THE ROLE OF MACROECONOMIC FACTORS IN UNITED STATES' HOUSING PRICE

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DECLARATION

We hereby declare that:

1) This undergraduate research project is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

3) Equal contribution has been made by each group number in completing the research project.

4) The word count of this research report is 21,357 words.

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LIST OF ABBREVIATIONS

ARCH	Autoregressive Conditional Heteroscedasticity
BLUE	Best Linear Unbiased Estimator
BNM	Bank Negara Malaysia
CNLRM	Classical Normal Linear Regression Model
CPI	Consumer Price Index
FHFA	Federal Housing Finance Agency
GDP	Gross Domestic Product
HCV	Housing Choice Voucher
HERA	Housing and Economic Recovery Act
HPI	Housing Price Index
INF	Inflation Rate
INTRATE	Interest Rate
JB	Jarque-Bera
LIHTC	Low-Income Housing Tax Credit
MEF	Malaysian Employer's Federation
MRA	Multiple Regression Analysis
NMTC	New Market Tax Credit
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Square
POLS	Pooled Ordinary Least Square
RESET	Ramsey's Regression Specification Error Test
TOL	Tolerance
UNEMP	Unemployment Rate
US	United States
USA	United States of America
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
VIF	Variance Inflation Factor

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PREFACE

In United State, housing activities are vital in macro-economic policy to adjust cyclical movements and maintain economic growth. Hence, this study on the role of macroeconomic factors in United States' housing price has been popular over the years. The macroeconomic factors such as unemployment rate, inflation rate, gross domestic product(GDP) and short term rate of interest influence the housing price.

This study is conducted based on the guideline that consists of 3 main sections:

First section: Preliminary pages that include page of copyright, declaration, acknowledgement, table of contents, list of tables, list of figures, list of abbreviations, list of appendices, preface and abstract.

Second section: The body(content) of the research:

Chapter 1: Research Overview
Chapter 2: Literature Review
Chapter 3: Methodology
Chapter 4: Data Analysis
Chapter 5: Discussion, Conclusion and Implications

Third section: The end materials consist of references and appendices

Fulfilling the above criteria completes this research study. This study provides various types of information about housing sector in United State which will be useful for future researchers.

ABSTRACT

This study aims to examine the role of macroeconomic factors in United States' housing price from 1997 until 2013. The continuous rising of housing price in United State is becoming one of the hot issues discussed nowadays. Thus, this study would like to investigate the significant relationship between the housing price and macroeconomic variables that affect housing price. The macroeconomic variables chosen are United States' unemployment rate, inflation rate, gross domestic product(GDP) and short term rate of interest. Besides, Ordinary Least Squares method is implemented to this study. This study will be done based on quarterly time series data over period from 1997 Quarter 3 until 2013 Quarter 4 with 66 observations. The findings are beneficial to various parties such as investors, policymakers, housing developers, speculators, buyers etc. The results concluded that GDP and unemployment rate have the major effects in determining the United States' housing prices.

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

The purpose of the study is to figure out the relationship between the housing price and the related independent variables which are short term rate of interest, unemployment rate, inflation rate and the gross domestic product(GDP) for 16 years by quarterly that fall in between year 1997-2013. The research background of the United States of America(USA) and the financial crisis are useful and benefits in obtaining a better understanding of the housing price in the United States of America(USA). It is important to understand the trend of the housing price as it would be one of the keys to reflect the growth of the USA economy. The other major objectives would be stated in the following discussion problem statement, objective part, hypothesis and its significance after the presentation of the research background.

1.1 Research Background

1.1.1 Research Background of United State

United State of America(USA), a country which consist of 50 states whereby there are 37 new states added during the 19th and 20th centuries. According to Central Intelligence Agency, United States(US) has plenty of the natural resources especially coal which contribute nearly 30% of the world's total. With the advantage of such resources gained, the arise of its economy has slowly evolve and lead US to a technological economy which we able to see it nowadays. Although US has a strong base of the economy, it has been narrowed after the end of the World War II. The position has stand behind China in the comparison of GDP in terms of Purchasing Power Parity conversion rates in year 2014.

Besides, US has incurred a lot of imported goods. One of the favorable goods is the imported oil. With the aid of the imported oil which contribute about 50% of the US consumption, it brings the several impact to the US economy especially from the view of housing price. Between year 2001 and 2006, the price of the crude oil has been doubles up and the housing price has been bounced to its peak. In the other way, the crude oil price has been increased significantly and this has burdened the consumers who have to pay for one of their main expenses which are their housing payment. The situation becomes ameliorate since the crude oil prices fall in year 2013 onwards.

1.1.2 Research Background of Financial Crisis

There was a dramatic decline in the housing values especially in developed and developing countries in year 2008. The phenomenon able to reflect how serious of the financial crisis is during the period. One of the determinants which make the housing

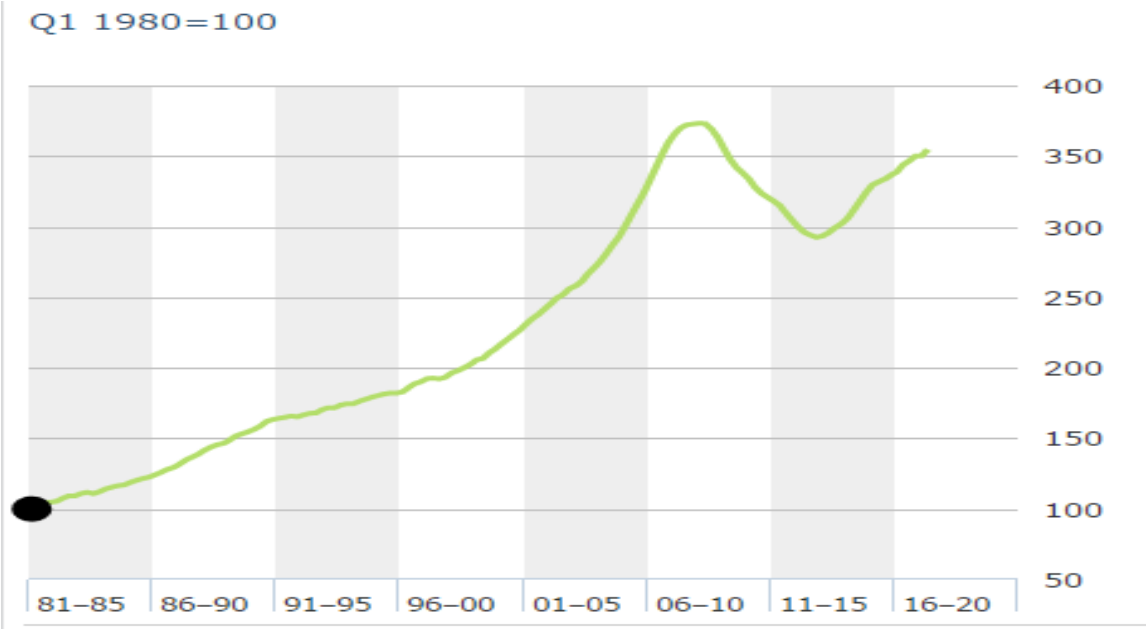
price in decreasing trend is the housing bubbles. One of the justification is the United States had a collapse of housing bubbles' in year 2007. The housing bubbles can be explained as a high price that derived by the investors' unrealistic beliefs and expect the price would become even higher in future. The investors have such belief rather than refer to any scientific economic fundamentals.

According to Central Intelligence Agency (2017), the US economy has been improved in a healthy stage throughout the seven years after the financial crisis. There are 10% more in the productivity of the output compare to the pre-crisis peak. In additional, the employment rate was slowly back to the track and even the fiscal sustainability and the corporate profits are in the increasing trend as well. However, the impact of the financial crisis has caused the growth of productivity moved in the decline rate in most of the activity's sectors. For example, those main industries those play an important role in US economy such as pharmaceuticals and ICT as well (Central Intellegence Agency, 2017).

1.1.3 Research Background of Housing Price Market in United States

According to Han et al. (2016), housing price can be defined as the figure in terms of money that the buyers willing to pay for this complex good. Housing price might relate with the other housing terminology which is housing bubble. Housing bubbles able to explain briefly about the entire trend of the housing price in the United States. According to Kindleberger (1987), a bubble is an incisive increase in the price of the assets in a continuous process and predicts it would be raised even higher and grabs the attention to the potential buyers. Around year 2000, there was the arise for the United States' housing bubble (Ge, 2017). Before the housing price decreased dramatically in the end of year 2006, its' average were almost doubled within just a few years.

Figure 1.1: US House-price Indicators(House-price Index)



Source: America's housing market in five interactive charts.

Based on the graph above, we able to see the housing price were in increasing trend since year 1981. In overall, the trend keeps on maintaining in increasing rate until end of year 2006. After that, the housing price falls dramatically and even reached to the trough at the 4th quarter of year 2011.

1.1.4 Research Background of the Drivers(Dependent Variables)

There are few graphs in the appendix part which are about the trend of the housing price independent variables(short term rate of interest, unemployment rate, inflation rate and GDP). The *Appendix 1* has illustrated the commercial and industrial loans, all commercial banks were in fluctuated trend over the years from 1970 until 2015. There is the highest peak of the percentage change of the interest rate at second quarter of year 1974 which was 29.1%. The scenario has been fluctuated until it reached to even lowest notch at the third quarter of year 2009 which was -27.7% after it experienced the economic crisis during year 2007 and 2008.

The highest unemployment rate has reached up to 10.9% at the fourth quarter in year 1982 (Elsby, Hobjin, & Sahin, 2010). It reached its lowest point at 3.9% in year 2000. There is a great recession in end of year 2007 and lead the labor market conditions have been deteriorated dramatically (Lawrence, 2010). Also, the United States has gone through the highest inflation, nearly 14% in year 1980. In year 2007 and 2008, there was a financial crisis happened and brings a lot of impacts to most of the countries' economy. One of the impacts is the United States' inflation reached at the lowest percentage which was -0.36% at the end of year 2008.

For the GDP of United States, there are many changes in these 45 years. The percentage changed from the preceding period of the United States' GDP in the second quarter of year 1978 is the highest, which was 25.2%. Once again, the lowest GDP percentage changed happened in the end of year 2008 which was -7.7% before it bounced back.

1.2 Problem Statement

According to Tsai and Peng (2011), the rise and fall of housing price have continuously occurs over the recent decades. In China, real estate industry has become the pillar and important industry of domestic economy since reform of urban housing system in 1998 (Feng, Lu, Hu, & Liu, 2010). Besides, Europe country such as Russia has faced unforeseen boosts in housing price that causes it less affordable for buyers as noted by Mints (2008). As stated by Osmadi, Kamal, Hassan and Fattah (2015), the main issue in Malaysia are the rising of housing price and unaffordability in buying a houses because the increases in living cost and current income also in stagnant condition has made it difficult for them to support their living after owned a properties. Besides that, Chen, Tsai and Chang (2007) from Taiwan founds that properties or houses in Taiwan are relatively expensive due to high population destiny and limited land supply. As in other observed countries, Mavrodiy (2015) founds that most expensive properties or real estates can be found in bigger cities. During 1980s,

housing prices in Australia was grew broadly achieved same level with general price inflation in economy and the majority of Australian households owned a property as their most important asset (Kohler & Merwe, 2015). For instance, Quiley (1999) and Wang (2013) also said that real estate or housing market and housing prices are correlated with general economic cycles. In this research, we have same view with Hon-Chung (2009) which is depending on several determinants on housing price, the tested outcomes and output from individual researches could not be generalized to all countries and areas with different surrounding conditions, but had to be thought about separately.

According Towbin and Weber (2015), United Stated has experienced an unprecedented boom in house prices between 1996 and 2006. In America, there was a sharp rising in the subprime mortgages duelled by low interest rate and lax lending standards and the recent subprime mortgage crisis has proved the key point that housing market plays in destabilizing the financial system (Tajik et al., 2015). Real estate development has a strong relationship with economic growth after analysing a large amount of data of different countries by American economist Simon Kuznets (Feng, Lu, Hu, & Liu, 2010). Furthermore, the sharp decline in home value in United States was causing many borrowers difficult to meet their mortgage payments and this will increases the psychological distress issues besides it also will lead to higher rates of depression (Yilmazer, Babiarz & Liu, 2015).

In additional, housing crisis that occurs in United States was unprecedented began from year 2006 due to lacking of hosing policy and the support of government that allows the speculation to continue preposterously in United States (Bostic & Ellen, 2014). According Moulton (2014), GSE Act's affordable housing goals that ran by government of United States was contributed to subprime mortgage crisis because loosened credit standards and order by GSE Act that help affordable housing loan is a tsunami of high risk lending that causes the GSE failure. Besides that, overloaded the housing finance system by GSE was causing an expected $ 1 trillion in mortgage loan losses.

Regarding the research done by Tajik, Aliakbari, Ghalia and Kaffash (2015), they founds that the falling houses prices caused a sharp increase in loan losses across bank of United States and this phenomena will lead to severe macroeconomic downturn. Besides, these authors also proved that there are strong negative relationship between housing price fluctuations and non-performing loan. This means the falling of housing price are due to high default rates. The price of houses also have significant relationship with GDP of United States (Valadez, 2011). Moreover, Kohn and Bryant (2011) also states economic factors such as inflation, income, and interest rate have been playing a significant role in driving up and down in housing prices in US.

1.3 Research Questions

The problem statement and objectives were stimulated the research questions. The research question is the question that the research project sets out to answer. A research question may set out variety of questions.

1.3.1 General Research Questions

i. Whether there are significant relationship between GDP and housing price?
ii. Is there any significant relationship between inflation rate and housing prices?
iii. Does there any significant relationship between unemployment rate and housing prices?
iv. Is there any significant relationship between short term rate of interest and housing prices?

1.4 Research Objectives

1.4.1 General Objective

This study is to examine the macroeconomic factors in affecting the housing prices in United States(U.S). The macroeconomic factors are including GDP, inflation rate, unemployment rate and short term rate of interest.

1.4.2 Specific Objectives

i. To examine the relationship between GDP and housing price.
ii. To evaluate the association between inflation rate and housing prices.
iii. To investigate the correlation of unemployment rate and housing price.
iv. To measure the association between short term rate of interest and housing prices.

1.5 Hypothesis Development

Housing Loan Rate

H_0: Housing price index and housing loan rate have no significant relationship

H_1: Housing price index and housing loan rate have significant relationship

Unemployment Rate

$H_{0:}$ Housing price index has no significant relationship with unemployment rate in U.S

H_1: Housing price index has significant relationship with unemployment rate in U.S

Inflation Rate

H_o: Housing price index and inflation have no significant relationship

H_1: Housing price index and inflation have significant relationship

Gross Domestic Product(GDP)

H_0: Housing price index and gross domestic product(GDP) have no significant relationship

H_1: Housing price index and gross domestic product(GDP) have significant relationship

1.6 Significant of the Study

This study is to examine the association of housing price movement that affected by GDP, inflation rate, short term rate of interest and unemployment rate. In this study, it contributes the significant of study to governments, policymakers, society and investors.

According to Pillaiyan (2015) and Kamal et al. (2016) stated that this study helps the governments and investors to have more details information on the macroeconomic factors that have significant relationship in affecting the housing price movements. Throughout this study, it enables the policy maker and governments to manipulate or control to influence the macroeconomic factors that have a big impact on housing

price movements. By using this way, it may help the governments and policy makers to control the housing price movement.

Furthermore, Kamal et al. (2016) mentioned that this research will provide the decisions making to investors. For potential investors may get a homeownership or create a new property based on the interest rate and housing prices movements. The investors are more likely to purchase house when there is the housing price drop in the future. Meanwhile, this research may also provide the future researchers to use large sample size for the research. This is due to small sample size may result in the limitations in the study. By using large sample size such as the number of durations, the result may be more accurate (Kamal et. al., 2016).

Moreover, this study also helps to provide the overview information for the governments and investors to predict the housing price future movements. Through this, it enables the governments or policy maker to carry out the new planning in order to face with unanticipated housing prices movements. Besides, it also has a big contribution for the investors in anticipate the housing prices movement. This is due to they can evaluate the housing prices and make the investment decisions in the future based on macroeconomic factors (Ong, 2013).

In short, this research provide the various outcomes for the investors, citizens, governments and policy maker in determine future investments and planning for housing market.

1.7 Chapters' Layout

Chapter 1 will be briefly discussed about the research background of the selected country, financial crisis, and the relevant variables. It is also included the problem statement, research questions & objectives, hypothesis development, significant of the study, chapter layout and the conclusion to summarize this particular chapter.

For Chapter 2, this chapter would be discussed the review of the literature in more details way and also the review of the relevant theoretical which including the studies of different variables used to affect the dependent variable by referring relevant journals. After this, it would come out with a proposed conceptual framework to show the finalized variables that would be going to be used for the studies and the conclusion to summarize this particular chapter.

Chapter 3 is Methodology which consists of Introduction as well. Before undergoing the data collection methods, have to come out with a research design. It followed by sampling design, data processing, multiple regression model, data analysis and the conclusion to summarize this particular chapter.

In chapter 4, there are several elements would be discussed. It focus more on the carrying out the different type of test to figure out the significance of the model. Other than this, it would be also the description of the empirical models, data & descriptive statistics, model estimation and interpretation, hypothesis testing, diagnostic checking and the conclusion to summarize this particular chapter.

Last but not least, the chapter 5 outline would be the discussion of the result outcome, implications to solve the possible problems and to finalize the entire studies in the final conclusion part.

1.8 Conclusion

As conclusion, this chapter consists few types of research background such as the financial crisis, our selected country(United States), the housing price and its factors. The factors are the independent variables which would be tested to see whether it is significant to the dependent variables(housing price) or not. There are few parts in this entire studies which including few chapter layouts. Hence, we wish to figure out the connection between the housing price and the variables affect it which are short term rate of interest, unemployment rate, inflation rate and GDP.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

This chapter focuses on the relationship between the dependent(housing price) and independent variables. With the view in the relevant journals, we found out there are numbers of researchers express their opinion in explaining the relationship between the housing price and the relevant variables such as short term rate of interest and so on. Indeed, there would be the statement agreed by part of the journalists and some of them might argue with it. In the literature review, we able to figure out clearly the relationship and the significance of selected factors towards the housing prices with the support of the researchers' viewpoint. The selected variables are short term rate of interest, unemployment rate, inflation rate and gross domestic product(GDP). This chapter had also consisting of the summary from the different variables used by different countries in the journals whereby it would be discussed deeply in the part of review of theoretical model. Based on the review of theoretical model, we had come out with our own hypothesis with the selected independent variables to support the explanation of the housing price in proposed conceptual framework. The last part of this chapter would be the conclusion on what are the outcomes we got for the relationship between the housing price and the selected independent variables.

2.1 Review of Literature

2.1.1 Housing Price Index(HPI)

In this 20 century, houses or properties normally are an asset that will own by household, and home equity is typically the largest component of household wealth. Besides that, several investors also will purchase property or house as important investment. In addition, several banks and finances companies will take housing as an important source of collateral for housing loan that will defaults by borrower. Therefore, researches can use housing price indexes(HPIs) to measures aggregate house price. Researches just take the average of all the house prices in the region to measure the housing price at first glance. But there is a drawback which is the houses are bought and sold only occasionally. Therefore, to overcome this problem, the repeat-sales methodology is the solution. In this methodology, the quality of the houses is controlled by comparing sales of the same houses across time. Furthermore, another function of this methodology is that any time two sales can be paired, the values of the house between the two sales dates are imputed using the two sales price. For instance, there is some example of repeat-sales indexes such as the S&P/Case-Shiller index, the Core Logic HPI, the Conventional Mortgage HPI and Freddie Mac HPI and the Federal Housing Finance Agency(FHFA) HPI (Silverstein, 2014).

Based on FHFA (2017), HPI could be also deemed as an index whereby it is weighted and measure the particular properties' average price changes from the aspect of the repeat sales. There are few methods to assess the HPI such as by referring the HPI Calculator, HPI Summary Tables, HPI Four-Quarter Appeciation US etc. For example, the HPI Calculator is a measurement by inserting the purchase price of the house in the particular region with an intended valuation quarter.

According to Federal Housing Finance Agency(FHFA), the housing price index(HPI) defined as the broad measure of the single-family house prices' movement. The

relevant index information is provided by Fannie Mae and Freddie Mac. FHFA was founded under Housing and Economic Recovery Act of 2008(HERA) and its main objective is to make sure the housing government sponsored enterprises being conducted in a secure manner. This is to ensure there is the source with high reliability as the reference either for the community investment or housing finance purpose.

Furthermore, there was several numbers of past researches that stated about the determinants of the housing price index in particular country. Those researches were proved whether the HPI is positively or negatively correlated with its determinants by ran a test. For example, housing price have negative relationship with unemployment rate in long run was proved by Mahalik and Mallick (2011). Besides, Mayer and Hubbard (2008) argued that real interest rate have an important impact on real estate and housing prices. This shows that the lower the level of interest rate, the more sensitive are house price changes to movements in interest rate and this was exactly what happened in many countries. This means that interest rate can affect the housing price through discounting the expected future cash flows. In Australia, housing price was rose due to fell of interest rate in early 2000s. For instance, the housing price in Australia was continued booming due to rising of price on raw materials that spurred the local economy (Mayer & Hubbard, 2008). According Stepanyan, Poghosyan and Bibolov (2010), they suggest that housing price developments can be explained by the dynamics of fundamentals such as GDP, interest rate and unemployment rate.

2.1.2 Short Term Rate of Interest

In year 2008, there were nearly 50% of the GDP were the housing loan in Greece. Housing interest rate had the most significant to the housing price, followed by inflation and employment. If the mortgage loan interest rate increases, the housing demand would be decreased as the intention of buying a house would be lower as

well. An increasing trend in money supply will affect short term rate of interest to become lower.

According the Goodhartand Hofmann (2008), they stated throughout the house wealth, there are few ways to influence the housing credit demand. One of the ways is the household will be attracted by the houses which able to be offered with more securities. If the housing securities value increases, it would lead the housing wealth increase whereby it would reduce the issue of the borrowing constraint.

The credit availability will encourage the growth of the housing demand whereby the household are constrained with the borrowing. The housing constrained would appear especially for those developing countries such as Turkey (Ramazan et al., 2007). This is due to the economy is still in developing phase and the financial market is less stable and less mature as well. The growth of the housing demand with an affordable credit would lead to a higher housing price due to there is over demand(shortage). The increasing in the housing price shows the household wealth has being increased at the same time. With the increasing in the household wealth, they able to make more additional or extra investment in the housing market as they afford to do so.

At the same time, with a shock(increase) of the lending rate will lead to the decreasing in the housing price since the demand is getting lower as people would not like to purchase. According to Zhu (2004), there is significant inverse connection between the interest rate and the housing price. In the other word, there is a connection negatively between mortgage lending rate and the housing price.

The interest rate is an extra price that we have to pay together with the principal that we had borrowed (Zhu, 2004). The households would be sensitive to the amount that they going to pay for their monthly installment. Assume that the interest rate is high, this would burden them to pay even more for their borrowing cost. The short term rate of interest and the housing price have negative significance relationship whereby the lesser the interest rate, the higher the housing price (Alaba & Adegoke, 2015). According to Mansor et al. (2014), there is a strong relationship which is negatively between the housing price in Malaysia and the short term rate of interest as well.

According to Alaba and Adegoke (2015), the research they made has proved there is a significant relationship between the housing price and the short term rate of interest. There are also a long term relationship between the short term rate of interest and housing price (Chen & Patel, 1998). The effect of interest rate to the housing price was different in different regions (Gupta & Kabundi, 2010). Joe, Eddie and Seabrook (2003) claimed that during the inflation duration, a lower interest rate was attached by a higher house prices but a lower interest rate did not decrease the housing price during the deflation period.

The change in the short term rate of interest was sensitive to the housing supply (Painter & Redfearn, 2002). Debelle (2004) has proved most of the households are quite sensitive to the interest rate changes in Sweden. Such sensitivity can be undergone via different kind of liquidity effects (Alaba & Adegoke, 2015). They also stated the desire of buying a house would be decreased if there is a high short term rate of interest.

2.1.3 Unemployment Rate

Grum and Govekar (2016) conducted a research in Slovenia, Greece, France, Norway and Poland and found that unemployment rate is significant to the housing price. The researchers found that adverse relationship between unemployment rate and housing price. Higher unemployment rate will cause the price of resident property decrease.

Brooks and Tsolacos (1999) found a negative correlation between unemployment rate and housing price. Higher unemployment rate indicates that uncertainty income in the near future which leads people pay more attention in their financial situation instead of demand for house. Therefore, demand for house decreases and the price decrease as well. It is supported by Lu and Bo (2014). They also conducted a research in UK and found an inverse relationship between housing price and unemployment rate.

Furthermore, Meen (2001) use the unemployment rate as simple indicator of labour market risk to test the willingness of employed household to get mortgage. The result shown higher unemployment rate reduced the willingness of employed household leads the demand for house decrease and housing price fall. A negative correlation between housing price and unemployment rate found in a research done by Meen (2001) in London. Moreover, the demand for housing decreases leads the building of new domestic housing become lesser and reducing supplier activity. Therefore, it will create more unemployed people in construction industry.

Birgitta and Taylor (2010) also found unemployment rate has an inverse relationship after a research done in UK. They explained that unemployed people less likely and less ability to migrate to other areas or regions so unemployment situation become more serious in same region reduced the homeownership and housing price as well. Unemployed people are lack of ability to own the house for themselves and thus the demand and housing price fall.

2.1.4 Inflation Rate

According to Zhu (2004), inflation rate and housing price has strong relationship with each other. The reason is because when there is inflation happened, the cost of raw materials for the building of houses will become more expensive and this will result in housing price increase. This researcher also proposed inflation as the main driver to properties being viewed as an investment and a good hedge against inflation by general public. Furthermore, Zhu (2004) also suggest that the effects of innovations in inflation on housing prices are often happens during long term periods. He also stated that high inflation also give to the attractiveness of real estate as a vehicle for long-term savings. In Malaysia, the researcher also found that the inflation rate has significantly affected the housing price (Kamal et al., 2013).

Tze (2013) mentioned that there are few numbers of studies also suggest that the inflation rate has positive correlated with house prices. Moreover, Zainuddin (2010)

suggested that there is a significant relationship between inflation and housing price during long run periods. Besides that, Shiller (2001) also mentioned that fundamental variables which often influence house price is inflation. In Malaysia, the fluctuated movements in the property market may affect by other movements of macroeconomic variables such as inflation (Mar Iman, 2012).

Shaari et al. (2016) stated that inflation rate is significant and positively affecting housing prices because people will still investing or buying property even though the price has increased during high inflation. Through analysis by Pillaiyan (2015), the housing price of Malaysia were state to have a strong relationship with inflation during long term periods.

Liew and Haron (2013) also stated that inflation rate is the important determinants on housing price and the researcher shows that periodical housing price was highly and strongly affected by rate of inflation. This is because high inflation rate will directly raises the cost of goods and services and proportionally will cause the housing price rise. As mentioned by Liew and Haron (2013), housing price is increasing exponentially with inflation rate. And this will causing the buyers delayed to buy a property or forced them to consider other than their preference or they may also suffers with higher housing loan due to rising of housing price. Besides that, Liew and Haron (2013) also indicated that high inflation will led to high proportion of housing cost in consumer cost portfolio and this will affect the demand of houses.

On the other hand, (Tan, 2011) proves his outcomes through hedonic pricing model and the results stated that inflation rate is not a significant determinant of housing price. Besides that, (Ong & Chang, 2013) also stated that level of price convergence interprets the changes of inflation level is quite important economically and this researcher find out that the association between inflation rate and housing prices are negative in Europe.

In additional, increases in inflation rate will serve to reduce incentive of people to invest in real estate market which will decreased the demand of houses. Furthermore,

inflation rate also affect the nominal housing payments and causing the rise of construction cost which will lead to decreased in housing demand (Feldstein, 1982).

The rise of inflation front loads real payment on a long-term fixed rate mortgage and this circumstances will lead to reduce the amount of property. It must be noted because increasing in money supply will causes housing price and inflation rise (Tze, 2013).

2.1.5 Gross Domestic Product(GDP)

According to Tze (2013) indicate that the GDP can be considered as one of the strongest effect on the housing price in Malaysia which is also known as dependent variable. Besides, the researcher also found that the housing price and GDP have positively relationship in Asia (Zhu, 2006). The researchers have showed that when the housing price rises, it will affect the GDP increase. Moreover, the researcher also found that during the economic growth people are more likely to do investment such as purchases house or deposit in bank to save in order to earn some of the interest. This can result in the money supply in market increase and the interest rate decreasing, and encourage people to borrow money and make some investment. Thus, this shows that GDP has positive correlation in influence the housing price.

Hence, Hii et al. (1999) shows that the macroeconomic variable such as GDP has significantly positive correlated with the housing price in Asian. Xiao (2015) also found that the GDP has positive correlation with housing price in China. Meanwhile, Qing (2010) mentioned that there is the same result with previous researchers which is the GDP and housing price are positively correlated in United States(US). This is due to GDP is represented the whole economic growth and activities of the particular country such as export, import, purchasing of goods and services which is produced in particular year. Besides, the researcher also stated that the GDP cannot affect the buyer's buying decision. On top of that, it shows that the increasing of purchasing of

houses will affect the GDP growth rate increase as well. This is due to the housing investment can be considered as one of the important part in affecting the GDP.

Furthermore, Otroket al. (2013) found that the relationship between GDP and housing prices are significantly correlated. Besides, there are few researchers also found that GDP can be known as one of the macroeconomic variables that are positively and highly affect the housing price index (Piazzesi & Schneider, 2009) (Panagiotidis & Printzis, 2015).

However, Li (2014) and Gaspareniene (2017) have mentioned that the GDP has insignificant relationship on the housing price index compared with others macroeconomic variables. Next, another researcher also indicates that the GDP has negative correlation affect the housing price (Ley & Judith, 2010). This is because the researcher found that the globalization has a bigger impact in affecting the housing price movement rather than only GDP affect the housing price movement in particular country.

2.2 Review of Relevant Theoretical Models

2.2.1 Regression Analysis

According to Li (2014), Ong (2013), Lai et al. (2015) and Mavrodiy (2005) have used the regression analysis to examine the relationships among the variables such as independent and dependent variables in order to explore these forms of relationships. For instance, it used to identify which independent variables are correlated with dependent variable(housing prices index). Besides, it also can be used to anticipate the changes of the housing prices in the future (Gallo, 2015). It was applied by the researchers to deduct the causal relationship between housing prices index, income level, interest rate, GDP and inflation rate.

Housing Prices Index = GDP + Inflation rate + Interest rate + Income level

2.2.2 Pearson Correlation Coefficient

Pearson correlation coefficient can be considered as Pearson product-moment correlation coefficient. Shaari et al. (2016) and Ong (2013) applied the Pearson correlation coefficient in their study to judge how strong of linear relationship between two variables such as variable X and Y. It can be used to indicate whether the variables have positive, negative or perfect correlation amongst the variables. It can also help to determine how well the data points fit the model (Bristol, 2017).

2.2.3 Error Correction Model

It is a category of multiple time series and this model is the most commonly used for the data which the variables have a long-run stochastic trend. Besides, it can also be considered one of the useful approach for examine the long-term and short-term effects. It can use to illustrate the deviations between the development of independent variables and dependent variables (Xu& Tang, 2014) (Karamelikli, 2016).

2.2.4 Unit Root Test

This test was applied by Pillaiyan (2015) and Mavrodiy (2005) use to measure whether the time series variable is non-stationary and possesses a unit root. It used to define the stochastic component contains a unit root. Besides, it also uses to examine the trend of time series data for all the variables and indicate whether there is a necessary to make the adjustment on the data.

2.2.5 Model Specifications

Model specification is an approach that used by the researchers to detect whether there is a model specification bias (Karamelikli, 2016) (Tajik et. al., 2015). Model specification bias is a problem that may occur due to omitting independent variable, wrong functional form of dependent and independent variables or including unnecessary independent variable.

2.2.6 Vector Autoregressive(VAR) Model

In the study of Xiao (2015), he used VAR models to analyse the impact of system related time series correlation and random disturbances on the system dynamics. Besides that, VAR models also can used to avoid the need for each endogenous variable modelling of all the endogenous in the structural equation system (Xiao, 2015). So Xiao (2015) was done his empirical research by distributing a VAR model to analyse dynamic effects of macroeconomic factors influencing the prices of real estate. On the other hands, Meidani, Zabihi, and Ashena (2011) also pointed out that they applied the VAR method towards their research due to lacked of better knowledge about relations and specification in modelling macroeconomic impact on the housing sector. Besides, they also states that VAR approach makes minimal theoretical demands on the structure of the model and this approach employs a common lag for all variables in all equations. Different author with provide different view on their analysis, several researchers such as Sims, Stock and Watson (1990) stated that in a system that including unit roots, standard Wald statistics based on ordinary least square(OLS) estimation of level VAR model for testing statistics coefficient restrictions have nonstandard asymptotic distribution and cannot be applied to mixed integration orders. A simple procedure requiring the estimation of an "augmented" VAR, even when the variables have different orders, which

guarantees the asymptotic distribution of the MWald statistic was pointed out by Toda and Yamamoto (1995).

2.2.7 Vector Error Correction Model(VECM)

To determine the number of co-integrating relationships among all the variables that affect the housing prices, Pillaiyan (2015) was fitted a co-integrating vector error correction model which developed by Johansen (1988). Furthermore, this method also suitable for analysing characterised of system by stable low-frequency comovement among variables that combined with short-term heterogeneous dynamics across variables (Gattini & Hiebert, 2010).

2.2.8 Multiple Regression Analysis(MRA)

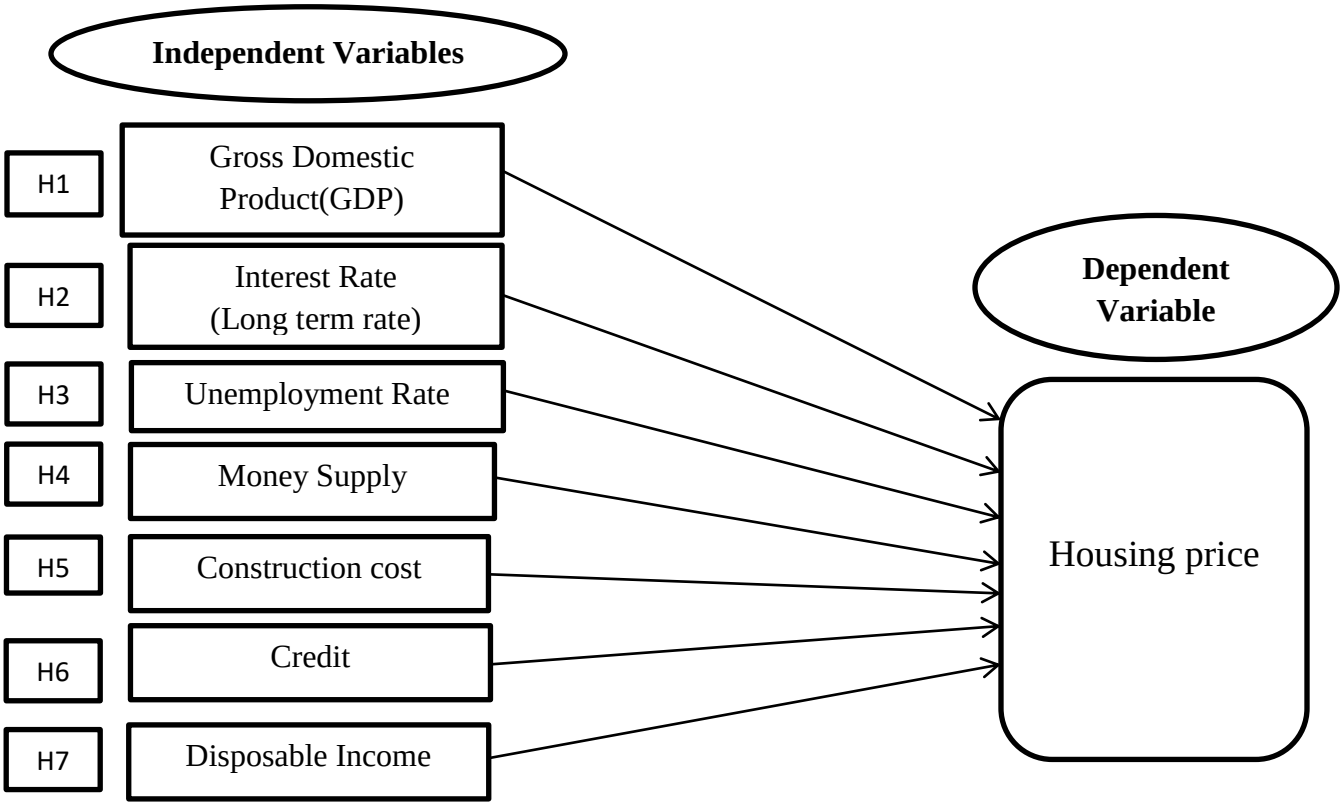
(MRA) also known as multiple linear regression analysis which is an extension of the methodology of linear regression to more than one independent variable. Besides, we could better describe and explain the variation in dependent variable by using more than one independent variable. The residential value assessment is a common application of multiple regression analysis. The author use this method to predict the price of all Malaysian residential house by collecting data of independent variables to improve their ability to estimate market value accurately. This method also help in express the relationship between the dependent variable and the independent variables (Tan, 2011). Besides, Yazgi and Dokmeci (2007) also stated that multiple regression analysis can used to compare different type of data that comes from different kind variables. And this method also can used to conduct multivariate analysis on fairly small samples (Yusof & Ismail, 2012).

2.2.9 Pearson Chi Square Analysis & Bivariate Correlation Analysis

According the study of Bujang, Zarin and Jumadi (2010), they mentioned that Pearson Chi Square Analysis and Bivariate Correlation Analysis were used to detect and determine whether the relationships among the demographic and factor that contribute in determining the level of house-buyers' affordability are significant or insignificant to each other. For instance, the Pearson Chi Square Analysis were used to test the effectiveness and significant value of data for the purpose of analysis. But on the other hands, the Bivariate Correlation Analysis was used to determine the coefficient correlation to test and measure the strength of association between two variables.

2.3 Review of Theoretical Model

Figure 2.1: Framework of Determinants of UK House Price



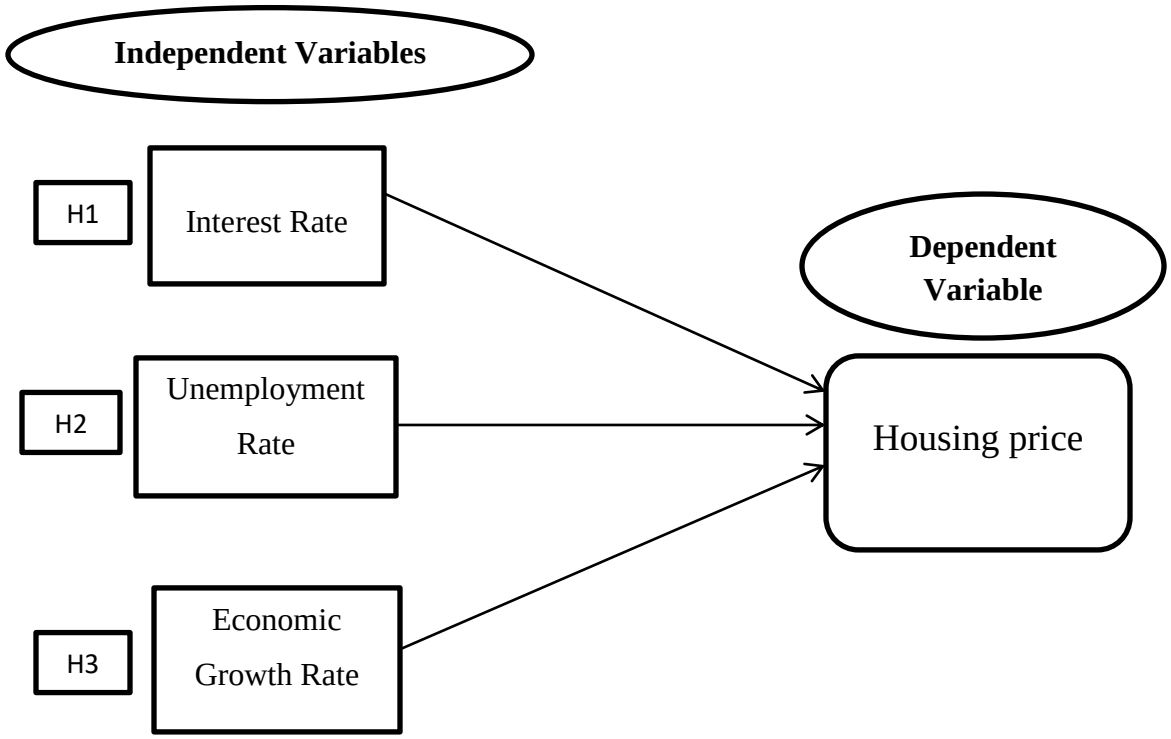
Source: The framework is adapted from Lu and Bo (2014), they investigate the relationship between the determinants (GDP, Interest Rate, Unemployment Rate, Money Supply, Construction Cost, Credit, and Disposable Income) with housing price in United Kingdom.

The researches Lu and Bo (2014), evaluate the interactions between economic factors and housing price performance in U.K by using quarterly data from 1971 Q1 to 2012 Q4.

Lu and Bo (2014) had applied co-integration approach and error correction model in this study to evaluate the long term and short term relationship between housing price and GDP, interest rate, unemployment rate, money supply, construction cost, credit, and disposable income.

Furthermore, Lu and Bo (2014) had also used Stationary Test, Unit Root Test to test the time series data in this study. Based on the result, they found that GDP, interest rate, unemployment rate, construction cost, and credit have positive relationship with housing price. However, disposable income and money supply have a negative impact on housing price.

Figure 2.2: Framework of Linear and Nonlinear Dynamics of Housing Price in Turkey

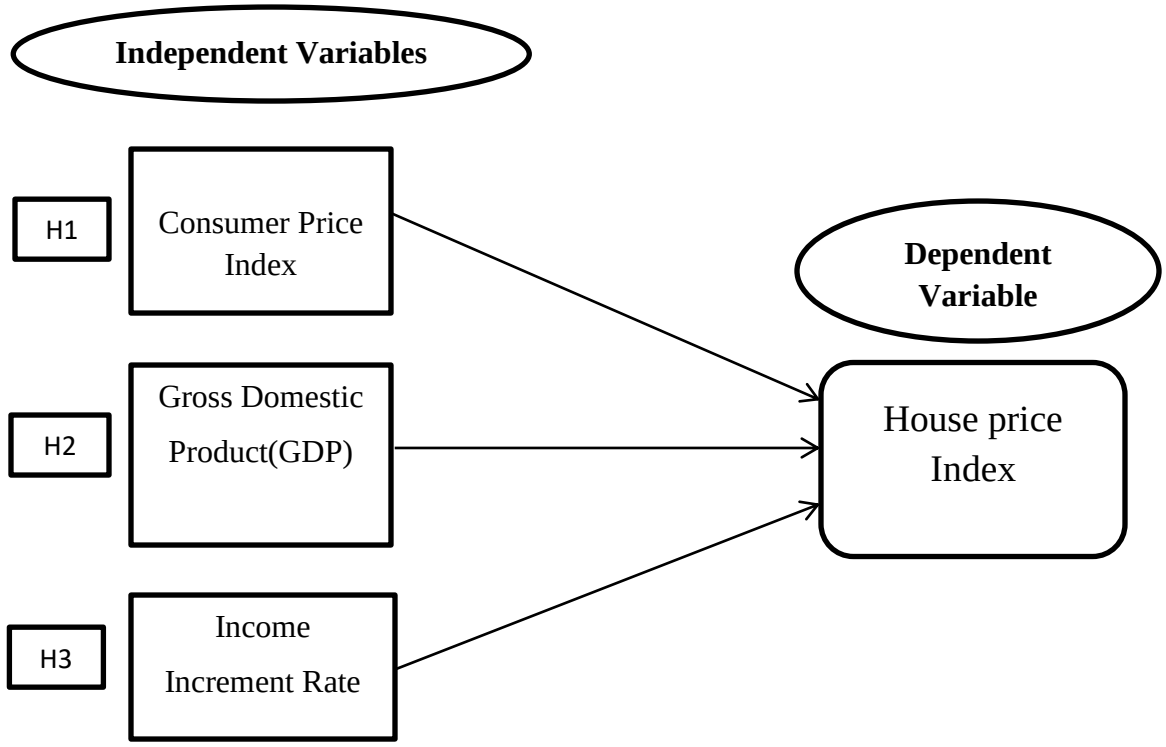


Source: The framework is adapted from Karamelikli (2016), this paper studied the determinants of housing price in Turkey. The dynamics between housing price and macroeconomic factors consist of interest rate, unemployment rate and economic growth rate are studied in this paper.

Karamelikli (2016) studied determinants of housing price in Turkey by using the monthly data instead of yearly and quarterly. The monthly data covered the period from January 2010 until February 2016 which obtained from Central Bank of Turkey statistics. There were 3 independent variables which include interest rate, unemployment rate and economic growth rate.

Karamelikli (2016) had applied symmetrical, asymmetrical and partially asymmetrical models for this study. Based on the result, both interest rate and unemployment rate were significantly affects the housing price in Turkey.

Figure 2.3: Framework of Macroeconomic Determinants of Malaysian Housing Market



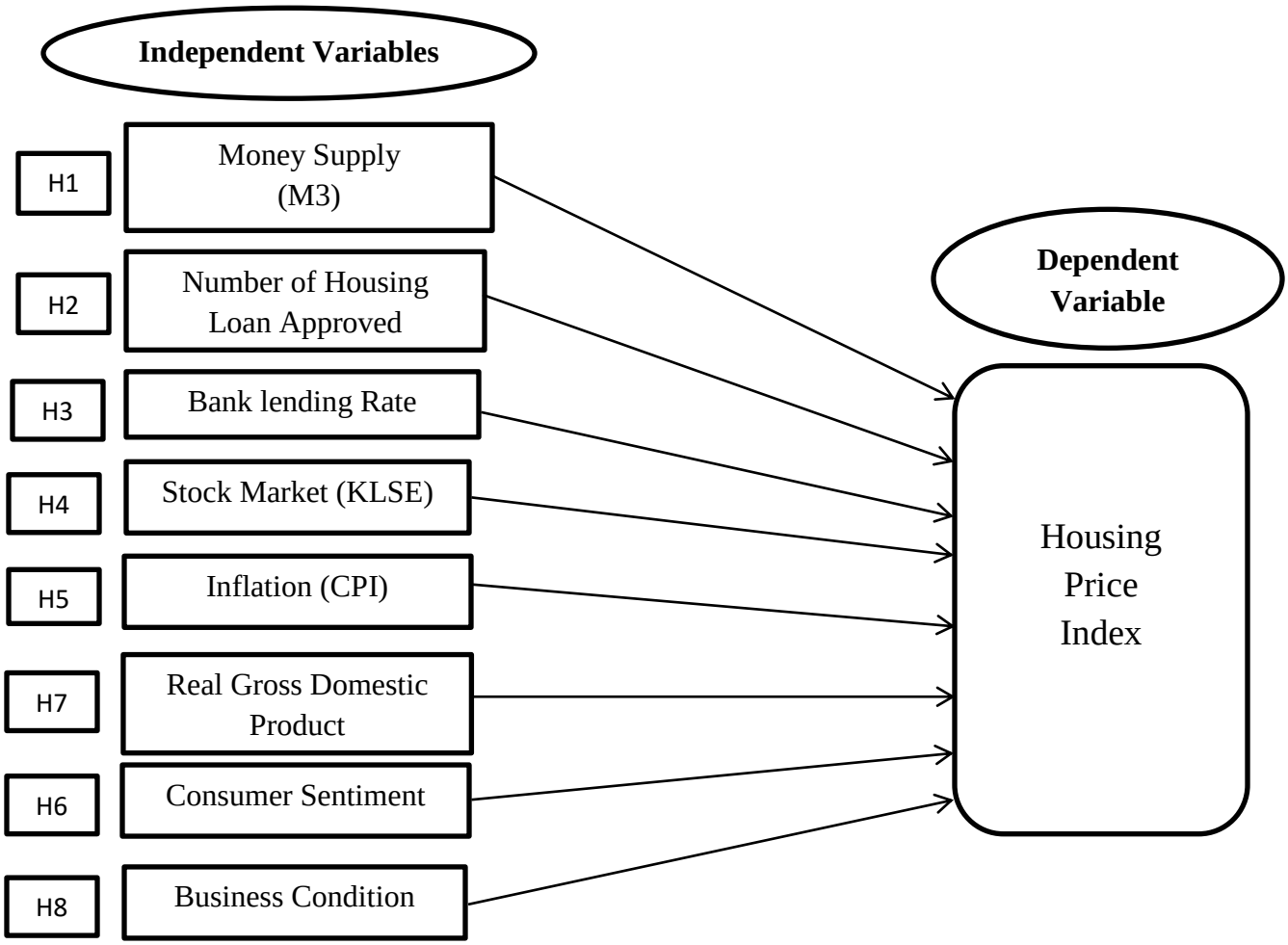
Source: The framework is adapted from Tze and Yee (2013), they studied the relationship between macroeconomic factors and housing price in Malaysia.

Tze and Yee (2013) studied the relationship between Housing Price Index and Inflation Rate, GDP Rate, and Income Rate in Malaysia. They design this study comprise of 50 secondary data of each variable from year 2000 until middle of year 2012 and all data are in quarterly basis. Besides, they collected all the data from World Bank, Malaysian Employer's Federation(MEF) and Bank Negara Malaysia(BNM).

In addition, Tze and Yee (2013) had applied few types of analysis were tested by using SPSS Version 20.0, there are Pearson Correlation Coefficient, Multiple

Regression Analysis, Multicollinearity Statistics and Finally Scenario Analysis. According to the result, they found that GDP has a significant relationship toward Housing Price Index compared to other macroeconomics factors.

Figure 2.4: Framework of Macroeconomic Drivers of House Prices in Malaysia



Source: The framework is adapted from Pillaiyan (2015), this paper studied how the macroeconomics drivers of house prices in Malaysia.

Pillaiyan (2015) had used total 8 independent variables in the paper. All data used for the analysis were quarterly data from 2000 to 2010. Besides, all these data are collected from Valuation and Property Services Department in Malaysia, Department of Statistic Malaysia and Bank Negara Malaysia(BNM).

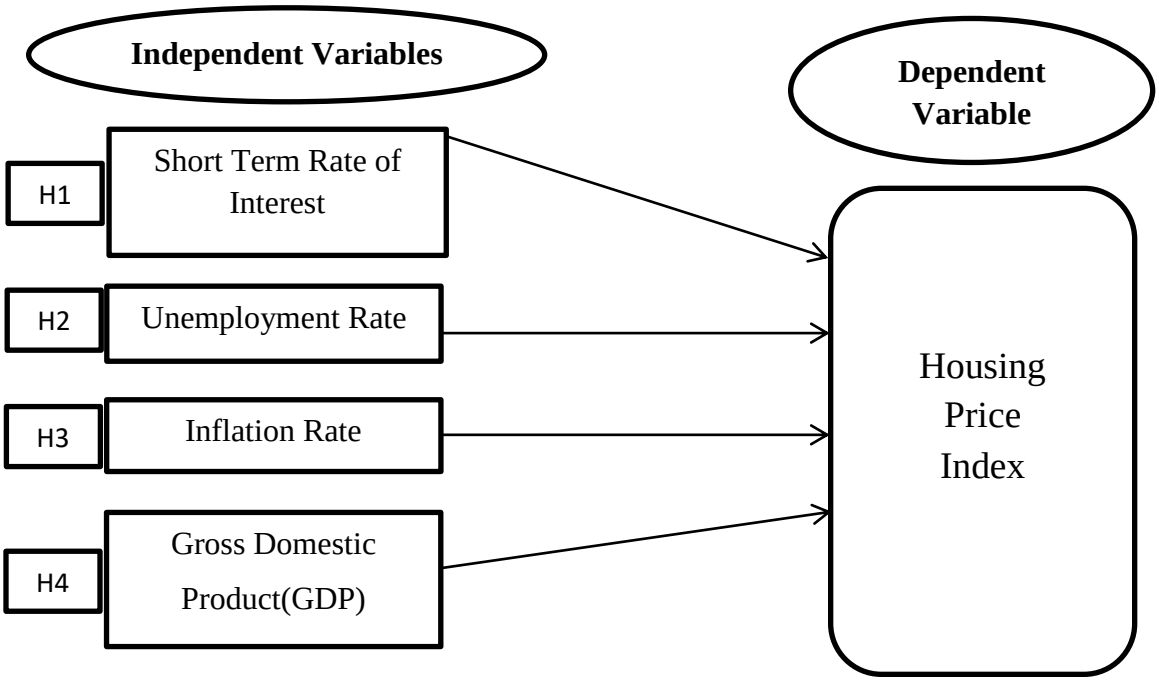
In addition, Pillaiyan (2015) had applied Unit Root Test, Vector Error Correction Model(VECM), The Trace and Max Test Statistics in study. Based on the result, the researcher found that there is a strong long term relationship between Inflation, Stock Market(KLSE), Money Supply(M3) and Number of Residential Loans Approved.

2.4 Proposed Conceptual Framework

Based on the literature review and the theoretical model especially, we have decided to choose 4 elements as the independent variables which would bring the influence to the effect on the housing price. These determinants are short term rate of interest, unemployment rate, inflation rate and GDP.

According to Lu and Bo (2014), the GDP, interest rate and unemployment rate are significant and have positive relationship with the housing price. For Turkey's housing price, unemployment rate and interest rate have affected it significantly (Karamelikli, 2016). In the journal of Tze and Yee (2013), they stated that GDP has a significant relationship to housing price index rather than other macroeconomic factors. Pillaiyan (2015) figure out that there are researchers claimed inflation has a strong relationship with the housing price index. These are the reasons we decided to use those factors as our independent variables for our study as it supported by various authors as well.

To figure out the effects bring to the dependent variables, the housing price in U.S. based on those independent variables, we had set few hypothesis as below:



We hypothesized the connection between these factors and the price of housing in U.S. There are 4 hypothesis:

H1: There is negative relationship between the short term rate of interest and the price of housing in U.S.

H2: There are negative relationship between the unemployment rate and the price of housing in U.S.

H3: There are positive relationship between the inflation rate and the price of housing in U.S.

H4: There are positive relationship between the GDP and the price of housing in U.S.

2.5 Hypothesis Development

2.5.1 Housing Loan Rate

H_0: Housing price index and housing loan rate have no significant relationship

H_1: Housing price index and housing loan rate have significant relationship

The housing price is one of the macroeconomic determinants which has the strongest explanatory over the housing price's variation. According to the journal from Mansor et al. (2014) indicated that short term rate of interest has a strong and negatively relationship with the housing price index.

Zhu (2014) found that housing loan rates are negatively related with the housing price. It is due to interest rate are extra price that we need to pay together with the principal that we borrowed. Therefore, higher interest rate means higher cost of borrowing caused housing demand and housing price fall.

Besides, with an increasing of the short term rate of interest will lead to the decreasing in the housing price since the demand is getting lower as people would not like to purchase. According to Zhu (2004), there is significant inverse connection between the interest rate and the housing price. In the other word, there is a negative relationship between mortgage lending rate and the housing price.

In short, this study expects housing price index and housing loan rate have a negative significant relationship in U.S. Therefore, it will reject the null hypothesis.

2.5.2 Unemployment Rate

H_0: Housing price index has no significant relationship with unemployment rate in U.S

H_1: Housing price index has significant relationship with unemployment rate in U.S

Unemployment rate is refer to the number of unemployed people as a percentage of the labour force. Besides, unemployed people are those who report that they are without work, that they are available for work and that they have taken active steps to find work in the last four weeks.

Based on Grum and Govekar (2016) conducted a research in Slovenia, Greece, France, Norway and Poland, it found that the unemployment rate is significant adverse relationship with the housing price. Therefore, higher unemployment rate will cause the price of resident property decrease. This is because when more people being unemployed, they are less likely to have financial ability to gain a residential property, so the resident price of property will decrease.

Brooks and Tsolacos (1999) also found a negative correlation between unemployment rate and housing price. Higher unemployment rate indicates that uncertainty income in the near future which leads people pay more attention in their financial situation instead of demand for house. Therefore, demand for house decreases and the price decrease as well. It is supported by Lu and Bo (2014). They also conducted a research in UK and found an inverse relationship between housing price and unemployment rate.

In addition, Birgitta and Taylor (2010) also found unemployment rate has an inverse relationship after a research done in UK. They explained that unemployed people less likely and less ability to migrate to other areas or regions so unemployment situation become more serious in same region reduced the homeownership and housing price as well.

This study expects housing price index and unemployment rate have a negative significant relationship in U.S. Therefore, it will reject the null hypothesis.

2.5.3 Inflation Rate

H_0: Housing price index and inflation have no significant relationship

H_1: Housing price index and inflation have significant relationship

Inflation measured by consumer price index(CPI) is defined as the change in the prices of a basket of goods and services that are typically purchased by specific groups of households. The study from Hayyu et al. (2016) stated that inflation rate is significant and positively affecting housing prices because people will still invests or buying property even though the price has increased during high inflation. This is supported by Pillaiyan (2015), the housing price of Malaysian were found to have a strong long term relationship with inflation.

Liew and Haron (2013) also stated that inflation rate is the important influencing parameter on housing price and the researcher shows that inflation rate had perceived highly pushed up periodical house price. This mean the inflation rate and housing price are positive correlated. This is because high inflation rate will directly raises the cost of goods and services and proportionally will cause the housing price rise.

According to Zhu (2004), inflation rate and housing price has strong relationship with each other. The reason is because when there is inflation happened, the cost of raw materials for the building of houses will become more expensive and this will result in housing price increase. This researcher also proposed inflation as the main driver to properties being viewed as an investment and a good hedge against inflation by general public.

However, study from Ong and Chang (2013) stated that price level convergence explains the changes of inflation level is quite important economically and this

researcher find out that the relationship between inflation rate and housing prices are negative in Europe.

This study expects housing price index and inflation rate have a positive significant relationship in U.S. Therefore, it will reject the null hypothesis.

2.5.4 Gross Domestic Product(GDP)

H_0: Housing price index and gross domestic product(GDP) have no significant relationship

H_1: Housing price index and gross domestic product(GDP) have significant relationship

GDP is the standard measure of the value of final goods and services produced by a country during a period minus the value of imports.

According to the research from Xiao (2010) have found that the GDP has positive relationship with housing price in China. Furthermore, Zhu (2016) also shows that the macroeconomic variables such as GDP has significantly positive correlated with the housing price in Asian. It is supported by Qing (1993), they also found the same result with previous researchers which is the GDP and housing price are positively correlated in United States(US). This is due to GDP is presented the whole economic growth of the country such as export, import and total market value for all the services and goods which is produced in particular year and country. Besides, the researcher also stated that the GDP cannot affect the buyer's buying decision. Conversely, it shows that the increasing of demand on housing will affect the GDP growth rate increase as well. This is due to the housing investment can be considered as one of the variable in affecting the GDP.

However, Ley and Judith (2010) indicated that the GDP has negative correlation affect the housing price. Moreover, Li (2014) and Gaspareniene (2017) have

mentioned that the GDP has insignificant relationship on the housing price index compared with others macroeconomic variables.

This study expects housing price index and GDP have significant relationship. Therefore, it rejects null hypothesis.

2.6 Conclusion

To conclude this chapter, the dependent and the independent variables have been supported by the numbers of the researchers in different perspective whereby we able to view it in the literature part. There are also consisting several models recommended by the scholars to find out the relationship between the price of housing and its independent variables. Furthermore, we had studied different countries to figure out the independent variables used which would affect the housing price in different countries before we decide the favorable independent variables(short term rate of interest, unemployment rate, inflation rate and GDP) that going to be used by us for our studies.

CHAPTER 3: METHODOLOGY

3.0 Introduction

This chapter comprises of research design, data collection methods, data processing, analysis method and diagnostic checking to illustrate the results of the research. All these processes are used to examine the research model on the following chapter. Moreover, this paper consist of four variables which are short term interest rate, inflation rate, gross domestic product(GDP), and unemployment rate which being used as the factors that will affect the housing price index(HPI) in United State. The sample period we used in this study is from year 1997Q3 to year 2013Q4. All the data are in quarterly form and it has total 66 observations for each of the variable. In addition, all the data are extracted from Organization for Economic Co-operation and Development(*OECD*) and internet sources.

Econometric tests or diagnostic checking is important in order to get the Best Linear Unbiased Estimator(BLUE) model which is achieving all the 10 assumptions. A BLUE model must be linear, unbiased, and only has minimum variance. Meanwhile, a diagnostic checking is used to check the econometric problem in the model the problem including Multicollinearity which check by Variance Inflation Factor(VIF), Heteroscedasticity which check by ARCH Test, Autocorrelation can be checked by Breusch-Godfrey Serial Correlation LM test, and Model Misspecification which check by Ramsey RESET Test. Besides, for the Pooled Ordinary Least Square(POLS) is used to estimate the true population relationship between dependent variable and independent variables.

3.1 Research Design

Figure 3.1: Flow of Research

The purpose of this research is to examine the relationship between Housing Price Index(Dependent variable) and macroeconomic factors including short term rate of interest, inflation rate, GDP, and unemployment rate(Independent variables).

The research design can be in the form of qualitative or quantitative. However, the quantitative data is more suitable and appropriate in this research study due to the numerical data can be used to carry out the hypothesis testing.

3.2 Data Collection Model

Data collection process is necessary for this study to investigate the relationship between the housing price index with exogenous variables. All the data is collected or gathered from secondary data resources and the data is derived from time series quarterly data. The data for each exogenous variables and endogenous variable are in numerical form which included 66 observations. Exogenous variables are short term rate of interest, inflation rate, GDP, and unemployment rate which used to determine the significant relationship toward Housing Price Index(HPI) in United stated. In addition, all the data are collected from the database of Organization for Economic

Co-operation and Development(*OECD*) from year 1997Q3 until year 2013Q4 in quarterly basis.

The reason of using secondary data resources is due to secondary data can reduce time consuming, easy to access, and cost saving. As compare with primary data which cost a lot of energy and money in order to get an accurate data.

3.2.1 Housing Price Index(HPI)

The source of data for Housing Price Index is gathered from the database of the Organization for Economic Co-operation and Development(*OECD*) and the period collected is from year 1997Q3 until year 2013Q4. It contains total 66 of observations for this study and the unit of measurement is in index form. Housing Price Index(HPI) is the average price change in repeat sales or refinancing on the same properties of single-family house prices in the U.S. It can use to indicate the housing price trends in U.S.

3.2.2 Short Term Interest Rate

The short term interest rate data is collected from Organization for Economic Co-operation and Development(*OECD*) database. All the data is collected in quarterly basis from year 1997Q3 until year 2013Q4. The unit of measurement is in form of percentage(%). Short term interest rate is used to measure the short term borrowing rate.

3.2.3 Inflation Rate

This research paper collected the inflation rate data from Organization for Economic Co-operation and Development(*OECD*) database. All the data is collected in quarterly basis from year 1997Q3 until year 2013Q4. The quarterly time series is in the form of percentage(%). Inflation rate refer to the cost of raw materials for the building of houses and this will cause changes in housing price.

3.2.4 Gross Domestic Product(GDP)

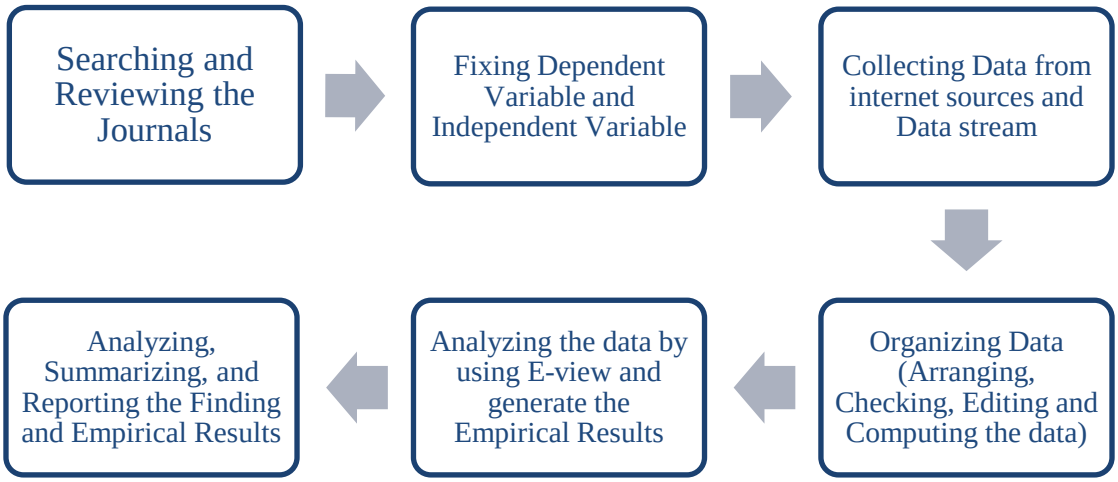
The time series GDP data is collected from Organization for Economic Co-operation and Development(*OECD*) database. All the data is quarterly time series data from year 1997Q3 until year 2013Q4 and the unit of measurement is percentage(%). GDP refer to the economic growth, if economic is growing more people will try to purchase house, and it will cause the housing price increase.

3.2.5 Unemployment Rate

Unemployment rate data for this research is collected from Organization for Economic Co-operation and Development(*OECD*) database. All the data is collected in quarterly basis from year 1997Q3 until year 2013Q4. Unemployment rate is the percentage of unemployment in United Stated.

3.3 Data Processing

Figure 3.2: Diagram of Data Processing



For data processing it involves 6 steps which shown in figure 3.2.

Step 1: Searching and Reviewing the Journals

By using database of Google Scholars, Science Direct, SAGE journals, JSTOR and others, we found a number of journals which related with our study about determinants of housing price in U.S. Meanwhile, all the journals are from different countries such as China, United Kingdom, United State, Turkey, Malaysia, Thailand and so on. All these information help in determining the suitable independent variables for this study.

Step 2: Fixing Dependent Variable and Independent Variables

After the discussion on the summaries of all journals and data availability, we set Housing Price Index(HPI) as our dependent variable. Besides, we choose Short term interest rate, inflation rate, GDP, and unemployment rate as independent variable for

this study as these variables brought significant result on past research. In addition, quarterly data is selected for this study in order to fulfill the number of observation requirement.

Step 3: Collecting Data from internet sources and Data stream

All the data for dependent variable and independent variable are collected from the database of Organization for Economic Co-operation and Development(*OECD*). The data collected is time series quarterly data and total 66 observations.

Step 4: Organizing Data(Arranging, Checking, Editing and computing the data)

The data are arranged in excel file after the data collection process. The data downloaded are repeated checking to ensure the data are in quarterly basis and it is in correct sequence. The error data is then edited and corrected. Furthermore, computing the data and detect whether there is any problem in the empirical model thorough diagnostic checking. If there is any econometric problems appear, we will editing the data and overcome it.

Step 5: Analyzing the data by using E-view and generate the Empirical Results

E-view is used to run the OLS and get the empirical results. Besides, T-test, F-test are obtained from the empirical result and R-squared and Adjusted R-squared also shown.

Step 6: Analyzing, Summarizing, and Reporting the Finding and Empirical Results

Lastly, verifying the result of each individual variable and whole model. Interpret the results and relationship between independent variable and dependent variable. Besides, it can also making comparison of those results with past researchers and check whether the results are consistent with the hypothesis made in chapter 1 and 2.

3.4 Data Analysis

Data analysis can define as the process of estimating and evaluating the data and to make sure the whole model and individual independents variables are significant on final by carrying out different types of test. Therefore, to measure and examine the relationship between housing price index, unemployment rate, short term rate of interest, GDP and inflation rate to fulfil the objective of this research by conducted several test. So the Ordinary Least Square(OLS) and diagnostic checking will be used on our study.

3.4.1 Time Series Data

Time series data are known as a series of data points indexed which are in time order. In detail, time series is a set of observation or data on the values that a variables takes different time. For example, the data may be collected in the form of regular time intervals, such as daily, monthly, weekly, quarterly, annually, quinquennially(every five years) or decennially. The signature and obvious characteristic of time series data is this type of data set are comes with a temporal ordering which separates it from cross sectional data. Moreover, sometime data are available both quarterly and annually as in the data on GDP and consumer expenditure (Gujarati & Porter, 2009).

3.4.2 Time Series Regression Model

This type of models attempt to explore the current response of using the response history which is autoregressive dynamics and the transfer of dynamics from relevant predictors. Nevertheless, we can use time series regression models to examine and analyse the measurements of data which occurs at successive time point. For instance, we can use time series regression modelling to examine the linear effects of the

current and past inflation rate and past unemployment rate on the current unemployment rate. Besides, this model also can use to forecasting GDP growth rates by using ARIMA model and include the CPI growth rate as predictor (Gujarati & Porter, 2009).

$y_t=\beta_0+\beta_1 X_t+\varepsilon_t$,

Where y_t is an observed response and the columns for contemporaneous values of observable predictors includes in X_t . For instance, y_t also known as value of *Y* in period *t*. Example of *t* can be monthly, yearly which is 1960 to1999 and does not have any missing months or years.

3.5 Descriptive Analysis

Descriptive statistic is a type of data analysis used to describe the basic features of the data in a study. Descriptive statistics are used to present quantitative descriptions in a manageable form and simplified huge amount of data in a sensible way. It provides simple summaries about the data and the measures such as measures of central tendency and measures of dispersion or spread or variability (Trochim, 2006).

i. Measures of central tendency

Measures of central tendency describe the central position of a frequency distribution for a group of data. The major types of measures of central tendency comprises of mean, median and mode. **Mean** is the average of all data or total sum of the data and divide by the number of values. **Median** is the exact middle number of the set of data (LaerdStatistics, n.d.). Among these three measures, mean is most suitable in measuring the central tendency as compared to others since it take all the data in consideration.

ii. Measures of dispersion

Dispersion refers to the spread of the values around the central tendency. The most common measures of dispersion is standard deviation. The standard deviation provides an accurate and detailed estimate of dispersion since an outlier can greatly exaggerate the range (Trochim, 2006).

3.6 Correlation

In order to interpret the correlation analysis, there is a tool to calculate it which called correlation coefficient. It is used to measure how well the linear association strength or degree is between the two variables (Burtis & Neher, 2011). The variables can be in the form of dependent variable and independent variable or both are independent variables. The correlation test would be used to detect the seriousness of multicollinearity between the variables and this would be discussed even detail in the part of diagnostic checking and data analysis chapter.

According to Ashenfelter et al. (2003), the correlation coefficient would be resulted in between -1 and +1. When the value is more than 0 and closed to +1, it means the linear is a stronger positive linear relationship. In the other way round, there will be negative correlation between the variables if the value is less than 0 and when the value is closed to -1, there will be a stronger linear negative relationship. There is no linear relationship between the variables when the correlation coefficient appeared as 0 (Burtis & Neher, 2011). However, there is between any variable and its own, the correlation will be always 1. The table below is the short summary in order to make it clearer:

Table 3.1: Summary of Correlation Result

-1 < r < 1		
When	r > 0	Positive correlation between the variables
	r < 0	Negative correlation between the variables
	r = 0	No correlation between the variables

3.7 Ordinary Least Square(OLS)

Ordinary least square is attributed to Carl Friedrich Gauss, a German mathematician. This method has some very attractive statistical properties that have made it one of the most powerful and popular methods of regression analysis under certain assumptions (Gujarati, 2004). Besides that, OLS explains and explores the relationship between endogenous variable and exogenous variables. Therefore, all of the assumptions of Classical Normal Linear Regression Model(CNLRM) must be fulfilled then only we can apply and use the OLS.

1. Linear regression model which means the regression model is linear in the parameters.
2. The values of X are fixed in repeated sampling which means the value in the repressors x are considered fixed in repeated samples.
3. There is zero means value of error terms which means the mean, or expected, value of the random disturbance term is zero.

   E(ui |Xi) = 0
4. Homoscedasticity among the error term.

   var (ui |Xi) = E[ui − E(ui |Xi)]2 = E(ui 2 | Xi) because of Assumption 3 = σ2 ***where var stands for variance.***
5. No autocorrelation between the error terms.

cov (ui, uj |Xi, Xj) = E{[ui − E(ui)] | Xi}{[uj − E(uj)] | Xj} = E(ui |Xi)(uj | Xj) = 0*where i and j are two different observations and where cov means covariance.*

6. There is zero covariance between independent variables and error terms.
7. The number of observations must larger than the number of parameters to be estimated **(N>K)**.
8. There must variability in X values and no outlier in values of X.
9. There is no multicollinearity between the independent variables.
10. The disturbances must be normal distribution.
11. No specification bias.

The OLS only can be BLUE when the 11 assumptions are fulfilled otherwise it will lead to biased and error results (Gujarati, 2012).

The concepts for BLUE can define as below:

1. *Best* means the estimators have minimum variance.
2. *Linear* means that linear in parameters.
3. *Unbiased* means the expected value are equal to the true values.
4. *Efficient* means the estimators are accurate and reliable. (Gujarati, 2012).

Finally, this research will form a regression model on housing price index together with GDP, inflation rate, unemployment rate and short term rate of interest by running E-view that can help us perform diagnostic checking to prevent suffer from econometric problem.

3.7.1 T-test Statistics

$H_{0:}$ β_1=0, β_2=0, β_3=0, β_4=0 (insignificant)

$H_{0:}$ β_1≠0, β_2≠0, β_3≠0, β_4≠0 (significant)

Where, β_1= Gross Domestic Product(GDP)

β_2= Inflation rate

β_3= Short term rate of interest

β_4= Unemployment rate

Besides that, t-test is analysis of two population means through statistical examination and this type of test only suitable for small sample size and if the sample size is to large or huge then only z-test applicable.

William Sealy Gosset is the founder of Student's t-test. The reason why he proposed and created this kind of test is because it can be used to solve the small sample size issue which is the observation is less than 30. For instance, having small sample size may cause the estimate mean and standard deviation will be different from actual mean and standard deviation (Student's t-test, n.d.).

Normally in actual life, t-test are used to verify and test the significant relationship between endogenous variable and exogenous variable. Furthermore, the null hypothesis of t-test shows there is no significant relationship between endogenous variable and exogenous variable. On the other hands, the alternative hypothesis represents that exogenous variable and endogenous variable is statistically significantly associated to each other besides they can affects and influences each other. Hence, if t-test statistics exceeds the critical value, it indicated that we should reject the null hypothesis as our conclusion. Besides that, we also can refer p-value to conclude our results. If p-value less than alpha, we also can direct accept the alternative hypothesis as our final results.

Nevertheless, this research will justify short term rate of interest, unemployment rate, inflation rate and GDP individually to test their individual significances on housing price index in US by running test.

3.7.2 F-Test Statistic

H_0: β_1=β_2=β_3=β_4=0 (insignificant)

H_1: $\beta_1 \neq 0$, at least one of β_i is different from zero (significant to Y), where i=1, 2, 3 & 4.

Where, Y= Housing Price Index in United State(HPI)

β_1= Gross Domestic Product(GDP)

β_2= Inflation rate

β_3= Short term rate of interest

β_4= Unemployment rate

Typically, F-test were developed by Snedecor and Cochran in 1983. An F-test is any statistical test that has an F-distribution under the null hypothesis. In general, an F-test in regression compares the fits of different linear models and F-test can assess multiple coefficients simultaneously. In actual, F-test only can be used when the variances of two populations are equal. This type of test can be one-tailed test or two tailed-test. For instance, the one-tailed test only test in one direction which means the variance from first population is either larger than or smaller than the second population variance. Besides that, we can control one or more independent variables and examine or observe the influence on the dependent variable to see the response of the independent variables by analysis the variances through ANOVA. There is several assumption of F-test which is the sample size must be large enough which is greater than 30 observation and the population must have same variance. Lastly, the samples are randomly selected and the populations are normally distributed (Gujarati & Porter, 2009)

Normally, we can determine the significant of the whole model by using F-test. Furthermore, the null hypothesis of F-test stated that there is no significant relationship between endogenous variable and exogenous variable, whereas

alternative hypothesis indicated that at least one of the independent variables is association with dependent variables. For the results, we will ignored the null hypothesis if the F-test statistic is greater than critical value which means we will accept the alternative hypothesis as our conclusion, at least one of the independent variables have significant relationship with dependent variable. Thus, F-test will be used in the research to justify the significant of whole model on determinants of housing price index.

3.8 Diagnostics Checking

3.8.1 Multicollinearity

Multicollinearity means two or more independent variables in a regression model are highly associated (Pedace, 2013). However, due to the assumption of Classical Linear Regression Model(CLRM) that not allowed the multicollinearity exists. Therefore, the researchers need to solve multicollinearity problems when there are high R^2 (more than 0.8) and few significant t test. High R^2 means model is good but only few independent variables can explain the model, so it will not make sense. Moreover, correlation test can be used to measure the degree of correlation between the explanatory variables to detect the multicollinearity problem. If the correlations between two explanatory variables are more than 0.8, it may suspects to have multicollinearity problem in the model.

Furthermore, the researchers may use another way to detect serious multicollinearity problem such as Variance Inflation Factor(VIF) and Tolerance(TOL). If VIF more than ten which means there is a serious multicollinearity problem whereas if VIF less than ten which means there is not serious multicollinearity problem (Paul, 2013). By

using TOL to detect multicollinearity problem, it shows that there is a serious multicollinearity problem when TOL close to zero.

Formula of Variance Inflation Factor(VIF) and Tolerance(TOL):

VIF = TOL = $(1-R_i^2)$

- **VIF** ≥ 10, serious multicollinearity problem
- **TOL** ≤ 0, serious multicollinearity problem

Hence, there are some ***consequences*** occur when there is multicollinearity exists in the regression model. Firstly, the Ordinary Least Square(OLS) estimator is still Best Linear Unbiased Estimator(BLUE) which is the OLS estimator is still unbiased and has minimum variance. OLS estimator can be considered as a best estimator but best may not be very good. Secondly, the variances and standard errors of the parameter estimates will increase. High variance means that the estimates are imprecise and show that it is unreliable. Besides, high variances and standard errors will cause low t-statistics (Paul, 2013).

3.8.2 Autocorrelation

Autocorrelation will occur only when the regression analysis using time series data. When autocorrelation happen, it shows that the error term μ in the regression equation has relationship with the dependent variables which can affect the dependent variable (Statistics Solutions, 2017). It will violate the assumption of CLRM. This is due to autocorrelation normally will occur only when the time series data in the model omits relevant independent variables, wrong functional form and data manipulation. Furthermore, it will tends to lead the estimated parameters become inconsistent, inefficient and biased. Therefore, Durbin-Watson Test, Durbin's h Test and Breusch-Godfrey LM test can be used to detect the autocorrelation problem.

Durbin-Watson Test can be used to detect the autocorrelation problem but it also consists some of the limitations. It only applicable for the first order series correlation, provide inconclusive result and the test cannot be applied in the models with lagged dependent variables.

The hypothesis can be shown as below:

H_0: There is no autocorrelation problem.
H_1: There is autocorrelation problem.

3.8.3 Heteroscedasticity

Heteroscedasticity happened when the variance of the error terms differ across observations. However, based on the CLRM assumption it stated that there is no Heteroscedasticity exists. Besides, they assume that the errors have constant variance which can be known as homoscedasticity. If the Heteroscedasticity problems exist, the OLS estimators are no longer BLUE. Therefore, the OLS estimator is still consistent but it is no longer efficient.

By using the Autoregressive Conditional Heteroscedasticity(ARCH) test, it can be used to detect Heteroscedasticity problem. If there is homoscedasticity, the model is not suspected has a Heteroscedasticity problem, which means that the model has minimum variance and constant. Since the model contains Heteroscedasticity problems, the researcher can carry out White Heteroscedasticity-Consistent Standard Errors and Covariance to curb the problems (OMICS International, 2014).

The hypothesis can be shown as below:

H_0: There is no Heteroscedasticity problem.
H_1: There is Heteroscedasticity problem.

The decision rule:

1) Reject H_0 when the p-value is less than alpha at significant level. Otherwise, do not reject. (It shows that there is Heteroscedasticity problem.)
2) Do not reject H_0 when the p-value is greater than alpha at significant level. Otherwise, reject H_0. (It shows that there is no Heteroscedasticity problem.)

3.8.4 Model Specifications

Model specification bias is a problem occurred due to omitting independent variable, including an unnecessary independent variable or wrong functional form of dependent or independent variable. Based on the econometrics' theory, omit the relevant variable will be more risky compared with include the irrelevant variable. This is due to omitting the relevant variables may have a big impact on affecting the regression result than include the irrelevant variables (Kuosmanen, n.d).

Model specifications problem will violates the CLRM assumptions. For omitting the relevant variables which may lead the OLS estimators become inconsistent and biased. For including the irrelevant variables, the OLS estimators will be consistent and unbiased but inefficient. This is because they have less variance and it will not influence the consistency of the variables. By using Ramsey's Regression Specification Error Test(RESET), the researchers can use it to detect the model specification problem (Gujarati, 1999).

The hypothesis test can be shown as below:

H_0: The model specification is correct.
H_1: The model specification is incorrect.

3.8.5 Normality Test

The researchers need to perform normality test for the error term, before they perform other hypothesis testing. This study contains with large sample size, the normality of the residuals is not so important as long as this study meet the normality assumptions. In this study, the researchers will carry out the following test in order to make sure that this study meets the normality assumptions.

The hypothesis test can be shown as below:

H_0: Error terms are normally distributed.
H_1: Error terms are not normally distributed.

3.8.6 Jarque-Bera Test

By using E-view software, the Jarque-Bera test can be carried out. Jarque-Bera test can be used to test whether the sample data have the skewness and kurtosis to match the normal distribution.

The Jarque-Bera test statistic can be defined as below:

In this research, the normality test will be carried out by using E-view software. Null hypothesis shows that the error terms are normally distributed. However, the alternative hypothesis indicated that the error terms are not normally distributed. Thus, if the test statistics is greater than upper critical value or p-value is lesser than significant level, then the null hypothesis will be rejected. As the null hypothesis will be rejected, it shows that the error terms are not normally distributed.

3.9 Conclusion

In conclusion, diagnostic checking and time series data regression model will be conduct on this research. The purpose of applying those tests is to meet the objective of this research and ensure all the model is stated correctly without any econometric problems in the model. Lastly, the empirical result will be conduct on Chapter 4.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

Based on the third chapter, regression analysis has been chosen in this study to investigate the housing price market from the third quarter of 1997 until fourth quarter of 2013 in United States. The analysis of this study contains of 66 observations.

Furthermore, it is important to run the data collection and discuss the results about the hypothesis testing(T-test and F-test) and econometric problems(Multicollinearity, Heteroscedasticity, Autocorrelation, Normality test and Model Specification). Throughout the diagnostic checking, it can be used to measure and ensure that the estimated parameters are consistent, efficient and unbiased. Moreover, the hypothesis testing can be used to test whether there is a significant relationship between inflation rate, unemployment rate, gross domestic product(GDP) and interest rate with the housing prices index in United States. In this chapter, the recommendations and ways to solve the econometric problems will be discussed at the followings.

4.1 Multiple Linear Regression Model

$HPI_t = \beta_0 + \beta_1 GDP_t + \beta_2 INF_t + \beta_3 INTRATE_t + \beta_4 UNEMP_t + \mu_t$ (Model 4.1)

$\text{Log } \widehat{HPI}_t = \hat{\beta}_0 + \hat{\beta}_1 GDP_t + \hat{\beta}_2 INF_t + \hat{\beta}_3 INTRATE_t + \hat{\beta}_4 UNEMP_t + \mu_t$ (Model 4.2)

$\text{Log } \widehat{HPI}_t = 4.850887 - 0.040188\ GDP_t + 0.028149\ INF_t - 0.027657 INTRATE_t - 0.030316\ UNEMP_t + \mu_t$

$R^2 = 0.1735$ Adjusted $R^2 = 0.1193$

N = 66 Observations

Where,

HPI_t : Housing Prices Index

GDP_t : Gross Domestic Product(Percentage)

INF_t : Inflation Rate(Percentage)

$INTRATE_t$: Interest Rate(Percentage)

$UNEMP_t$: Unemployment Rate(Percentage)

μ_t : Error Term

t : Quarterly Period(1997-2013)

In this study housing prices can be known as the dependent variables in the regression model and it also represents as the housing prices in United States which is measures in index point. In the regression model, the independent variables will be GDP, interest rate, inflation rate and unemployment rate. Besides, all the independent variables are measured in percentage.

Throughout this chapter, the diagnostic checking will be carried out to examine the estimated regression model. If there is an econometric problem exists in the estimated model, various methods such as white test and Newey-West test will be used to solve

the econometric problems. Hence, the hypothesis testing will be conduct to ensure that the result is consistent with the theories and previous researchers.

4.2 Data and Descriptive Statistics

Table 4.1: Descriptive Statistics

	GDP	HPI	INF	INTRATE	UNEMP
Mean	0.553945	4.631862	2.352293	2.832121	6.090908
Median	0.646370	4.617717	2.201500	2.503335	5.466665
Maximum	1.888490	4.851801	5.302810	6.626670	9.933330
Minimum	-2.112600	4.400127	-1.623360	0.123330	3.900000
Std. Dev	0.664871	0.127452	1.182364	2.253425	1.868996
Skewness	-1.218963	0.214493	-0.588138	0.208734	0.764212
Kurtosis	6.419894	2.111574	4.709014	1.460812	2.179030
Observations	66	66	66	66	66

In this study consists of 66 observations and time-series quarterly data which are taken from the housing price index in United States from year 1997 until year 2013.

Based on the table 4.1, the results show that the average of housing price index(dependent variable) in United States is 4.63%. The housing price index reached the highest was 4.85% meanwhile the lowest reached was 4.40%. Therefore, the standard deviation was 0.127452 and the median housing price index was around 4.62%. Besides, the housing price index was skewed to the left because the skewness is more than zero, which was 0.214493. The data of housing rice index was not volatile because the Kurtosis is less than 3, which only 2.111574.

On top of that, the average GDP rate was 0.55%. The highest GDP rate from year 1997 third quarter to year 2013 fourth quarter was 1.89% whereas the lowest was -

2.11%. Hence, the standard deviation was 0.664871 and the median of GDP rate was 0.65%. As the skewness of GDP is right-skewed, because the skewness is less than zero which was -1.218963. The data of GDP rate has a very big fluctuation because the Kurtosis was more than 3 which was 6.419894.

Furthermore, the average inflation rate was 2.35%. The highest inflation rate was 5.30% while the lowest inflation rate was -1.62% from 1997 third quarter until 2013 fourth quarter. Thus, the standard deviation was 1.182364 and the median of inflation rate was 2.20%. In addition, the skewness of inflation rate is right-skewed because the skewness is less than zero which was -0.588138. The data of inflation rate has volatility. This is due to the Kurtosis was more than 3 which was 4.709014.

Moreover, the average interest rate was 2.83%. The highest interest rate was 6.63% whereas the lowest was 0.12% from year 1997 third quarter to year 2013 fourth quarter. Besides, the standard deviation of interest rate was 2.253425 and the median of interest rate was 2.50%. In addition, the skewness of interest rate is left-skewness because the skewness is more than zero which was 0.208734. The data of interest rate is less volatile because the Kurtosis is less than 3, only 1.460812.

Lastly, the average unemployment rate was 6.09%. The highest unemployment rate was 9.93% while the lowest rate will be 3.9% from year 1997 third quarter until year 2013 fourth quarter. Thus, the standard deviation of unemployment rate was 1.868996 and the median unemployment rate was 5.47%. As the skewness of unemployment rate is left-skewness because the skewness is more than zero which was 0.764212. The data of unemployment rate is less fluctuation because the Kurtosis is less than 3 which only 2.179030.

4.3 Model Estimation and Interpretation

The Model 4.2 will be tested by using the OLS regression method in order to test the model with Eviews for the hypothesis testing and diagnostic checking using the data collection.

$$\text{Log } \widehat{HPI}_t = \hat{\beta}_0 + \hat{\beta}_1 GDP_t + \hat{\beta}_2 INF_t + \hat{\beta}_3 INTRATE_t + \hat{\beta}_4 UNEMP_t + \mu_t$$

Table 4.2: Initial Regression Output

Variables	Coefficient
$\hat{\beta}_0$	4.850887
$\hat{\beta}_1$	-0.040188
$\hat{\beta}_2$	0.028149
$\hat{\beta}_3$	-0.027657
$\hat{\beta}_4$	-0.030316

4.3.1 Interpretation of Beta

$\hat{\beta}_0$ **:** 4.8509

4.8509 is the intercept that indicates the average of housing price index in United States when the GDP, inflation rate, interest rate and unemployment rate is equal to zero.

$\hat{\beta}_1$ **:** -0.04019

If the gross domestic product(GDP) increases by one percentage point, on average, the housing price index in United States will decreases by 0.04019%, holding other variables constant.

$\widehat{\boldsymbol{\beta}}_{\boldsymbol{2}}$ **:** 0.02815

If the inflation rate increases by one percentage point, on average, the housing price index in United States will increases by 0.02815%, holding other variables constant.

$\widehat{\boldsymbol{\beta}}_{\boldsymbol{3}}$ **:** -0.02766

If the interest rate increases by one percentage point, on average, the housing price index in United States will decreases by 0.02766%, holding other variables constant.

$\widehat{\boldsymbol{\beta}}_{\boldsymbol{4}}$ **:** -0.03032

If the unemployment rate increases by one percentage point, on average, the housing price index in United States will decreases by 0.03032, holding other variables constant.

4.3.2 Interpretation of R-squared, Adjusted R-squared and Standard Error

R^2 = 0.1735 **Adjusted R^2 = 0.1193**

S.E of Regression = 0.1196 **Mean dependent var = 4.6319**

The Coefficient of Determination, R^2 = 0.1735

It is a summary measure of goodness of fit to the data. R^2 is found to be 0.1735. This means that 17.35% of the variation in United States housing price index can be explained by the variation in GDP, inflation rate, interest rate and unemployment rate.

Adjusted R-squared, $\bar{R}^2$ = 0.1193

The adjusted R^2 is a modified version of R^2 that has been adjusted for the number of the predictors in the model. Adjusted R^2 is found as 0.1193. This indicates that 11.93% of the variation in United States housing price index can be explained by the variation

in GDP, inflation rate, interest rate and unemployment rate. The adjusted R^2 can be negative, but it is usually not and it is always lower than R^2.

Standard Error to Mean Ratio

$$\frac{Standard\ Error\ of\ Regression}{Mean\ Dependent\ Variable}\ x\ 100\% = \frac{0.1196}{4.6319}\ x\ 100\%$$

$$= 2.58\%$$

Standard error to mean ratio is another term of coefficient of variation. The result shown there is about 2.58% or 0.0258 of the standard error to mean ratio. The lower the ratio, the better our estimation is.

4.4 Hypothesis Testing(Ordinary Least Square)

The hypothesis testing will be conducted to ensure that there are no econometric problems in the estimated regression model. Therefore, there are various types of diagnostic checking will be carried out such as normality test, multicollinearity, autocorrelation, heteroscedasticity and model specification test in order to ensure the model is significant in the study.

4.4.1 T-test

Hypothesis testing for individual variables(P-value Approach)

Dependent Variable: HPI
Method: Least Squares
Date: 06/17/17 Time: 19:40
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.850887	0.144748	33.51257	0.0000
GDP	-0.040188	0.022916	-1.753689	0.0845
INF	0.028149	0.013980	2.013481	0.0485
INTRATE	-0.027657	0.012973	-2.131881	0.0371
UNEMP	-0.030316	0.016325	-1.857040	0.0681

4.4.1.1 Gross Domestic Product(GDP)

Variables	**T- Statistic**	**P-value**
GDP	-1.753689	0.0845

Hypothesis

H_o : Housing price index and GDP have no important relationship in United States.

H_1 : Housing price index and GDP have important relationship in United States.

Decision Rule

Reject H_o, if p-value of test statistic is lower than the significance level of 1%, 5% or 10%. Otherwise, do not reject H_0.

Decision Making

Do not reject H_0 since the p-value of test statistic is 0.0845 which is greater than significance level at $\alpha = 0.01$ and $\alpha = 0.05$.However, reject H_0 at the significant level of $\alpha = 0.10$. This is because since the p-value of test statistic is 0.0845 which is lesser

than significant level at $\alpha = 0.10$, therefore, reject H_0. Throughout this result, it can be considered as the GDP has the ***significance relationship*** with the housing price index at $\alpha = 0.10$.

Conclusion

Based on the above result, there is sufficient evidence to conclude that GDP and housing price index have important relationship with each other in United States at significance level at $\alpha = 0.10$.However, the t-statistic shows that they are ***negatively correlated***. This is due to the researchers found that the globalization has strongly influences the housing price index rather than only GDP in particular country can affect the housing price movement (Ley & Judith, 2010).

4.4.1.2 Inflation Rate

Variables	T-Statistic	P-value
INF	2.013481	0.0485

Hypothesis

H_o : Housing price index and inflation rate have no important relationship in United States.

H_1 : Housing price index and inflation rate have important relationship in United States.

Decision Rule

Reject H_o, if p-value of test statistic is lower than the significance level of 1%, 5% or 10%. Otherwise, do not reject H_0.

Decision Making

Do not reject H_0 since the p-value of test statistic is 0.0485 which is greater than significance level at $\alpha = 0.01$. However, reject H_0 at the significant level of $\alpha = 0.05$ and $\alpha = 0.10$. This is because since the p-value of test statistic is 0.0845 which is lesser than significant level at $\alpha = 0.05$ and $\alpha = 0.10$, therefore, reject H_0. Throughout this result, it can consider as the inflation rate has the ***significance relationship*** with the housing price index at $\alpha = 0.05$ and $\alpha = 0.10$.

Conclusion

Based on the above result, there is sufficient evidence to conclude that the inflation rate and housing price index have important relationship with each other in United States at significance level $\alpha = 0.05$ and $\alpha = 0.10$.Based on the result and t-statistic, it shows that the inflation rate and housing prices index have ***positive relationship***. This is due to the higher the inflation rate, the costs of raw materials to build the houses will increase as well (Zhu, 2004). Therefore, the housing prices index level will increase as well. It shows that there is a significant relationship between inflation rate and housing prices index (Kamal et al., 2013) (Liew & Haron, 2013).

4.4.1.3 Interest Rate

Variables	T-Statistic	P-value
INTRATE	-2.131881	0.0371

Hypothesis

H_o : Housing price index and interest rate have no important relationship in United States.

H_1 : Housing price index and interest rate have important relationship in United States.

Decision Rule

Reject H_o, if p-value of test statistic is lower than the significance level of 1%, 5% or 10%. Otherwise, do not reject H_0.

Decision Making

Do not reject H_0 since the p-value of test statistic is 0.0371 which is greater than significance level at $\alpha = 0.01$. However, reject H_0 at the significant level of $\alpha = 0.05$ and $\alpha = 0.10$. This is because since the p-value of test statistic is 0.0371 which is lesser than significant level at $\alpha = 0.05$ and $\alpha = 0.10$, therefore, reject H_0. Throughout this result, it can consider as the interest rate has the ***significance relationship*** with the housing price index at $\alpha = 0.05$ and $\alpha = 0.10$.

Conclusion

Based on the above result, there is sufficient evidence to conclude that the interest rate and housing price index have ***important relationship*** with each other in United States at significance level $\alpha = 0.05$ and $\alpha = 0.10$. Throughout the result and t-statistic, it shows that the interest rate and housing prices index have ***negatively correlated***. This is due to the higher of the housing loan interest rate; there will be the lower of demand to purchase the houses (Zhu, 2004). Besides, the researchers also mentioned that there is a strong negative relationship between interest rate and housing prices index. The interest rate has the strong explanatory in explaining the housing prices variation (Mansoret at., 2014).

4.4.1.4 Unemployment Rate

Variables	T- Statistic	P-value
UNEMP	-1.857040	0.0681

Hypothesis

H_o : Housing price index and unemployment rate have no important relationship in United States.

H_1 : Housing price index and unemployment rate have important relationship in United States.

Decision Rule

Reject H_o, if p-value of test statistic is lower than the significance level of 1%, 5% or 10%. Otherwise, do not reject H_0.

Decision Making

Do not reject H_0 since the p-value of test statistic is 0.0681 which is greater than significance level at $\alpha = 0.01$ and $\alpha = 0.05$.However, reject H_0 at the significant level of $\alpha = 0.10$. This is because since the p-value of test statistic is 0.0681 which is lesser than significant level at $\alpha = 0.10$, therefore, reject H_0. Throughout this, it can be considered as the unemployment rate has the ***significance relationship*** with the housing price index at $\alpha = 0.10$.

Conclusion

Based on the above result, there is sufficient evidence to conclude that unemployment rate and housing price index have ***important relationship*** with each other in United States at significance level at $\alpha = 0.10$. Throughout the result and t-statistic, it shows that the unemployment rate and housing prices index have ***negatively correlated***. The researchers found that higher unemployment rate will lead to the housing price index decrease (Grum & Govekar, 2016). Besides, Lu and Bo (2014) also mentioned that if there is unemployment rate increase, the demand of houses will decrease and it will lead to housing price decreases as well. In overview, the unemployment rate has an inverse relationship with the housing price index (Taylor, 2010).

4.4.2 F-Test

There is a different between the t-test and F-test for testing the model. This is due to t-test is hypothesis testing for testing individually while F-test to investigate the overall significance of the model which include all the independent variables such as GDP, inflation rate, interest rate and unemployment rate. For the F-test, the significance level will be 5% which is $\alpha = 0.05$. The result will be conducted as the below:

The overall significance of model : F-Test			
F-statistic	3.200408	Prob. F	0.018847

Hypothesis:

H_o:$\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ (The model is insignificant)

H_1 : At least one of the $\beta_i$is different from zero, where i= 1, 2, 3, 4 (At least one exogenous variable is important to the model)

Decision Rule

Reject H_o, if p-value of F-test statistic is lower than the significance level of 5%. Otherwise, do not reject H_0.

Decision Making

Reject H_0 since the p-value of F-test statistic is 0.018847 which is lower than significance level at $\alpha = 0.05$.

Conclusion

Based on the above result, there is sufficient evidence to conclude that at least one of β is dissimilar from zero at the significance level at $\alpha = 0.05$ and $\alpha = 0.10$. This means that the independent variables(GDP, inflation rate, interest rate and unemployment rate) are significantly in affecting the housing prices index in United States.

4.5 Diagnostic Checking

In order to get the Best Linear Unbiased Estimator(BLUE), there have certain assumptions of Classical Normal Linear Regression Model(CNLRM) must be fulfilled. Therefore, diagnostic checking will be carried out to detect and ensure no econometric problems existed in the model. Econometric problems comprised of multicollinearity, heteroscedasticity, autocorrelation, model misspecification and normality of error term.

4.5.1 Multicollinearity Test

Multicollinearity test will be conducted to ensure no linear and non-linear relationship between explanatory variables. Multicollinearity only arises when some or all of the explanatory variables are highly correlated. If multicollinearity present in the model, it has difficulty in telling which independent variables are influencing dependent variable.

Hypothesis:

H_0: No multicollinearity existed among independent variables.
H_1: Multicollinearity existed among independent variables.

i) High pair-wise correlation coefficients

Table 4.3: Correlation Analysis

	Correlation			
	GDP	**INF**	**INTRATE**	**UNEMP**
GDP	1.000000	0.034171	0.175761	-0.216546
INF	0.034171	1.000000	0.368439	-0.436318
INTRATE	0.175761	0.368439	1.000000	-0.861535
UNEMP	-0.216546	-0.436318	-0.861535	1.000000

* r > 0, implying that two variables have a positive correlation.

* r < 0, implying that two variables have a negative correlation.

* r = 0, implying that two variables have no correlation.

The correlation coefficient(r) ranges in between +1 and -1. A positive correlation coefficient indicates a direct relationship between the variables. A negative correlation coefficient indicates an inverse relationship among the variables. The closer the r to 1, the stronger the association between the variables regardless the sign is positive or negative. If the correlation coefficient, r between 2 variables is more than 0.8, it is suspected to have multicollinearity problem in particular variables.

The correlation analysis table shown the highest pair-wise correlation is -0.861535 which are interest rate and unemployment rate. The negative result shows a growth in interest rate will lead the unemployment rate fall. Since the correlation coefficient between interest rate and unemployment rate is more than 0.8, hence a TOL and VIF will carry out subsequently.

ii) Variance Inflation Factor(VIF) and Tolerance(TOL)

- **VIF** ≥ 10, serious Multicollinearity problem
- **TOL** ≤ 0, serious Multicollinearity problem

Regression Analysis, **GDP and INF**, (refer to Appendix 4.1)

$$\mathbf{VIF} = \frac{\mathbf{1}}{(\mathbf{1}-\boldsymbol{R_i^2})} = \frac{\mathbf{1}}{(\mathbf{1}-\mathbf{0.001168})} = 1.0012$$

$$\mathbf{TOL} = \frac{\mathbf{1}}{\mathbf{VIF}} = \frac{\mathbf{1}}{\mathbf{1.0012}} = 0.9988$$

Regression Analysis, **GDP and INTRATE**, (refer to Appendix 4.2)

$$\mathbf{VIF} = \frac{\mathbf{1}}{(\mathbf{1}-\boldsymbol{R_i^2})} = \frac{\mathbf{1}}{(\mathbf{1}-\mathbf{0.030892})} = 1.0319$$

$$\mathbf{TOL} = \frac{\mathbf{1}}{\mathbf{VIF}} = \frac{\mathbf{1}}{\mathbf{1.0319}} = 0.9691$$

Regression Analysis, **GDP and UNEMP**, (refer to Appendix 4.3)

$$\textbf{VIF} = \frac{\mathbf{1}}{(\mathbf{1}-R_i^2)} = \frac{\mathbf{1}}{(\mathbf{1}-\mathbf{0.046892})} = 1.0492$$

$$\textbf{TOL} = \frac{\mathbf{1}}{\mathbf{VIF}} = \frac{\mathbf{1}}{\mathbf{1.0492}} = 0.9531$$

Regression Analysis, **INF and INTRATE**, (refer to Appendix 4.4)

$$\textbf{VIF} = \frac{\mathbf{1}}{(\mathbf{1}-R_i^2)} = \frac{\mathbf{1}}{(\mathbf{1}-\mathbf{0.135747})} = 1.1571$$

$$\textbf{TOL} = \frac{\mathbf{1}}{\mathbf{VIF}} = \frac{\mathbf{1}}{\mathbf{1.1571}} = 0.8642$$

Regression Analysis, **INF and UNEMP**, (refer to Appendix 4.5)

$$\textbf{VIF} = \frac{\mathbf{1}}{(\mathbf{1}-R_i^2)} = \frac{\mathbf{1}}{(\mathbf{1}-\mathbf{0.190374})} = 1.2351$$

$$\textbf{TOL} = \frac{\mathbf{1}}{\mathbf{VIF}} = \frac{\mathbf{1}}{\mathbf{1.2351}} = 0.8097$$

Regression Analysis, **INTRATE and UNEMP**, (refer to Appendix 4.6)

$$\textbf{VIF} = \frac{\mathbf{1}}{(\mathbf{1}-R_i^2)} = \frac{\mathbf{1}}{(\mathbf{1}-\mathbf{0.742242})} = 3.8796$$

$$\textbf{TOL} = \frac{\mathbf{1}}{\mathbf{VIF}} = \frac{\mathbf{1}}{\mathbf{3.8796}} = 0.2578$$

Table 4.4: Result of VIF

	Growth Domestic Product(GDP)	Inflation Rate (INF)	Short term Interest Rate (INTRATE)	Unemployment Rate (UNEMP)
Growth Domestic Product(GDP)	1.0000	1.0012	1.0319	1.0492
Inflation Rate (INF)	1.0012	1.0000	1.1571	1.2351
Short Term Interest Rate (INTRATE)	1.0319	1.1571	1.0000	3.8796
Unemployment Rate(UNEMP)	1.0492	1.2351	3.8796	1.0000

Based on the result shown in table 4.4, the Variance Inflation Factor(VIF) between the independent variables not exceeds 10. Therefore, no serious multicollinearity existed in this model and no independent variable is needed to be excluded. Hence, the estimators still remain unbiased, efficient and consistent.

Table 4.5: Result of TOL

	Growth Domestic Product(GDP)	Inflation Rate (INF)	Short term Interest Rate (INTRATE)	Unemployment Rate (UNEMP)
Growth Domestic Product(GDP)	1.0000	0.9988	0.9691	0.9531
Inflation Rate (INF)	0.9988	1.0000	0.8642	0.8097
Short Term Interest Rate (INTRATE)	0.9691	0.8642	1.0000	0.2578
Unemployment Rate (UNEMP)	0.9531	0.8097	0.2578	1.0000

Based on the result shown in table 4.5, the degree of tolerance between the independent variables are more than 0. Therefore, no serious multicollinearity existed in this model. Hence, the estimators still remain unbiased, efficient and consistent.

4.5.2 Autocorrelation

Autocorrelation also called serial correlation, it arises only when there is a correlation or relationship among the error term in the regression model. The autocorrelation problem is not allowed exist in the regression model since it is one of the assumptions in Classical Normal Linear Regression Model. This econometric problem may

influence the OLS estimator become inefficient. Thus, Breusch-Godfrey LM test will be used to detect the autocorrelation in the model.

Hypothesis:

H_0: There is no autocorrelation problem.
H_1: There is autocorrelation problem.

Decision rule

Reject H_0 if P-value less than alpha α, otherwise do not reject H_0.

Table 4.6: Breusch-Godfrey Serial Correlation LM Test

F-statistic	200.4031	Prob.F (2,59)	0.0000
Obs*R-squared	57.53121	Prob.Chi-Square(2)	0.0000

Decision making

Reject H_0 since the P-value (0.0000) is less than alpha α (0.05).

Conclusion

Autocorrelation is existed in this model at the significant level 5%.
Therefore, Newey-West HAC Standard Errors & Covariance test will be used to overcome the autocorrelation problem in this model.

4.5.3 Heteroscedasticity

One of the assumptions in Classical Normal Linear Regression Model is homoscedasticity or constant variance of error term in order to make sure to get a Best Linear Unbiased Estimator. Thus, an Autoregressive Conditional Heteroscedasticity(ARCH) test will be conducted to detect and ensure no heteroscedasticity problem in the regression model. Heteroscedasticity is the variance

of error terms are not constant which may impact on the estimator become inefficient because it violates the minimum variance.

Hypothesis:

H_0: The model has homoscedasticity.

H_1: The model has heteroscedasticity.

Decision rule

Reject H_0 if P-value of Chi-Square less than alpha α, otherwise do not reject H_0.

Table 4.7: Autoregressive Conditional Heteroscedasticity(ARCH)

F-statistic	114.4980	Prob.F (1,63)	0.0000
Obs*R-squared	41.92932	Prob.Chi-Square(1)	0.0000

Decision making

Reject H_0 since P-value of Chi-Square (0.0000) is less than alpha, α (0.05).

Conclusion

The model is suffered from the heteroscedasticity problem, thus, Newey-West HAC Standard Errors & Covariance test will be used to overcome the autocorrelation problem and heteroscedasticity problem in this model. Therefore, both autocorrelation and heteroscedasticity problems are solved. The new OLS was come out.

4.5.4 Model Specification

By detecting the problem of model specification, the Ramsey RESET Test will be used to test the model.

Hypothesis:

H_0: The model specification is correct.

H_1: The model specification is incorrect.

Decision rule

Reject H_0 if P-value less than alpha α, otherwise do not reject H_0.

Table 4.8: Ramsey RESET

F-statistic	0.026915	Prob.F (1,60)	0.8702
Loglikelihood ratio	0.029600	Prob.Chi-Square(1)	0.8634

Decision making

Do not reject H_0 since the P-value (0.8634) is larger than alpha,α (0.05).

Conclusion

The model has met the model specification assumption at significant level 5%.

4.5.5 Normality Test

Jarque-Bera(JB) is usually run to ensure the normality assumption is fulfilled so that the error terms are normally distributed and independent variables will normally distributed as well.

Hypothesis:

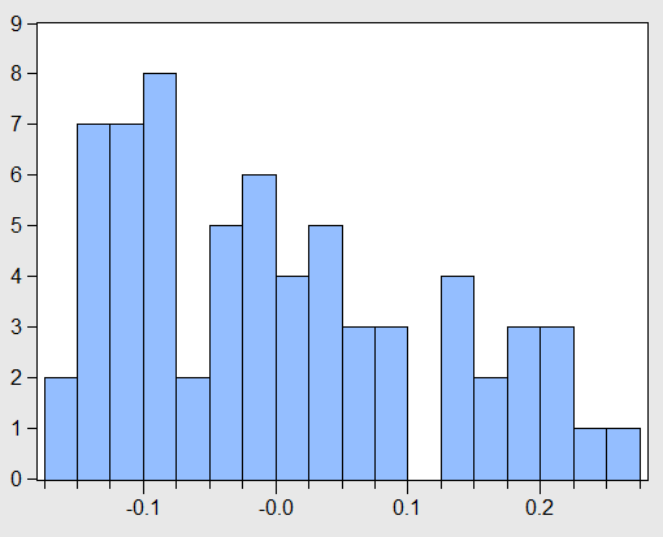
H_0 : The error terms are normally distributed.

H_1: The error terms are not normally distributed.

Decision rule

Reject H_0, if p-value of Jarque-Bera test less than alpha α, otherwise do not reject H_0.

Table 4.9: Jarque-Bera Test



Jarque-Bera	5.348026
Probability	0.068975

Decision making

Do not reject H_0 since p-value of Jarque-Bera (0.068975) is more than alpha, α (0.05).

Conclusion

The model has met the normality assumption in Classical Normal Linear Regression Model at significant level 5%.

4.6 New Regression Result(Ordinary Least Square)

The new regression result will be carried out due to the initial Ordinary Least Square has faced with autocorrelation problems and heteroscedasticity problems. By using the White test and Newey-West test, the new OLS need to be conducted to solve the autocorrelation problem and heteroscedasticity problem. After the econometric problems have been solved and new regression result has been carried out, the result

shows that the coefficient still similar as the previous OLS result. However, the standard error, t-statistic and probability of the variables were different as before. Through this, it may lead the hypothesis testing result may be different. For instance, for the independent variables which have significant relationship with the dependent variable, now may become insignificant correlated with the dependent variable. Hence, the latest hypothesis testing need to be carried out in order to ensure that there are no econometric problems exists in this study.

4.6.1 Hypothesis Testing

Dependent Variable: HPI
Method: Least Squares
Date: 06/17/17 Time: 22:28
Sample: 1997Q3 2013Q4
Included observations: 66
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.850887	0.148084	32.75761	0.0000
GDP	-0.040188	0.018936	-2.122283	0.0379
INF	0.028149	0.021389	1.316041	0.1931
INTRATE	-0.027657	0.018649	-1.483027	0.1432
UNEMP	-0.030316	0.018121	-1.672922	0.0995

4.6.1.1 Gross Domestic Product(GDP)

Variables	**T- Statistic**	**P-value**
GDP	--2.122283	0.0379

Hypothesis

H_o : Housing price index and GDP have no important relationship in United States.

H_1 : Housing price index and GDP have important relationship in United States.

Decision Rule

Reject H_o, if p-value of test statistic is lower than the significance level of 1%, 5% or 10%. Otherwise, do not reject H_0.

Decision Making

Do not reject H_0 since the p-value of test statistic is 0.0379 which is greater than significance level at $\alpha = 0.01$. However, reject H_0 at the significant level of $\alpha = 0.05$ and $\alpha = 0.10$. This is because since the p-value of test statistic is 0.0379 which is lesser than significant level at $\alpha = 0.05$ and $\alpha = 0.10$, therefore, reject H_0. Throughout this result, it can consider as the GDP has the ***significance relationship*** with the housing price index at $\alpha = 0.05$ and $\alpha = 0.10$.

Conclusion

Based on the above result, there is sufficient evidence to conclude that GDP and housing price index have important relationship with each other in United States at significance level at $\alpha = 0.05$ and $\alpha = 0.10$. However, the t-statistic shows that they are negatively correlated. This is due to the researchers found that the globalization has strongly influences the housing price index rather than only GDP in particular country can affect the housing price movement (Ley & Judith, 2010).

4.6.1.2 Inflation Rate

Variables	T-Statistic	P-value
INF	1.316041	0.1931

Hypothesis

H_o : Housing price index and inflation rate have no important relationship in United States.

H_1 : Housing price index and inflation rate have important relationship in United States.

Decision Rule

Reject H_o, if p-value of test statistic is lower than the significance level of 1%, 5% or 10%. Otherwise, do not reject H_0.

Decision Making

Do not reject H_0 since the p-value of test statistic is 0.1931 which is greater than significance level at $\alpha = 0.01$, $\alpha = 0.05$ and $\alpha = 0.10$. Throughout this result, it shows that the inflation rate has ***insignificance relationship*** with the housing price index at $\alpha = 0.01$, $\alpha = 0.05$ and $\alpha = 0.10$.

Conclusion

After conducted the new OLS method and solve the econometric problems, the hypothesis testing has conclude that the inflation rate and housing price index have ***no important relationship*** with each other in United States at significance level $\alpha = 0.01$, $\alpha = 0.05$ and $\alpha = 0.10$. Tan (2011) also found that the inflation rate is not a significant determinant of housing price movement.

4.6.1.3 Interest Rate

Variables	T-Statistic	P-value
INTRATE	-1.483027	0.1432

Hypothesis

H_o : Housing price index and interest rate have no important relationship in United States.

H_1 : Housing price index and interest rate have important relationship in United States.

Decision Rule

Reject H_o, if p-value of test statistic is lower than the significance level of 1%, 5% or 10%. Otherwise, do not reject H_0.

Decision Making

Do not reject H_0 since the p-value of test statistic is 0.1432 which is greater than significance level at $\alpha = 0.01$, $\alpha = 0.05$ and $\alpha = 0.10$. Throughout this result, it can consider as the interest rate has the ***insignificance relationship*** with the housing price index at $\alpha = 0.01$, $\alpha = 0.05$ and $\alpha = 0.10$.

Conclusion

After conducted the new OLS method and solve the econometric problems, the hypothesis testing has conclude that the interest rate and housing price index have ***insignificant correlated*** with each other in United States at significance level $\alpha = 0.01$, $\alpha = 0.05$ and $\alpha = 0.10$.

4.6.1.4 Unemployment Rate

Variables	T- Statistic	P-value
UNEMP	-1.672922	0.0995

Hypothesis

H_o : Housing price index and unemployment rate have no important relationship in United States.

H_1 : Housing price index and unemployment rate have important relationship in United States.

Decision Rule

Reject H_o, if p-value of test statistic is lower than the significance level of 1%, 5% or 10%. Otherwise, do not reject H_0.

Decision Making

Do not reject H_0 since the p-value of test statistic is 0.0995 which is greater than significance level at $\alpha = 0.01$ and $\alpha = 0.05$.However, reject H_0 at the significant level of $\alpha = 0.10$. This is because since the p-value of test statistic is 0.0995 which is lesser than significant level at $\alpha = 0.10$, therefore, reject H_0. Throughout this, it can be considered as the unemployment rate has the ***significance relationship*** with the housing price index at $\alpha = 0.10$.

Conclusion

Based on the above result, there is sufficient evidence to conclude that unemployment rate and housing price index have important relationship with each other in United States at significance level at $\alpha = 0.10$. Throughout the result and t-statistic, it shows that the unemployment rate and housing prices index have negatively correlated. The researchers found that higher unemployment rate will lead to the housing price index decrease (Grum & Govekar, 2016). Besides, Lu and Bo (2014) also mentioned that if there is unemployment rate increase, the demand of houses will decrease and it will lead to housing price decreases as well. In overview, the unemployment rate has an inverse relationship with the housing price index (Taylor, 2010).

4.6.2 F-Test

There is a different between the t-test and F-test for testing the model. This is due to t-test is hypothesis testing for testing individually while F-test to investigate the overall significance of the model which include all the independent variables such as GDP,

inflation rate, interest rate and unemployment rate. For the F-test, the significance level will be 5% which is $\alpha = 0.05$. The result will be conducted as the below:

The overall significance of model : F-Test			
F-statistic	3.200408	Prob. F	0.018847

Hypothesis:

$H_o : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ (The model is insignificant)

H_1 : At least one of the $\beta_i$is different from zero, where i= 1, 2, 3, 4 (At least one exogenous variable is important to the model)

Decision Rule

Reject H_o, if p-value of F-test statistic is lower than the significance level of 5%. Otherwise, do not reject H_0.

Decision Making

Reject H_0 since the p-value of F-test statistic is 0.018847 which is lower than significance level at $\alpha = 0.05$.

Conclusion

Based on the above result, there is sufficient evidence to conclude that at least one of β is dissimilar from zero at the significance level at $\alpha = 0.05$ and $\alpha = 0.10$. This means that the independent variables(GDP, inflation rate, interest rate and unemployment rate) are significantly in affecting the housing prices index in United States.

4.6.3 Interpretation of R-squared, Adjusted R-squared and Standard Error

R^2 = 0.1735 **Adjusted R^2 = 0.1193**

S.E of Regression = 0.1196 **Mean dependent var = 4.6319**

The Coefficient of Determination, R^2 = 0.1735

It is a summary measure of goodness of fit to the data. R^2 is found to be 0.1735. This means that 17.35% of the variation in United States housing price index can be explained by the variation in GDP, inflation rate, interest rate and unemployment rate. Based on the result of R^2 = 17.35%, it can be considered as low R^2 because it is less than 50% or 0.50.

The researcher also found that he has faced with the low R^2 problem which is only 0.157 or 15.70% (Ong, 2013). However, the researcher stated that low R-square does not mean that it will affect the whole result and it only will has the small effect sizes which is require the larger samples. In this result, there is low R-square because we only use 66 observations to run the E-views test. This is because that if we carried the larger sample size, the probability of the independent variables will become higher and will tend to result in insignificant relationship with the dependent variable. Through this, in this study only consists of 66 observations.

Adjusted R-squared, $\bar{R}^2$ = 0.1193

The adjusted R^2 is a modified version of R^2 that has been adjusted for the number of the predictors in the model. Adjusted R^2 is found as 0.1193. This indicates that 11.93% of the variation in United States housing price index can be explained by the variation in GDP, inflation rate, interest rate and unemployment rate. Based on the result of R^2 = 11.93%, it can be considered as low R^2 because it is less than 50% or 0.50. The adjusted R^2 can be negative, but it is usually not and it is always lower than R^2.

According to Ong (2013) also found that he has faced with the low adjusted R^2 problem which is only 0.1193 or 11.93%. However, the researcher stated that low adjusted R-square does not mean that it will affect the whole result and not necessary is the bad impact on the statistical result.

Standard Error to Mean Ratio

$$\frac{Standard\ Error\ of\ Regression}{Mean\ Dependent\ Variable}\ x\ 100\% = \frac{0.1196}{4.6319}\ x\ 100\%$$

$$= 2.58\%$$

Standard error to mean ratio is another term of coefficient of variation. The result shown there is about 2.58% or 0.0258 of the standard error to mean ratio. The lower the ratio, the better our estimation is.

4.7 Conclusion

This chapter aims to conduct diagnostic checking to detect the existence of econometric problems. It study found there have heteroscedasticity and autocorrelation problems. However, this study uses Newey-West HAC Standard Errors & Covariance to overcome both problems. Moreover, the model has met the normality and model specification assumption. Furthermore, two independent variables which are GDP and unemployment rate shown a significant relationship with housing price.

In addition, the following chapter will discuss about the statistical results, policy implications, limitations of this study and recommendations for future study.

CHAPTER 5: DISCUSSION, CONCLUSION AND IMPLICATIONS

5.0 Introduction

An overall outline and details from chapter 1 until chapter 4 will be finalise in this chapter. Furthermore, the details and summary of statistical analysis and major findings in topic 4 also will further discuss in this chapter. Besides that, the objective that wrote in chapter 1 also will use to compare with the results in chapter 4 to show whether there is a significant relationship between independent variable such as(GDP, INF, INTRATE, and UNEMP) with housing price index in United State. Additionally, several policies or implications will stated and suggested in this research, then followed by limitation of this researches. Finally, this study also will provide recommendation for future researches.

5.1 Summary of Statistical Analysis

The purpose for the study is to figure out the connection between the significance of the Housing Price Index and the independent variables which are short term rate of interest, inflation rate, gross domestic products and unemployment rate. Besides, there are total of 66 observation used throughout the period between the 3rd quarter of year 1997 and the 4th quarter of year 2013.

In chapter 4, there are few independent variables which have no significance with the housing price index after the model has undergone with a new regression result. The variables are short term rate of interest and the inflation rate. However, another two independent variables which are unemployment rate and GDP have significant relationship with the housing price index. To be specific, both of these variables have a significance relationship and it is negatively with the housing price index.

Table 5.1: Summary of Diagnostic Checking

Econometric Problems	Results
Multicollinearity	No serious multicollinearity existed, still remain unbiased, efficient and consistent.
Autocorrelation	It is existed, has been solved by using Newey-West HAC Standard Errors & Covariance test after that.
Heteroscedasticity	It is existed, has been solved by using Newey-West HAC Standard Errors & Covariance test after that.
Normality Test	The error terms are normally distributed.
Model Specification	The model is specification.

Based on the diagnostic checking summary derived from the chapter 4, the estimated model has no serious multicollinearity problem and the model is free from mis-specified. The error terms of the estimated model are also normally distributed.

Nevertheless, the model has suffered the autocorrelation and heteroscedasticity problems. In order to solve and ensure the model is free from any econometric problem, the Newey-West test has been used as the method to solve autocorrelation and heteroscedasticity problems. As a result, although there are few independent variables have no significant relationship with the housing price index, the entire estimated model is considered as BLUE and it fulfilled with the assumption of CNLRM.

5.2 Discussions of Major Findings

Table 5.2: Summary of the Results and Theories

Dependent Variable	Independent Variables	Significance Level	Expected Sign (Theoretical)	Result
Housing Price Index	Gross Domestic Product	5%	Positive and significant	Negative and significant
Housing Price Index	Inflation rate	5%	Positive and significant	Insignificant
Housing Price Index	Interest rate	5%	Negative and significant	Insignificant
Housing Price Index	Unemployment rate	5%	Negative and significant	Negative and significant

Through the table above, the results that shows in Chapter 4 are totally different with what did this research expect in chapter 1 except the unemployment rate. According to table 5.2, the outcomes from chapter 4 stated that Gross domestic product and

unemployment rate are negatively significant to housing price index in United State. On the other hand, interest rate and inflation rate are independent variables that insignificant and not important to housing price index in US. Besides that, the actual results of all independent variables are also not consistent with the expected sign that stated above.

For instance, this research expected that GDP and inflation rate are positively related with housing price index whereas the interest rate and unemployment rate are negatively significant to housing price. Furthermore, several researcher such as Qing (2010) and Xiao (2015) were proved that GDP can positively affect the housing price in China. Besides, Qing (2010) founds that the housing price and GDP are positively correlated in US due to GDP is presented the whole economic growth of the country such as export, import and total market value for all the services and goods so this means that when the GDP increase which shows the economic condition in particular country is healthy and also shows that resident of those country have ability to purchase house or investing in property sector. For inflation rate, Liew and Haron (2013) founds that inflation rate can influence housing price. This means that inflation rate had perceived highly pushed up periodical house price and they are positively correlated. This due to high inflation rate will directly raises the cost of goods and services and proportionally will cause the housing price rise. In others hand, interest rate are negatively correlated with the housing price index was indicated by Mansor et al. (2014). Interest rate are negative relationship with the housing price because interest rate are extra cost that need to pay and bear together with the principal that we borrowed with financial institution. When interest rate rise, the cost of borrowing also will increased and will caused the housing price fall (Zhu, 2014). For unemployment rate, several researchers such as Brooks and Tsolacos (1999) stated that relationship between unemployment rate and housing price are negatively correlated because the rise of unemployment rate shows that uncertainty income in the near future which leads people pay more attention in their financial situation instead of demand for house.

However, the outcomes from table 5.2 shows that only unemployment rate have the same results as expectation result. Besides, this actual results shows that inflation rate and interest rate are no relationship with housing price index, while GDP is negatively related to US housing price. Through the research that done by Ley and Judith (2010), they found that GDP and housing price have inverse relationship because globalization nowadays has bigger impact on influence the price of houses rather than GDP. The decline of home prices in USA also negatively affect the GDP also proved by Mikhed and Zemcik (2007). For the unemployment rate, Grum and Govekar (2016) indicated that housing price is negatively correlated with unemployment rate. This shows that rise in unemployment rate will cause the price of property falls. The reason is because when unemployment rate increase, its shows that more people have no job and they are unable to purchase a residential property, in long term the housing price will decrease. Besides that, Brooks and Tsolacos (1999) also founds that unemployment rate is significant adverse relationship with housing price because the rise of unemployment rate means there is a uncertainly income in the near future which leads people pay more attention in their financial situation instead of demand for house.

About the variable of inflation rate and interest rate towards housing price in United State, the results from chapter 4 showed that both variable are no relationship with housing price index. For the inflation rate, Tan (2011) also founds that inflation rate and housing price are no relationship through result from regression analysis that compare the changes of economic factors. On the others hand, McGibany and Nourzad (2004) founds that there is no change in housing price whether the interest rate rise or falls during short term period. In Sweden, Warsane, Wilhemson and Borg (2010) also proved that production of housing stock in a highly demanded region was not affect by interest subsidy.

5.3 Implication of the Study

The implication of this research can be explain as what the study signifies or implies. Besides, this report also will discuss the possibilities of future research accordingly. According to this research, there were less likely of macroeconomic factors that could influence the housing price in United State. This paper is to explore and investigate the correlation or significance of these four independent variable, GDP, inflation rate, interest rate and unemployment rate towards the housing price index of United State. Furthermore, this paper can helps and benefits several groups of community, which are policy makers, construction companies, home buyers, investors, financial industry as well as the future researchers who are doing research on housing price in United State.

In April 2008, United States was suffer from financial turmoil that triggered from the increasing defaults in the sub-prime mortgage market (Jarocinski & Smets, 2008). Besides, Leamer (2007) states that Federal Government is the first gave to a booming housing market and led to a sudden contraction as the yield curve inverted. Similarly, Taylor (2007) proves that the period of exceptionally low short-term interest rate may causes the housing prices booming and this will lead to an upward spiral of higher houses price, decreases delinquency and foreclosure rates, more favorable credit ratings and financing conditions and higher demand in residential property. Through the statement above, floating interest rate can influence and affect the decision of home buyer whether to purchase or make an investment in sector of real property. This means that lower interest rate would decreased the cost of borrowing and this will encourage more investor to owned the property. This will cause the demand for housing rise and it may lead to housing prices booming condition in long term. For instance, Jarocinski and Smets (2008) founds that housing demand shocks can significant affect the residential investment and housing prices. Therefore, policy makers should be very cautious and careful in implementing the suitable policy by pre-emptive easing of policy when a house price bubble burst to avoid losses in economics activity of United States (Mishkin, 2007).

The federal public housing program was launched and created below the United States Housing Act of 1937 as a public works program. Public housing represents a significant investment on the part of the federal government. Nowadays, more than 2.6 million seniors, people with disabilities, and low-wage individuals was involved in this program. Furthermore, this program sustains low-wage workers and supports local industry. The expenditures of public housing also contribute to local economies by giving subsidies to help low-income workers obtain jobs and also providing an indirect subsidy to local employers who are stay in otherwise unaffordable markets. Lastly, this program also constitutes an economic and social asset that cannot sustain by private market (Econsult Corporation, 2007).

For private sector investor, they are drawn to impact investment through tax credits. The U.S. community sector can offers the Low-Income Housing Tax Credit(LIHTC) that create an industry of private sector investment in affordable housing through bringing commercial capital into subsidized investments. Besides that, the U.S. community also promoted the New Markets Tax Credit(NMTC) to commercial real estate investment in low-to moderate- income communities. For instance, these kinds of tax expenditures are thought to give substantial leverage for investment in socially beneficial projects (Wood, 2014).

Another interesting program that can help the low-income Americans to own a property is the Housing Choice Voucher program(HCV) which are merged from The Quality Housing and Work Responsibility Act of 1998 with certificate and voucher programs. Through this program, the legislation allowed housing authorities to set up multiple payment standards in the same metropolitan area to reflect internal different in rent levels and gave the owners of property more latitude in deciding whether to lease apartment to voucher holders. For the extremely low-income households, the legislation states that they must receive at least 75% of all vouchers that was issued every year. Finally, vouchers that provided by this program was assisted more than 2.2 million household in the end of 2009 (Buckley & Schwartz, 2011).

5.4 Limitations of the Study

Throughout the study, there are few limitations have been found out. Firstly, the number of the observation is limited which is just only 66 observations have been using. These data are derived from the 3rd quarter of 1997 until 4th quarter of 2013. The reason behind of it is all of the independent variables would become insignificant to the housing price index if the number of observation keep on increasing. Apart from these, such situation would arise another problem which is the coefficient of determination will be resulted in a very low percentage value if the number of observation is low as well. The higher the percentage value in the coefficient of determination means there would be more persuasive to conclude the changes of the dependent variables can be interpreted by the variation of its independent variables.

This study is using the quantitative data as the independent variables which are short term rate of interest, inflation rate, gross domestic product and the unemployment rate as well. Among these variables, there are two of them which are short term rate of interest and inflation rate have no significance relationship with the housing price index. This might cause the estimated regression model less reliable for the entire study. According to Candas, Kalkan and Yomralioglu (2015), other variables such as floor, heating system, earthquake zone etc. have the significance relationship also to the housing price.

The estimated model has suffered the problems of autocorrelation and heteroscedasticity. Although they have been solved after that, it caused the independent variables such as short term rate of interest and inflation rate become insignificant to the housing price index. With this, the regression model would become less persuasive and reliable. Besides, the study only used the ordinary least square(OLS) method to analyze and interpret the data obtained. The reason is OLS is one of the easiest methods to be used and understand. However, this is just the only perspective to overview the entire of this study. The result might be distinct if the study has been used by other method or test such as unit root test, error correction model, pearson correlation coefficient and so on.

Last but not least, this research is about the study of the overall housing market in United States. The result generated can be only view generally instead of specifically. Although United States is an advanced and developed country, there are certain geographical areas still considered as rural areas such as Kauai County in Hawaii and Ulster County in New York. According to Kirkpatrick (1923), the rural scholar's conception has been long captured by the differences of geographic in the relative cost of living. In several region, there have no any comparable apartments to be priced (Zimmerman, Ham & Frank, 2008). Even though the study is more than enough to explain the overall market of the housing price, there are still having certain rural areas as mentioned as above which have different cost of living whether in terms of the residents' wealth and the their living standard.

5.5 Recommendation for Future Research Study

Throughout the study, there are few suggestions which can help to improve the study for the future research purpose. The number of observation can be derived in the form of monthly or yearly instead of quarterly. At the same time, the data can be lengthen from even earlier years in order to ensure there are sufficient observation to be used if the data is obtained in yearly based since there are 4 quarters in a years.

However, the number of observation should be under control as it might bring certain side effect. Based on the discussion in chapter 4, the coefficient of determination has a low percentage value since the number of observation of this study is considered less. If the model increased with the number of observation, it might bring another unfavorable result which is the independent variables' probability would become higher and this may lead to even more independent variables tend to become insignificant to the dependent variable as what happen in this study. For example, out of four independent variables of the housing price index, there are variables of short term rate of interest and inflation rate, are not significant to the housing price index.

Regarding to the econometric problem, the study has been encountered with autocorrelation and heteroscedasticity. For future study, the researchers may try to avoid the model from suffering any econometric problem. Newey-West HAC Standard Errors & Covariance test is one of the methods to solve those econometric problems. Nevertheless, the existence of the insignificant variables has arisen after the econometric has been solved as what has been done in previous chapter. Precaution is always better than treatment. The researchers or scholars might try to avoid the sample of data behave differently.

The change of independent variables has been recommended as well especially to replace the short term rate of interest and inflation rate. There are few independent variables such as floor, heating system, earthquake zone etc. which have been mentioned earlier whereby they have significance relationship also to the housing price (Candas, Kalkan & Yomralioglu, 2015). The replacement of the independent variables would differ the result and might become more favorable for the entire studies.

The scope of study could be narrowed and be more specified instead of studying for the entire United States housing price market. This is due to the data obtained is an overview of the entire United States market and it cannot be represented to study the housing price in certain geographical regions especially those rural areas. Such action would bring an even high accuracy to study the housing price index performance.

5.6 Conclusion

In a nutshell, this chapter is an overall conclusion to summarize the result that we obtained from the previous chapter. Refer to the chapter 4, the model that we used is free from the econometric problems after we undergone it with the diagnostic checking. As the result shown in previous chapter, the model has suffered the autocorrelation and heteroscedasticity problems. The unemployment rate and the gross domestic product are significant and have the negative relationship with the

housing price index in United States. Meanwhile, the short term rate of interest and inflation rate, both of them have no significant to the United States' housing price index.

Throughout this chapter, it mainly focuses and covers on the major findings of the study, implications, limitations found and the recommendation. Those issues have been pointed out to discuss as to ensure the researchers or the scholars could avoid those problems in their relevant research studies in future.

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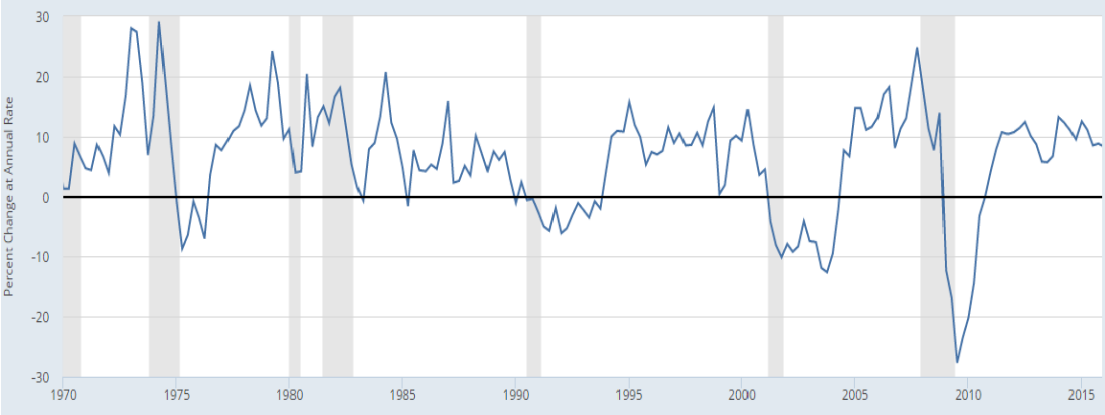
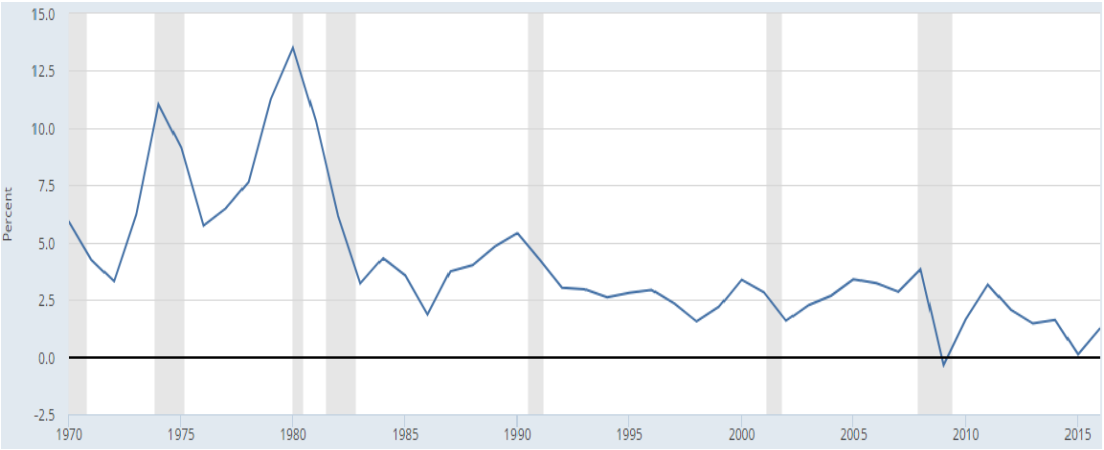
APPENDICES

Chapter 1: Research Overview

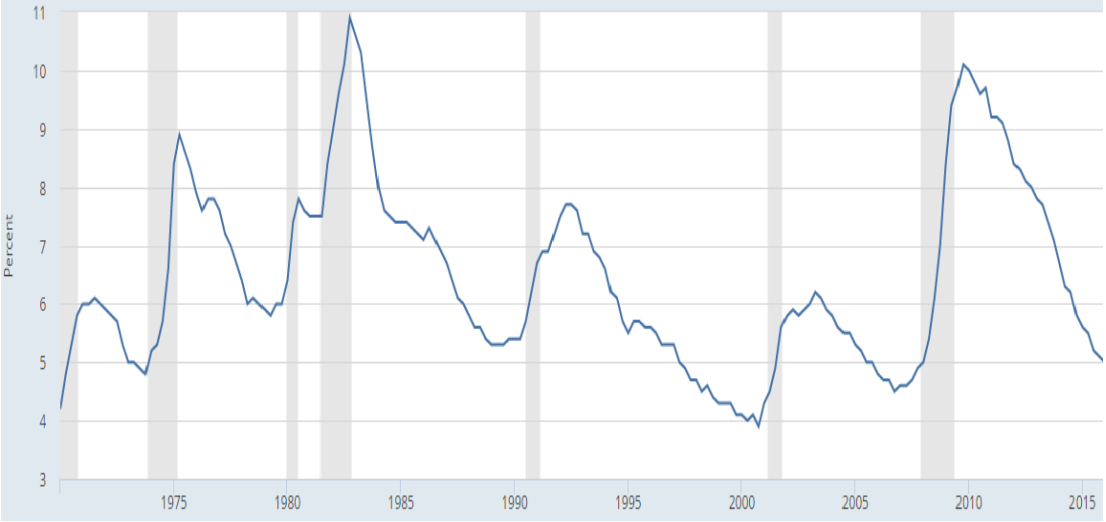
Appendix 1: United States' Lending Interest Rate between Year 1970 and Year 2015.



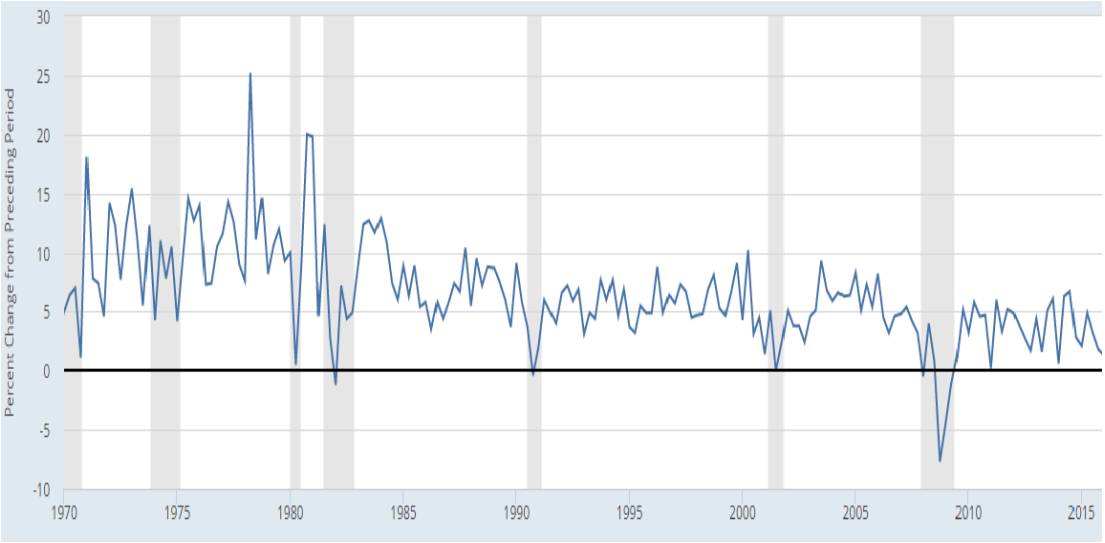
Appendix 2: United States' Inflation Rate between Year 1970 and Year 2015.



Appendix 3: United States' Unemployment Rate between Year 1970 and Year 2015.



Appendix 4: United States' GDP between Year 1970 and Year 2015.



Chapter 4: Data Analysis

Appendix 1: Ordinary Least Square Model

Dependent Variable: HPI
Method: Least Squares
Date: 06/17/17 Time: 19:40
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.850887	0.144748	33.51257	0.0000
GDP	-0.040188	0.022916	-1.753689	0.0845
INF	0.028149	0.013980	2.013481	0.0485
INTRATE	-0.027657	0.012973	-2.131881	0.0371
UNEMP	-0.030316	0.016325	-1.857040	0.0681

R-squared	0.173460	Mean dependent var	4.631862
Adjusted R-squared	0.119261	S.D. dependent var	0.127452
S.E. of regression	0.119611	Akaike info criterion	-1.336412
Sum squared resid	0.872712	Schwarz criterion	-1.170529
Log likelihood	49.10159	Hannan-Quinn criter.	-1.270863
F-statistic	3.200408	Durbin-Watson stat	0.138564
Prob(F-statistic)	0.018847		

Appendix 2: Descriptive Analysis

	GDP	HPI	INF	INTRATE	UNEMP
	GDP	HPI	INF	INTRATE	UNEMP
Mean	0.553945	4.631862	2.352293	2.832121	6.090908
Median	0.646370	4.617717	2.201500	2.503335	5.466665
Maximum	1.888490	4.851801	5.302810	6.626670	9.933330
Minimum	-2.112600	4.400127	-1.623360	0.123330	3.900000
Std. Dev.	0.664871	0.127452	1.182364	2.253425	1.868996
Skewness	-1.218963	0.214493	-0.588138	0.208734	0.764212
Kurtosis	6.419894	2.111574	4.709014	1.460812	2.179030
Jarque-Bera	48.50769	2.676658	11.83698	6.994290	8.277696
Probability	0.000000	0.262284	0.002689	0.030284	0.015941
Sum	36.56036	305.7029	155.2513	186.9200	402.0000
Sum Sq. Dev.	28.73351	1.055862	90.86898	330.0651	227.0545
Observations	66	66	66	66	66

Appendix 3: Correlation Analysis

Correlation				
	GDP	INF	INTRATE	UNEMP
GDP	1.000000	0.034171	0.175761	-0.216546
INF	0.034171	1.000000	0.368439	-0.436318
INTRATE	0.175761	0.368439	1.000000	-0.861535
UNEMP	-0.216546	-0.436318	-0.861535	1.000000

Appendix 4(Auxiliary Test for Multicollinearity)

Appendix 4.1: GDP and Inflation

Dependent Variable: GDP
Method: Least Squares
Date: 06/18/17 Time: 15:21
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.508745	0.184665	2.754961	0.0076
INF	0.019215	0.070249	0.273530	0.7853

R-squared	0.001168	Mean dependent var	0.553945
Adjusted R-squared	-0.014439	S.D. dependent var	0.664871
S.E. of regression	0.669654	Akaike info criterion	2.065724
Sum squared resid	28.69996	Schwarz criterion	2.132077
Log likelihood	-66.16889	Hannan-Quinn criter.	2.091943
F-statistic	0.074818	Durbin-Watson stat	1.116616
Prob(F-statistic)	0.785327		

Appendix 4.2: GDP and Interest Rate

Dependent Variable: GDP
Method: Least Squares
Date: 06/18/17 Time: 15:28
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.407076	0.131017	3.107047	0.0028
INTRATE	0.051858	0.036307	1.428324	0.1581

R-squared	0.030892	Mean dependent var	0.553945
Adjusted R-squared	0.015750	S.D. dependent var	0.664871
S.E. of regression	0.659615	Akaike info criterion	2.035513
Sum squared resid	27.84588	Schwarz criterion	2.101866
Log likelihood	-65.17194	Hannan-Quinn criter.	2.061733
F-statistic	2.040109	Durbin-Watson stat	1.151964
Prob(F-statistic)	0.158061		

Appendix 4.3: GDP and Unemployment Rate

Dependent Variable: GDP
Method: Least Squares
Date: 06/18/17 Time: 15:34
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.023149	0.276407	3.701605	0.0004
UNEMP	-0.077034	0.043412	-1.774474	0.0807

R-squared	0.046892	Mean dependent var	0.553945
Adjusted R-squared	0.032000	S.D. dependent var	0.664871
S.E. of regression	0.654147	Akaike info criterion	2.018865
Sum squared resid	27.38613	Schwarz criterion	2.085218
Log likelihood	-64.62255	Hannan-Quinn criter.	2.045084
F-statistic	3.148758	Durbin-Watson stat	1.178275
Prob(F-statistic)	0.080741		

Appendix 4.4: Inflation and Interest Rate

Dependent Variable: INF
Method: Least Squares
Date: 06/18/17 Time: 15:39
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.804791	0.220027	8.202597	0.0000
INTRATE	0.193319	0.060973	3.170554	0.0023

R-squared	0.135747	Mean dependent var	2.352293
Adjusted R-squared	0.122243	S.D. dependent var	1.182364
S.E. of regression	1.107741	Akaike info criterion	3.072357
Sum squared resid	78.53377	Schwarz criterion	3.138710
Log likelihood	-99.38778	Hannan-Quinn criter.	3.098576
F-statistic	10.05241	Durbin-Watson stat	0.564502
Prob(F-statistic)	0.002336		

Appendix 4.5: Inflation and Unemployment Rate

Dependent Variable: INF
Method: Least Squares
Date: 06/18/17 Time: 15:42
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.033527	0.453037	8.903305	0.0000
UNEMP	-0.276024	0.071153	-3.879279	0.0002

R-squared	0.190374	Mean dependent var	2.352293
Adjusted R-squared	0.177723	S.D. dependent var	1.182364
S.E. of regression	1.072161	Akaike info criterion	3.007065
Sum squared resid	73.56993	Schwarz criterion	3.073418
Log likelihood	-97.23314	Hannan-Quinn criter.	3.033284
F-statistic	15.04880	Durbin-Watson stat	0.590505
Prob(F-statistic)	0.000250		

Appendix 4.6: Interest Rate and Unemployment Rate

Dependent Variable: INTRATE
Method: Least Squares
Date: 06/18/17 Time: 15:45
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.159000	0.487180	18.80003	0.0000
UNEMP	-1.038741	0.076516	-13.57552	0.0000

R-squared	0.742242	Mean dependent var	2.832121
Adjusted R-squared	0.738214	S.D. dependent var	2.253425
S.E. of regression	1.152965	Akaike info criterion	3.152385
Sum squared resid	85.07695	Schwarz criterion	3.218738
Log likelihood	-102.0287	Hannan-Quinn criter.	3.178604
F-statistic	184.2948	Durbin-Watson stat	0.126094
Prob(F-statistic)	0.000000		

Appendix 5: Autocorrelation(Breush-Godfrey Serial Correlation LM Test)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	200.4031	Prob. F(2,59)	0.0000
Obs*R-squared	57.53121	Prob. Chi-Square(2)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 06/17/17 Time: 22:26
Sample: 1997Q3 2013Q4
Included observations: 66
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.126551	0.055469	2.281481	0.0261
GDP	0.014467	0.008388	1.724835	0.0898
INF	-0.017039	0.005679	-3.000469	0.0039
INTRATE	-0.007886	0.004804	-1.641606	0.1060
UNEMP	-0.011870	0.006138	-1.933742	0.0579
RESID(-1)	0.855523	0.124431	6.875470	0.0000
RESID(-2)	0.106667	0.130050	0.820196	0.4154

R-squared	0.871685	Mean dependent var	4.36E-16
Adjusted R-squared	0.858636	S.D. dependent var	0.115872
S.E. of regression	0.043566	Akaike info criterion	-3.329073
Sum squared resid	0.111982	Schwarz criterion	-3.096837
Log likelihood	116.8594	Hannan-Quinn criter.	-3.237306
F-statistic	66.80102	Durbin-Watson stat	1.303616
Prob(F-statistic)	0.000000		

Appendix 6: Heteroscedasticity(Using ARCH Test)

Heteroskedasticity Test: ARCH

F-statistic	114.4980	Prob. F(1,63)	0.0000
Obs*R-squared	41.92932	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/22/17 Time: 11:20
Sample (adjusted): 1997Q4 2013Q4
Included observations: 65 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002243	0.001487	1.508330	0.1365
RESID^2(-1)	0.803938	0.075132	10.70037	0.0000

R-squared	0.645066	Mean dependent var	0.013036
Adjusted R-squared	0.639433	S.D. dependent var	0.014674
S.E. of regression	0.008811	Akaike info criterion	-6.595325
Sum squared resid	0.004891	Schwarz criterion	-6.528421
Log likelihood	216.3481	Hannan-Quinn criter.	-6.568927
F-statistic	114.4980	Durbin-Watson stat	2.062547
Prob(F-statistic)	0.000000		

Appendix 7: Model Misspecification Test (Using Ramsey RESET Test)

Ramsey RESET Test:

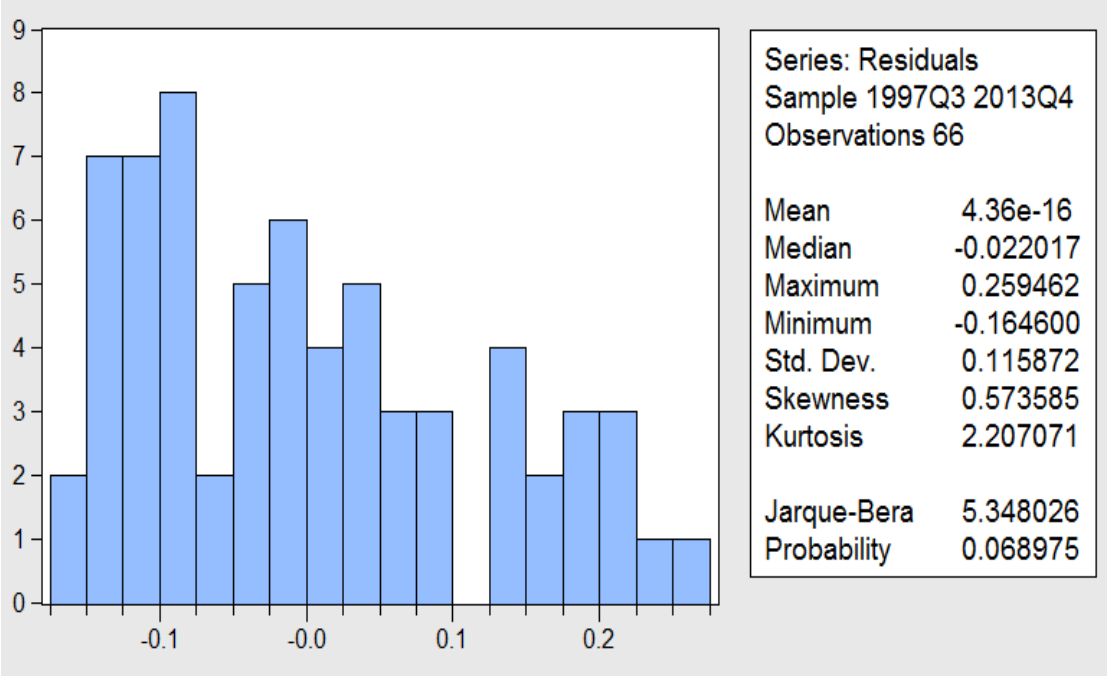
F-statistic	0.026915	Prob. F(1,60)	0.8702
Log likelihood ratio	0.029600	Prob. Chi-Square(1)	0.8634

Test Equation:
Dependent Variable: HPI
Method: Least Squares
Date: 06/17/17 Time: 23:19
Sample: 1997Q3 2013Q4
Included observations: 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.88602	95.92306	-0.113487	0.9100
GDP	0.209799	1.523953	0.137668	0.8910
INF	-0.146301	1.063438	-0.137574	0.8910
INTRATE	0.143589	1.043893	0.137551	0.8911
UNEMP	0.157338	1.143949	0.137540	0.8911
FITTED^2	0.670218	4.085255	0.164058	0.8702

R-squared	0.173831	Mean dependent var	4.631862
Adjusted R-squared	0.104983	S.D. dependent var	0.127452
S.E. of regression	0.120576	Akaike info criterion	-1.306557
Sum squared resid	0.872321	Schwarz criterion	-1.107498
Log likelihood	49.11639	Hannan-Quinn criter.	-1.227899
F-statistic	2.524866	Durbin-Watson stat	0.138600
Prob(F-statistic)	0.038582		

Appendix 8: Normality Test



Appendix 9: The New OLS Model

Dependent Variable: HPI
Method: Least Squares
Date: 06/17/17 Time: 22:28
Sample: 1997Q3 2013Q4
Included observations: 66
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.850887	0.148084	32.75761	0.0000
GDP	-0.040188	0.018936	-2.122283	0.0379
INF	0.028149	0.021389	1.316041	0.1931
INTRATE	-0.027657	0.018649	-1.483027	0.1432
UNEMP	-0.030316	0.018121	-1.672922	0.0995

R-squared	0.173460	Mean dependent var	4.631862
Adjusted R-squared	0.119261	S.D. dependent var	0.127452
S.E. of regression	0.119611	Akaike info criterion	-1.336412
Sum squared resid	0.872712	Schwarz criterion	-1.170529
Log likelihood	49.10159	Hannan-Quinn criter.	-1.270863
F-statistic	3.200408	Durbin-Watson stat	0.138564
Prob(F-statistic)	0.018847		