the STES methods short-time horizon volatility forecasting performance in different periods as compared with comparison forecasting models.

Chapter 7 analyzes data to answer RQ4. This chapter will show how the STES methods long-time horizon volatility forecasting performance as compared with comparison forecasting models.

Chapter 8 analyzes data to answer RQ5. This chapter will show what is the relationship between the Malaysian house price index (HPI) and property index (PI). Besides, which MIDAS model is better in modelling and forecasting is evaluated.

Lastly, chapter 9 is to conclude this thesis by summarizing the research findings, conclusion, implication of research findings, limitations of this study and recommended future studies.

1.18 Chapter Summary

In summary, this study intends to improve the volatility forecasting literature of STES methods in Malaysian property stock market. This knowledge could provide potential information correlated with the Malaysian economy such as inflation, business cycles, consumer price index, Malaysian real estate market, and more.

Most of the studies done focus on the developed countries data, house price, house price indexes and house price return forecasting in the time-varying framework. Furthermore, there is lack of studies and discussion on the volatility (using NIC) across different time frames (such as before, during and after the global financial crisis). Besides, there is a lack of property stocks volatility forecasting studies in a developing country as compared with developed country.

A reliable volatility forecasting in Malaysian property stock market could be a valuable input in the decision-making process by providing capital budgeting guidelines for the investor, household spending, advance notice on the real estate market bubble risk (overprice on housing price) and more (N. Chen et al., 2014; Huang & Wang, 2005; Masih, 1999). Since previous studies cannot conclude which forecasting model is good/the best in volatility forecasting, it is essential for us to identify which is the best volatility forecasting model for Malaysian property stock market and as well as for the Malaysian real estate market.

This study would like to examine which forecasting models (among the tested models) can forecast better on the Malaysian property stocks volatility in different economic conditions, short and long-time horizon datasets. Various forecasting models (GARCH family models and STES methods) will be evaluated to ascertain the most appropriate model in modelling and forecasting the Malaysian property stock market volatility. This paper provides advance research for investor and the government to formulate their strategies and policies better especially in real estate market of developing countries like Malaysia.

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I graduated with a Bachelor of Science Agribusiness (Perniagaantani major in Food Science) from Universiti Putra Malaysia (UPM) in year 2008 and started to work as management trainee in Tiong Nam Logistic Berhad.

In year 2009, I started to work as medical equipment sales with ERIKG Sdn Bhd. While working, I further my Master Business Administration (MBA) (major in International Business) in Graduate School of Management (GSM currently known as Putra Business School) UPM and graduated in year 2011.

In year 2012, I leave ERIKG Sdn Bhd as Manager and worked as Sales Consultant of TWINS Realty.

In year 2013, I further my Doctor of Philosophy (PhD) in Putra Business School UPM in management. At the same year, I leave TWINS Realty and started to work as Real Estate Negotiator (REN) with GS Realty Sdn Bhd until now. However, upon my supervisor requested, I have switched from Putra Business School to Faculty Economic Pengurusan (FEP) UPM to continue as PhD student of Business Economic in year 2014.

Thanks to my supervisor, from year 2014 to 2016, I have given chance to work as part time tutor in FEP (Faculty Ekonomic & Pengurusan) (that I never thought that I could before this).

PUBLICATION

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