FACTORS AFFECTING HOUSING PRICES: A CASE STUDY IN CHINA

BY

HO WING KEN

KWAN XIAO HUI

NERISSA SHIM FENG TING

TAN YAN YI

WONG KAR HORN

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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.

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Name of Student:	**Student ID:**	**Signature:**
1. HO WING KEN	16ABB02956	_____
2. KWAN XIAO HUI	15ABB05579	_____
3. NERISSA SHIM FENG TING	15ABB02964	_____
4. TAN YAN YI	15ABB02963	_____
5. WONG KAR HORN	16ABB01342	_____

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag Model
BLUE	Best Linear Unbiased Estimators
CLRM	Classical Linear Regression Model
CNLRM	Classical Normal Linear Regression Model
CPI	Consumer Price Index
ECM	Error Correction Model
ECVAR	Error Correction Vector Autoregressive
GDP	Gross Domestic Product
GFA	Gross Floor Area
HP	Housing Price
IMF	International Monetary Fund
INF	Inflation Rate
IR	Interest Rate
In	logarithm form
JB	Jarque-Bera test
KPSS	Kwiatkowski–Phillips–Schmidt–Shin test
LM	Lagrange multiplier test
LR	Lending Rate
LS	Land Availability
NARDL	Non-linear Autoregressive Distributed Lag Model
NBS	National Bureau of Statistics

NPP	Normal Probability Plot
OLS	Ordinary Least Square
PP	Philips-Perron test
RESET	Regression Specification Error Test
SD	Standard Deviation
TOL	Tolerance Factor
VAR	Vector Autoregression Model
VDC	Variance Decomposition Analysis
VECM	Vector Error Correction Model
VIF	Variance Inflation Factor

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PREFACE

In China, housing market is known as the most important sector affecting the overall economy condition in the country. Hence, this study focus on understanding the factors that might affect the housing price. The factors such as economic growth, interest rate, inflation rate and land availability influence the housing price.

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

First section: Preliminary pages which include page of copyright, declaration, acknowledgement, table of contents, list of tables, list of figures, lists of abbreviation, 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: Discussions, Conclusion and Implications

Third section: The end materials of research consisting of the references and appendixes.

This research study is completed by fulfilling all the criteria above. This study will be useful in providing a wide range of information for future research as well as other communities on the housing price and overall housing market in China.

ABSTRACT

This study aims to examine the relationship between housing price and four independent variables such as economic growth, inflation rate, interest rate and land availability in China from the second quarter of 2005 to fourth quarter of 2017. During the last decade, the housing price in China have been increasing to an unprecedented level. Therefore, this study would like to investigate the factors that might affect the housing price in China. In this research paper, the researchers adopted three methods to examine the relationship between housing price and its determinants, where the methods include Autoregressive Distributed Lag (ARDL) model and Non-Autoregressive Distributed Lag (NARDL) model. This study is completed based on a quarterly time series data with a total of 52 observations starting from 2005 Quarter 2 to 2017 Quarter 4. Based on the results in the study, it is concluded that economic growth (GDP), inflation rate and land availability have the major effects on affecting the housing price in China.

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

Firstly, the research background regarding the housing prices and the history of China's housing market will be discussed. Consequently, problem statement will be illustrated to address the issues of housing prices in China. Then, research questions and objectives will be stated to depict the aims of this study. Last but not least, significance of study will be included to emphasize the importance of the study that may beneficial various parties.

1.1 Research Background

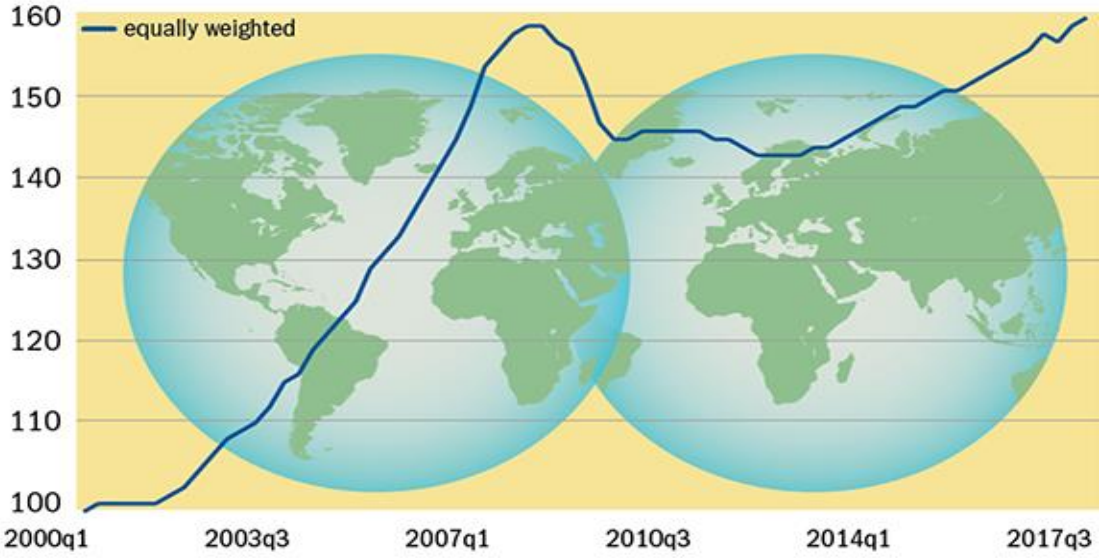
In general, housing is not only known as a basic need for human habitation but also a dwelling that serves as living places for individuals as well as families. Housing is a basic social condition and the standard of living can be affected by it. For instances, the daily lives of people can be influenced by the location of homes, the design of homes and how well they are weaved into the environmental, social and cultural communities realistically. However, in order to afford a house for basic needs, the housing price becomes an important factor to be taken into consideration because the affordability of individuals to buy a house is significantly related to the housing price. Therefore, there is an increasingly concern on the housing price movement because it will affect the ability to borrow and the wealth position of an individual since housing is an important type of loan collateral and household asset.

A rising house price has a negative impact as it will reduce the affordability of those individuals especially the first home buyers who want to buy their own homes. In other

words, they would need to save more money to pay for the initial deposits because the deposits and mortgage payments became higher now as compared to the past. Besides that, the changes in the housing price can urge the individuals to replace it towards non-housing expenditure. The position of some groups of people will be affected by the rising housing price. For example, the current home owners would be home buyers in the future. As a result, these wealth transfers may have macroeconomic effects when each of these categories is expected to have different propensities to spend.

Other than the impacts from a rising house price, the falling house price also has few negative impacts to the economy. For instances, the wealth position of individuals will be declined in response to the decline in the value of its household asset. Consequently, this will lead to lower spending as well as lower economic growth in the country. Besides that, householders will fall into the trap of "negative equity", a situation where the money that they paid is greater than the value of their house. Hence, it will discourage people to borrow but encourage them to save, which in turns causes a lower consumer spending and a lower Gross Domestic Product (GDP) in the country.

Figure 1.1: Global Real House Price Index



Note: x-axis: years; y-axis: housing price index

Sources: International Monetary Fund

Figure 1.1 depicts Global Housing Price Index, which tracks the movements of housing price based on country. The global housing price index was growing rapidly from 2000 first quarter until it reached a peak of 158.8641 points in 2008 first quarter. However, it experienced a sharp decline to 145.2004 points in 2009 second quarter due to the tighter lending conditions, the threat of subprime mortgage market in United States and the occurrence of global financial crisis in 2008. According to Bianco (2008), the subprime mortgage crisis has caused dissension among borrowers, lenders and legislators and also contributing to the most severe recession in decades. After that, the global housing price index fluctuated between 140 points and 146 points from 2009 second quarter to 2013 fourth quarter. From that onwards, the global housing price indices have been steadily growing up and reached a peak of 159.5768 points in 2017 third quarter.

1.1.1 Research Background of Housing Market in China

All the land in China were owned publicly before 1988 (Barth, Lea & Li, 2012). The Chinese Constitution prohibited any selling, purchasing or leasing of land and also forbade any illegitimate transaction of land. The government of China only allowed people to use the land when deemed appropriate while the rights were not transferable to anyone. During that time, home resources were allocated based on a working unit-employee linkage whereby the working period of a person and the household size will determine the size and location of their home.

However, the China's housing policy experienced some significant changes in pace with the economic reform that took place after 1988. This reform has fully discarded the previous system which was the linkage between employment units and housing distribution and undergone three stages for its reforming.

The first stage of the housing reform in 1988 was based on a trial basis whereby many experiments have been conducted across all the states in China while the Chinese government started the privatization and commercialization of housing

to stimulate home ownership (Man, 2011). For the second stage of housing reform from 1993 to 1997, the Chinese government focused on rebuilding the housing construction, encouraging higher income groups to participate in the development of housing market and providing subsidy for middle- and low-income groups so that they are capable to own a house. Consequently, the nature of housing was able to convert from a public owned goods to privately-owned commodities which can be traded in the open market. In the third stage in 1998, a housing provision market-based system was established while the cash subsidies were introduced to newcomers for housing. For lower- and middle-income groups, some subsidized housings were introduced by the government while the needs of higher income groups were depending on the commercial housing market.

Eventually, a sound and stable housing market was established while the successful implementation of housing reforms has led the housing sector to become one of the most significant segments of China's economy.

1.1.2 Trend of Housing Prices Changes in China

Figure 1.2: China House Price Index

Note: x-axis: years; y-axis: housing price index

Sources: Bank for International Settlement

From Figure 1.2, the housing price index of China was initially at 87.77 points in 2005 second quarter. It fluctuated over the period from 2005 to 2009 but showed an overall upward trend even though with the existence of global financial crisis from 2007 to 2008. In the end of 2007 until the beginning of 2008, the housing price index in China dropped by 2.5 points due to the global financial crisis occurred from 2007 and 2008. In order to revive the economy from downturn, the central government of China introduced a fiscal stimulus package involving RMB 4 trillion as well as including the massive credit expansion (Stohldreirt, 2012). For instance, the government reduced the interest rate and increased the stock of loan by more than 50% so that there are more mortgage loans to be provided for individual as well as providing credits to housing development companies (Dreger & Zhang, 2010). Therefore, these factors resulted to an increase in the housing price index of 2008.

From 2009 onwards, the housing price index experienced a sharp increase and reached a peak of 100.87 points in the 2010 second quarter due to the subsided global financial crisis, relaxed financial conditions and the strategies implemented by Chinese government (Yao, 2015). For instances, the researcher highlights that the government reduced the deed tax to 20% and also reduced the mortgage interest rate by 20% in order to improve the affordability of housing in China. However, it dropped significantly to 95.26 points in 2013 first quarter before having an increase to a higher peak of 101.33 points in 2014 second quarter. After that, it showed another drastic drop to 93.95 points in 2015 first quarter and fluctuated minimally and stood at 93.96 points in 2016 first quarter. According to Kruger, Mo and Sawatzky (2016), the previous downturns in 2014 were caused by property tightening measured by government and some market forces such as slow economic growth, the construction of unsold inventories, innovation that have potential investment opportunities and the implementation of tax imposed on property in the future.

From 2015 onwards, the China housing price index increased gradually and reached the peak of 105.88 in 2017 third quarter due to the relaxing of property tightening policy, excessive debts of governments and serious funding problems

of property developers. Therefore, the drastic increase in the housing price in China has led to a huge attention from both the government and citizens. Hence, it is vital for this project to study the factors that affect the housing price in China so that the government or policy makers may take the study into consideration to establish appropriate measures to control the soaring housing price.

1.2 Problem Statement

China has become the fastest growth in terms of economy in the world. Real estate market is the most active market in China (Deng, Ma & Chiang, 2009). According to He and Wen (2017), the Chinese government cancelled the housing benefit distribution system and replaced it with market-oriented housing system. Housing benefit distribution system is a system in which the government helps the individuals with low income to pay rents. The rents can be paid to council or a private landlord. Market-oriented housing system is a system in which the government allows the public to buy and sell property freely and consequently leads to a market-oriented economy. Under this negotiation system, it gives the opportunity to the citizens to own a house and leads to an increase in demand for houses. This situation has led to the boom of housing price at the end of 1999 (Du, Ma & An, 2011). The residents suffered because of the rising in housing price at the moment.

Firstly, this study found that housing price may influenced by interest rate. According to the boom and bust of housing price in China, the quantitative footprint of interest rates on the housing price became notable but not significant to reach a meaningful degree of restraint (Kuttner & Shim, 2016). There are many scholars argue that China's monetary policy may be one of the key driving forces contributes to the rising of housing price. Some of the studies also find that the monetary policies influenced the interest rate and consequently affected the housing price in China. Besides, there are

empirical results display lower interest rate is able to speed up the growth of housing price in China (He & Wen, 2017).

Next, economic growth is able to influence China's housing price. In 2015, there was approximately US$163 trillion in global residential real estate values and consequently enlarged the world's gross domestic product (GDP) and comprised 45% of mainstream global assets. This information shows that a very huge change on global asset value can be represented by relatively small Chinese impact on other countries' real estate (Chang, Anderson & Shi, 2018).

Furthermore, Christou, Gupta, Nyakabawo and Wohar (2018) mention that the price solidity plays an important role in an economy because economic activities, investment decisions and financial sector would be affected by the price level. In addition, the relationship of real estate returns and inflation has become an attentiveness among the investors. This is due to the inflation hedging of real estate is used to make justifications for the inclusion in the investment portfolio. At the end of 1999, China experienced a boom in housing price which is in line with high Consumer Price Index (CPI). This evidence illustrates that an increase in inflation causes the increment of housing price in China.

Apart from that, there are a few studies on the relationship between land availability and housing price in China. According to the Demand and Supply Theory, an increase in demand will increase the price. Plenty of news reporters find that the demand for space in China increases while there is lack of space for housing purpose. Ross (2017) finds that there are approximately one million people in Beijing were living at the underground basement and bomb shelters because of the rising in housing price. Apart from that, Uzuner and Adewale (2019) find that there is asymmetric effect between the land supply of agriculture and housing price. The asymmetric effect may exist between land available for residential and housing price. In other words, a decrease in the availability of land may lead to an increase in housing price. However, the housing price may not fall due to the increase in the availability of land. Hence, as there are less studies on the relationship between housing price and land availability, it serves as a newness in the study together with other independent variables to indicate the housing price in China.

1.3 Research Questions

1.3.1 Main Research Question

The general research question of this study is what are the main determinants that affect housing price in China?

1.3.2 Specific Research Question

i. Is there any long-run relationship between interest rate, economic growth, inflation, land availability and housing price in China?
ii. Is there any two-ways causality between interest rate, economic growth, inflation, land availability and housing price in China?
iii. Is there any asymmetric effect between land availability and housing price in China?

1.4 Research Objectives

1.4.1 Main Research Objective

The main objective of this study is to examine the determinants of housing price in China.

1.4.2 Specific Research Objective

i. To examine the long run relationship interest rate, economic growth, inflation, land availability and housing price in China.

ii. To examine the two-ways causality between interest rate, economic growth, inflation, land availability and housing price in China.
iii. To examine the asymmetric effects between land availability and housing price in China.

1.5 Significance of the Study

In this era of globalization, housing price in China has increased rapidly and brought attention to various parties. Citizens with lower income could not afford to own a house, instead they choose to rent a house due to skyrocketing in China's housing price. Not to deny that this issue is alarming in China and thus, the importance of this study is to identify whether the variables such as GDP, inflation rate, interest rate and land availability have significant effect towards housing price index.

The new contribution of this study is to include land availability on the housing price in China. Based on the study from Murray & Sun (2015), land availability refers to the land available to build residential property. Shelter is one of the basic needs for human being. However, there is lack of literature and past studies on how land availability affects housing price. Various parties may not aware about this information and this encourage us to include land availability as new contribution in this study. By using various types of techniques and analysis, the relationship between land availability and housing price can be examined.

Furthermore, this study provides investors, speculators and potential developers an expectation on the housing price in China. It is essential for them to know the indicators of housing price because investors will only invest when they have sufficient confidence towards the China's residential property market. Moreover, they may take the study as a reference before making any investment planning in order to secure their returns and eliminate exposure risk simultaneously. Not to deny that this study is also beneficial to financial analysts, as it may provide guidelines for them to advise their clients on making informed choices on housing investment.

As housing price in China increases drastically, most of the citizens do not have the ability to own a house. Hence, this study serves as a reference for the citizens to understand the indicators of housing price before they own a house. Not to deny that this study can be used as a guidance for the policymakers and the government. Policymakers may take this study as a consideration in order to implement policies that address housing price issues. The evidence gathered from this study may serve as a reference for the government to take adequate measures and implement suitable approaches to resolve the issues of housing prices. Last but not least, this study can be used as a guidance for future researchers and give contribution to the literature on the indicators of housing prices.

1.6 Conclusion

In brief, the housing prices in China are increasing rapidly throughout the years. Due to the fluctuation of housing price in China, there is a conduct on the further research on the issue of housing price in China. Apart from that, some methods will be carried out to test the relationship between different variables which are interest rate, economic growth, inflation and land availability towards housing price. In addition, most of the researchers did not study on land availability towards housing price. Therefore, the impact of land availability on housing price is included in the significance of study which will provide a new contribution for future researchers.

Furthermore, the details of this study will be shown in the following chapters. The reviews of past studies and the theoretical models will be discussed in Chapter 2. Furthermore, Chapter 3 illustrates the data and methods that will be used to conduct this research. The results obtained and the interpretation regarding the results will be depicted in the next chapter. Moreover, Chapter 5 outlines the main findings, limitation and recommendations for the future researchers.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

Literature reviews refers to the studies that have been done and published by the past researchers. Reviewing past studies is an important step in conducting research because general ideas to explain the relationship between dependent variable and independent variables will be developed prior generating data and obtaining results. Refer to the past studies, the reviews of theoretical models regarding the topic of housing prices will be developed. The past studies of the relationship between independent variables and dependent variable will be discussed in this chapter.

2.1 Review of Relevant Theoretical Models

2.1.1 Demand and Supply Theory

The demand and supply theory is used to support the relationship between interest rate and housing price. It acts as one of the most fundamental principles governing the economy in every country. Generally, the demand refers to quantity of goods and services demanded by the individuals while the supply refers to the quantity of goods and services provided by the sellers in the market. Since the price of goods and services is the reflection of supply and demand, it is vital to understand the relationship between demand and supply. When the demand and supply are the same, the market is equilibrium between price and quantity whereby the resources of the economy are allocated in the most efficient method. This theory is applicable to the impact of interest rate on housing price. According to

Tsatsaronis and Zhu (2004), the reduction in interest rate tends to increase the house price. When the interest rate drops, the decrease of cost of borrowings leads to an increase in the demand for house and thus, the housing price will be increased. For instances, there is an increase of 1.2% in housing prices over the last two years when the real short-term interest rate dropped by 1% (Tsatsaronis & Zhu, 2004). Furthermore, they also state that the demand for housing tends to increase under the circumstances of declining interest rate, due to the lower servicing costs of mortgages that is affordable by some of the households with their household budget and current income. As a result, when the interest rate decreases, the demand on house tends to increase, which in turns lead to an increase in the housing price. Therefore, it shows a negative relationship between the housing price and interest rate.

2.1.2. Housing Cycle Theory

Needleman (1965) mentions that continuous stages of the housing price markets are moved in cyclic in nature. The relationship between the housing prices and the number of vacancies and created a "housing cycle" theory which selected vacancy proportion for the intensity of housing used. Initially, the housing prices are low and the proportion of vacancies are high, signaling that there is excess housing which are left vacant. When the population is growing, the demand for houses increase and lead to the proportion of vacancies reduce. This situation in turn increase the housing price. At this point, the demands for housing increase due to an increase in households. This condition causes the housing price to skyrocket to very high price and causes normal households cannot afford to purchase a house. Hence, the buyers will purchase a house after the housing price drops. After that, this cycle will be repeated when there is excess housing which are vacant.

Needleman (1965) also illustrates that the housing cycle theory begins with a deficit in supply of houses in the events that there is high demand for housing. This condition causes the housing price increases and eventually promote

investment in housing. Hence, an increase in the number of investors will contribute to an increase in the number of houses. More houses will be built at this point. As supply of houses increase, the price of the housing will reduce. Investors will think that their investments are unprofitable at this moment and hence, they stop to invest on housing. This situation eventually caused a shortage in house due to an increase in demand of housing. Therefore, the housing cycle will repeat itself.

2.2 Review of Literature

Major empirical findings from the past literature studies done by the previous researches will be discussed and reviewed. From the previous literature findings, the significance relationships (positive or negative or no relationship) between housing prices and its determinants can be identified. The study focuses on the independent variables such as economic growth, inflation, interest rates and land availability.

2.2.1 Economic Growth and Housing Price

Panagiotidis and Printzis (2016) mention that economic growth is one of the macroeconomic factors that affects the housing price. These researches examine the interdependence between housing price and its macroeconomic determinants by using a two stage Vector Error Correction Model (VECM). In the first stage, VECM approach includes the estimation of cointegration matrix by eliminating all the exogenous variables. For the second stage, exogenous variables can be accounted for and OLS is used for the equation respectively. As a result, economic growth has a positive impact on housing prices. The results are supported by Chang, Simo-Kengne and Gupta (2014) who mention that there is a high positive correlation between economic growth and changes in housing. They also showed the average per capital real output growth had increased from

1 to 2.3% and the house price had raised about 5% from year 1996 to year 2011 in South African. Besides, Zhang, Hua and Zhao (2012) adopt NARMAX model with linear terms, NARMAX model with nonlinear terms and VECM model to examine the macroeconomic variables towards housing prices in China. The results from nonlinear model revealed that GDP is one of the macroeconomic variables that has significant nonlinear impact on housing price dynamics.

Some of the past studies show that the relationship between economic growth and housing price is significantly positive relationship (Égert & Mihaljek, 2007; Cheng & Fung, 2015). Égertand Mihaljek (2007) states that the housing price in Hungary and the Czech Republic grew between the range of 9% and 13% in year 2002 to year 2006 due to the real Gross Domestic Product (GDP) in central European countries such as Hungary, Slovenia, Czech Republic and Slovenia had raised about 50% from year 1995 to year 2005. They also propose some examples which is Bulgaria and Croatia. Between year 1995 and year 2005, the real Gross Domestic Product (GDP) had increased about 40% and lead to a rise of 9%-13% in the housing price in Croatia and 20%-35% in Bulgaria over the period of year 2002 to year 2006. Agnello and Schuknecht (2011) propose that the growth in per-capita real GDP ($GDPPG_t$) is positively associated with housing price. The real GDP growth will lead to the higher life-time income growth. Consequently, citizens are willing to take more debt and spend on housing. Thus, there is a positive relationship between income per capita growth and probability of housing boom which resulting in rising of housing prices. The findings are supported by Agnello and Schuknecht (2011) who used panel error correction model (ECM) and cointegration tests to conduct their research. Also, Cheng and Fung (2015) also support that income per capita GDP is positive related to housing prices because of the higher income leads to increase demand for private housing, in turn rising of housing prices and GDP growth.

Moreover, according to Adams and Fuss (2010), they use the economic activity to measure the economic growth. A panel cointegration analysis, panel unit root tests and error correlation model are used to determine the long run and short run impacts of macroeconomic determinants toward housing prices. Based on their

studies, an increase in economic activities will lead to an increase in housing. If there is 1% increases in economic activity, there will be a growth of 0.34% in housing prices over the long run. This indicates that housing price and economic growth has a positive relationship. Cheng and Fung (2015) also state that when the economic growth increase, people tend to increase their spending and lead to the demand for private houses increase and subsequently the housing price will increase. Leung (2003) also agrees that there is a positive significant relationship between housing price and economic growth.

On the contrary, Chang, Anderson and Shi (2018) mention that the real residential housing prices is significantly negative relationship with the China's real GDP growth. According to their findings, the estimated coefficient for past GDP growth of China is 0.229. This indicates that China's past GDP decreases by 1%, on average, the housing price will increase by 0.23% approximately. Since the economic growth lead to higher income growth, the citizen would prefer to purchase foreign property instead of domestic property due to the higher quality education in foreign country; hence, it will lead to a drop in the housing demand in domestic country.

Additionally, some scholars argue that there is no significant result to show the relationship between aggregate consumption and housing prices changes. This implies that the relationship between economic growth and housing price is insignificant (Li & Yao, 2007; Bajari et al., 2005; Gaspareniene, Remeikiene & Skuka, 2017). Gaspareniene et al. (2017) assess the interdependence between the major macroeconomic factors on housing price level in Lithuania and find that GDP is one of the major macroeconomic factors on housing price level. They carry out Pearson's correlation coefficient and linear regression analysis. The results show that the annual GDP in Lithuania reduced by 17.6% from 2008 to 2009 due to the financial crisis and gradually rising from year 2009 to year 2015. During financial crisis, GDP and housing price level declined at the same time. This shows GDP rate fluctuations affect the housing price level. The linear regression equation shows that an increase of 1 million EUR in GDP rate will

give a rise in housing price level by 0.0032 EUR. In this case, GDP has an insignificant relationship with the housing price level in Lithuania.

2.2.2 Inflation and Housing Prices

Apergis and Rezitis (2003) mention that inflation is one of the key determinants of housing price. They use consumer price index as the proxy for inflation and adopt vector autoregression (VAR) model to examine the long run relationship between housing price and inflation. They find that when consumer price index (CPI) increases by 1, the housing price index will increase by 0.82. This shows that inflation has positive effect on housing price. The results are supported by Kearl (1979) who claims that an increase in inflation will lead to an increase in housing price and cause the demand for housing decreases. Chou and Shih (1995) also illustrate that long term inflation and low interest rate can lead to a rise in housing price in Hong Kong. In year 1989, inflation rate in Hong Kong rose and the interest rate declined. This causes the real interest rate in Hong Kong fell in the mid of 1989. In order to protect their purchasing power of currency, the investors in Hong Kong increase their investment in properties. As the demand for the property increase and thus, the price of the property increases.

Zou and Chau (2015) who measure inflation by using consumer price index (CPI), claim that consumer price index (CPI) is a key factor that drives up the housing price. During inflationary period, the expected rate of inflations will lead to an increase in housing price as the demand of housing assets rises. A higher expected inflation rate reduces the real after-tax cost of the house owner and thus, the demand for houses increases and lead to an increase in housing price. They applied Johansen trace test to error correction model (ECM) and weak exogeneity test to measure the relationship between inflation and housing price in Shanghai, China. However, the results show that the consumer price index (CPI) are significant for nine lag terms. This indicates that inflation has positive significant relationship with housing price in the short-term. In the long-run equilibrium, inflation will

slightly affect the housing price indicates that inflation has positive relationship with housing price.

According to Katrakilidis and Trachanas (2012), inflation is one of the main factors that drives the housing price. These researchers adopt asymmetric Autoregressive Distributed Lag (ARDL) model to examine the effect of inflation on housing price and apply consumer price index (CPI) as the proxy for inflation. When consumer price index (CPI) increases by 1%, the housing price will increase by 1.2%. When consumer price index (CPI) drops by 1%, the housing price will decrease by 3.38% in Greece. This result shows that inflation is positive correlated with housing price. Moreover, Katrakilidis and Trachanas (2012) extend their analysis into dynamic effects. The results show that housing price respond more quickly to an increase in consumer price index compared to a decrease in consumer price index. During inflation period, housing price in Greece responds more quickly in the short-run as compare to the long-run.

Based on Apergis (2003), inflation is an important factor that affect housing price due to 35.5% of variation in real housing price is affected by inflation. Inflation and housing have a positive correlated relationship. Besides, he measures inflation by using consumer price index (CPI). In the first stage, the researcher did the cointegration analysis by applying Johansen test to Vector Autoregressive (VAR) model. Based on the results, the coefficient consumer price index (CPI) is 0.82 and the p-value of the test statistic is 0, this indicates that consumer price index (CPI) is significantly and positively affect the housing price. Then, the analysis is extended by estimating the error correction vector autoregressive (ECVAR) model. Therefore, lag term was added for each of the independent variables. The lag term of consumer price index (CPI) shows a positive coefficient. This shows that inflation has a positive effect on housing price.

However, Follain (1982) claims that the housing price has a negative relationship with inflation. The researcher states that when the rate of expected inflation increases, the nominal interest rate will rise. This indicates that the mortgage loan amount obtained by a household will decrease and thus, people tend to not buying

a house and the demand for house decreases. As a result, the housing price will decrease when there is higher inflation (Tsatsaronis & Zhu, 2004).

Some of the researchers mention that there is insignificant relationship between housing price and inflation. Meanwhile, Barkham, Ward and Henry (1996) adopt cointegration test to examine the long run relationship between housing price and inflation by using consumer price index (CPI) as the proxy for inflation. Based on their results, there is an insignificant relationship between housing price and inflation in the short run. However, there is a long-run significant relationship between inflation and housing price.

2.2.3 Interest Rate and Housing Price

According to Zhang, Hua and Zhao (2012), the interest rate is a vital factor to influence housing prices in Norway. They adopt a NARMAX method with linear terms to cope with the complexities in house price dynamics. Real-world non-linear systems such as water management system and chaotic electronic circuit can be modeled by NARMAX model since it is a generalization of ARMAX model. It is useful to apply in linear case in the existence of variables or terms. In addition, the structure of this model can be formatted by selecting the terms with a chosen cutoff value. According to Gaspareniene, Remeikiene and Skuka (2017), interest rate is one of the major macroeconomic determinants of housing price. They highlight that 49.23% of variation in interest rate could be explained by the fluctuation of housing price level in Lithuania. They employ correlation and linear regression analysis where Pearson's correlation coefficient was conducted. Some of the studies use present value model to investigate the relationship between interest rate and housing price and find that real interest rates have a significantly positive relationship with housing prices. They use present value model because they suspect that the house price should equal to the present discounted value of the future rents. Thus, present value model fits to produce a better outcome for variables (Shi, Jou & Tripe, 2014). In contrast, some studies depict that the relationship between interest rate and housing price are insignificant. They test the

specification of their model by applying unit root tests to identify non-stationarity in the series for the case of potential breaks in data. They use maximum likelihood to estimate fractional integration parameters for the residual components after they de-trended the data by using exponential moving averages with a smoothing factor of 0.1. After that, the researchers use the parameters to fractionally differentiate the series in order to ensure their stationarity (McQuinn & O'Reilly, 2008; Tse, Rodgers & Niklewski, 2013).

Furthermore, Kim and Min (2011) propose that there are three factors that explained the phenomenon of increase in housing in Korea since year 1970s. Owing to the restructuring in the construction industry, after Asian financial crisis occurred, the supply of housing in Korea declined from 600,000 in year 1997 to 300,000 in year 1998. This subsequently led to a rise of housing price. Secondly, a decrease in interest rates had increased the annual lease price due to Asian financial crisis, which in turn increased housing price in Korea. The third factor is loans lending were increased by Korean banks to households resulted in increasing of housing price. However, Korean government strictly controlled the interest rate at the moment. Consequently, the impacts of interest rates on housing prices in Korea are relatively small or inelastic.

Moreover, McQuinn and O'Reilly (2008) specify that income level and interest rates influence the financial institution's decision to lend to individuals. Based on the results, it gives impact on housing price. An existing research proves that income level influences housing demand regarding to the housing purchasing power (Wang, Wang, Li, Zhang, Jin, Su & Wu, 2016). Theoretically, there is a boom of housing price if the income of households increases. Consequently, low-income households can't afford to purchase a house (Zhang, 2015). Based on the past findings in Canada, if there is 1% increase in household incomes, the house price will raise by 1.11% (Wang et al., 2016).

Additionally, McQuinn and O'Reilly (2008) depict that there was a sustained rise in Irish house price under a low interest rate environment. The price of new Irish houses had increased by 260% from year 1995 to year 2005. In brief, an increase in income levels and undertake a low and stable interest rate environment cause

the raise in housing price. As the bank's interest rate is low, the costs of loan for consumer drop. Hence, consumers are easier to get their loans to purchase houses and lead to an increase in demand for houses.

Furthermore, New Zealand citizens have choice in choosing the lending interest rate. They can choose to borrow at either fixed rate or floating rate (Crowe, Dell'Ariccia, Igan & Rabanal, 2013). In fact, a drop of interest rates will lead to rise in real housing price in New Zealand by 20%. This indicates there is a significantly negative relationship between interest rate and housing price. Consequently, high interest rates contribute to a decrease in housing price and ceteris paribus. Eventually, housing rental will be more attractive because of the credit crunch has reduced the consumers' confidence. At this moment, citizens who are unable to afford a house will choose to rent a house to stay (Tse, Rodgers & Niklewski, 2013).

Bank loans or mortgages is the main source of funding for purchasing houses. Borrowers from New Zealand choose either fixed rates or floating rates as their lending interest rates (Shi, Jou & Tripe, 2014). The differences between fixed rates and floating rates are floating rates loan borrowers able to switch to fixed rates at any time. Fixed rates loan borrowers are only eligible to fix their interest rates for a period range from six months to five years. Furthermore, the fixed and floating interest rates do not have a large impact on housing price changes since households rarely focus on the interest rate to buy or sell houses. The findings from Shi, Jou and Tripe (2014) show a positive relationship between interest rates of floating and fixed rates with housing price. If the real floating rate increases by one percentage point, real housing price will increase by 1.72%. Furthermore, most of the researchers use lending interest rate to measure interest rate (Gaspareniene, Remeikiene & Skuka, 2017; McQuinn & O'Reilly, 2008; Kim & Min, 2011). The lending interest rate can be defined as extra charges that the borrower needs to repay to lender together with the principal.

Ong (2013) shows that the relationship between interest rate and housing price is not significant. The reason is the purchaser and speculators will not take interest rate as a consideration when buying house if everyone is looking for the same thing.

Consequently, the demand and supply will be not balance. Under this condition, the investor will feel optimistic and confident enough to purchase house by own opinion without looking at the interest rate.

2.2.4 Land Availability and Housing Price

Due to lack of studies to explore the relationship between land availability and housing price, land availability serves as a new contribution in the study. Land availability is defined as a floor space of residential buildings completed and in square meter measurement. According to Rowley and Costello (2010), land availability and housing price are positively related. They highlight that there is an increase in the housing price when the land supply increases, due to the reasons that there may have developments and improvements in the infrastructure around that area.

However, Aura and Davidoff (2008) state that the land availability and housing price are negative correlated. For instance, the housing supply will increase as the floor space for residential buildings increase, which in turns lead to a decrease in the housing price. This is supported by Yu and Hui (2018) who measure the land availability by using the total number of housing property which denote as total Gross Floor Area (GFA). They apply Vector Error Correction Model (VECM) to examine the long-run and short-run relationship between housing price and land availability in Hong Kong. They find that the negative relationship between land availability and housing price only appear in the short-run.

Zahirovich-Herbert and Gibler (2014) highlight that the new residential construction which can be known as land availability has an influence on housing price in United State by using ordinary least square (OLS) method. These scholars claim that the sales price of existing houses are positively correlated with the construction of new houses. They mention that the housing price will increase by 0.27% when there is a new house constructed within one-quarter mile of the subject property. However, they find that land availability is insignificantly

affecting housing price when there is a new house constructed more than one-quarter mile of the subject property.

2.3 Conclusion

In a nutshell, there are theories to support the relationship between the independent variables and dependent variable. For instances, demand and supply theory as well as housing cycle theory. Also, there are empirical evidence to illustrate the relationship between the independent variable and dependent variable according to the past studies. However, there are lack of studies to explain the relationship between land availability and housing price. Hence, it serves as a newness in the study. In order to fulfill the objectives of the study, the research will be carried out.

CHAPTER 3: METHODOLOGY

3.0 Introduction

The design of the research and the sources of data for each variable will be discussed in this chapter. Besides, the definition of housing prices, interest rate, inflation, economic growth and land availability will be illustrated. Apart from that, a research framework as well as the empirical model for this study will be developed. Lastly, the methods and tests that will be conducted in the study are included in this chapter.

3.1 Research Design

This study focuses on quantitative research and the quarterly data of China for housing prices, interest rate, inflation, economic growth and land availability will be used. Next, this study aims to investigate the association among housing price and selected independent variables in China by using time series analysis. Moreover, the causality and the correlation of the variables will be examined.

3.2 Sources of Data

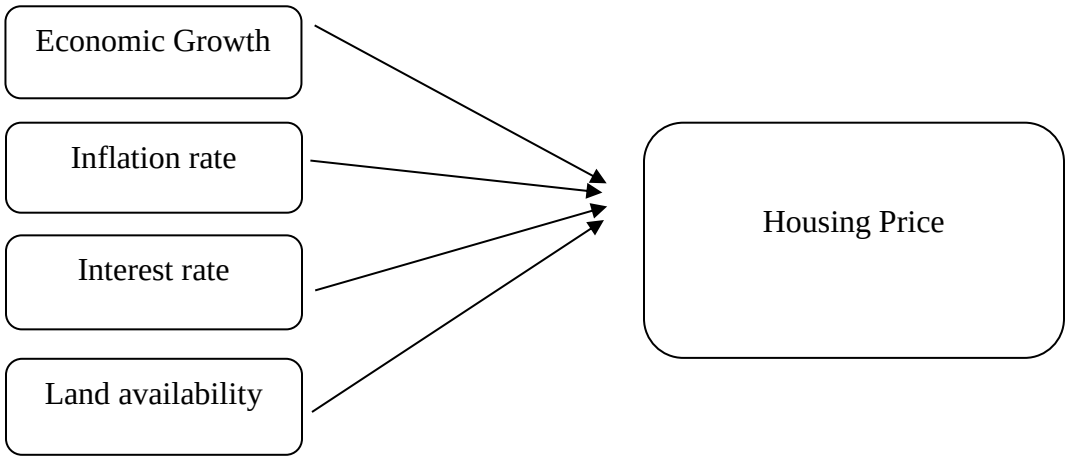
The data sources for housing price, economic growth, and inflation are taken from Federal Reserve Bank of St. Louis. While the data for interest rate is taken from International Monetary Fund (IMF) and the data for land availability is collected from National Bureau of Statistics of China (NBS). The data are collected from quarter 2 of year 2005 until quarter 4 of year 2017.

3.3 Definition of Variables

The dependent variable, housing price, can be defined as the total or the sum in money to purchase a house. Housing price is usually measured by using housing price index in which it is a tool to illustrate an increasing or decreasing of home values in order to estimate the prices. In general, interest rate is a proportion of a loan charged by a lender to the borrower for the use of assets. It is normally charged based on the percentage of a loan outstanding. The assets borrowed could include cash, vehicle or building, consumer goods and more. For inflation, it is defined as the rate at which the general level of prices for goods and services is rising. It also means that there is an increase in the cost of living where the purchasing power of the currency is falling. Meanwhile, the economic growth is an increase in the capacity of an economy to produce goods and services while compared from one period of time to another. In other words, it is the increase in the inflation-adjusted market value of the goods and services produced by an economy over time. It is measured as the percent rate of increase in real gross domestic product (GDP). Lastly, the land availability can be defined as the land needed by a group or people in order to build shelter.

3.4 Research Framework

Figure 3.1: Framework of Determinants of China House Price



The demand and supply theory is applied to explain the relationship between interest rate and housing price where it shows that the interest rate is negatively related to the housing price. Besides that, this theory can also be applied to the relationship between economic growth (GDP) and housing price where it shows that they are positively related.

3.5 Empirical Model

Functional Model:

HP= f (IR, INFL, GDP, LS)

HP = Housing Price

IR = Interest Rate

INFL = Inflation

GDP = Economic Growth

LS = Land Availability

Economic Model:

$HP_t = \beta_0 + \beta_1 IR_t + \beta_2 INFL_t + \beta_3 GDP_t - \beta_4 LS_t + \varepsilon_t$

Where,

HP_t = Housing Price (Housing Price Index)

IR_t = Interest Rate (Lending Rate)

$INFL_t$ = Inflation (Inflation Rate)

GDP_t = Economic Growth (Gross Domestic Product)

LS_t = Land Availability (Floor space of residential buildings completed)

ε_t = Error term

(i) Gross Domestic Product (GDP)

Gross Domestic Product (GDP) is an indicator used to measure the health of a nation's economy. It is the value of final goods and services produced within the

country during a specified time period, typically one year. One of the approaches to measure the GDP is the income approach that can be done by adding up all the earnings in a particular year such as salaries to employee, gross and net profits for business firms and others. On the other hand, expenditure method is another method to calculate GDP by adding all the expenditures such as consumer consumptions, government consumptions, investments and net exports.

A change in GDP has greater impact towards the economy of a country, especially affecting the people lives. For investors, it is risky for them to invest when the GDP is falling so that the stock market will be seriously affected when there is a sharp change in GDP. The stock price tends to drop as the business corporations are expected to make lesser profit in a weak economy condition but it could be a good decision to invest if they believed that the GDP will rise in the future. Therefore, investment strategy of investors should be based on the study and analysis of both positive and negative changes of GDP.

A change in GDP may also affect the housing price since both of them are complementarily related to each other. According to Xu (2017), the growth rate of construction and real estate industry have exceeded the economic growth rate which is measured by GDP. For instances, when the GDP of China increased by 10.1% in 2004, the value of real estate also increased by 17.71% while the value of construction increased by 16.22%, showing that there is a positive impact to the value of house prices as a change in the GDP.

(ii) Inflation rate

Whenever there is a sustainable increase in the level of price for goods and services in a country, there is an inflation. The cost of living will be increased while the purchasing power of a particular currency of a country will be decreased when inflation occur. In other word, one has to spend more to buy a cinema ticket, to buy drinks or to visit a doctor since the currency value today is less valuable as compared to that value in the past. The changes in inflation rate have some effects toward the housing price. In other words, when there is an increase in the inflation rate, the prices of the basic commodities as well as the raw materials increase as

well. For example, these basic commodities include the wood, steel, copper and some other materials that are used primarily to build a house. Hence, the construction companies are more likely to increase the housing prices since it costs the construction companies more to build a house now. The inflation rate in China now is 1.90% in June of 2018 as the food prices increased rapidly since March while the cost of non-food continued to increase gradually. From 1986 until 2018, the average inflation rate in China is 5.24%, having a peak rate of 28.40% in February of 1989 and lowest rate of -2.20% in April of 1999.

(iii) Interest rate

Interest rate represents amount charged by a lender to the borrower for the use of their asset, typically cash, automobile, real estate and it is expressed in the form of percentage. Interest rates serve as a tool to encourage people with surplus of funds lend their money to other parties with shortage of funds. It is usually the bank's job to lend money and charge interest so that they can make profits from charging a higher interest rate to borrowers while paying a lower interest rate to the depositors, hence it will gain from the discrepancies in interest rate.

Regarding the impact of interest rate on housing prices, the changes of interest rates can significantly influence the housing prices. When the interest rate is expected to rise, it will increase the cost of mortgage payment, which may encourage individuals to rent a house instead of purchasing a home since it is relatively expensive. Besides that, the current home-buyer may decide to sell their home since they are not capable to afford the house due to the higher mortgage cost as the results of increasing interest rate. Therefore, when there is an increase in interest rate, it will increase the supply of house since everyone sells their house while the demands of house will reduce since no one can afford to buy a house now. As a result, the house price will drop eventually.

(iv) Land Availability

Land availability is the newness in the study, it refers to the amount of land available to build residential property (Yu & Hui, 2018). According to Murray and

Sun (2015), land availability is a habitable space which provides a land to construct shelter for human being. It is typically measured in terms of square meters.

In fact, the changes in land availability may have impacts towards the housing price. In other words, when there is an increase in the amount of land available for residential purpose, it will lead to a reduction in the housing price, due to the excessive supply as compared to demand. Conversely, it will increase the housing price if the amount of land available for residential purpose is limited.

3.6 Analysis Method

3.6.1 Unit Root Test

According to Phillips and Xiao (1998), unit root test is used to examine the stationary time series data and stochastic trends of the variables. Besides, unit root test is used to ensure the effectiveness and stationarity of the variables in order to avoid imitation regression occurred (Wang, Kang, Wang & Xu, 2017). There are approaches of unit root test such as Augmented Dickey-Fuller (ADF) test, Philips-Perron (PP) test which will be included in the study.

3.6.1.1 Augmented Dickey-Fuller (ADF) Test

The augmented Dickey-Fuller (ADF) unit root test is used to determine the stationarity of a set of time series model which is more complex and larger sample (MacKinnon, 1996). ADF test is used in the test which shows negative value. The greater the negative value, the stronger the rejection of the hypothesis that there is unit root with some level of the confidence. Since it is able to handle more complicated and larger sample of time series model and thus, it is more suitable to apply.

H_0: There is a unit root for the series. (The model is not stationary.)

H_1: There is no unit root for the series. (The model is stationary.)

3.6.1.2 Phillips-Perron (PP) Test

According to Mirza and Kanwal (2017), Phillips-Perron test integrates non-parametric adjustments in the error term in order to make any serial correlation robustness. When Phillips-Perron test generates forms of heteroscedasticity, it is robust in the error term. Besides, it does not state any lag length for the regression purpose.

H_0: There is a unit root for the series. (The model is not stationary.)

H_1: There is no unit root for the series. (The model is stationary.)

3.6.2 Autoregressive Distributed Lag (ARDL) Model

Autoregressive Distributed Lag (ARDL) model is a standard least squares regression model where the dependent variable is a function of its own past lagged values as well as the current and past values of other independent variables. In recent year, the models are widely used as a method to deal with the co-integrating relationship between different variables (Pesaran & Shin, 1998).

The ARDL has an advantage in which its procedure can differentiate the dependent and independent variable when there is a single long run relationship since it holds an assumption that there is only a single reduced form equation relationship exists between the endogenous and exogenous variables (Pesaran, Smith & Shin, 2001). Besides that, Nkoro and Uko (2016) mention that the ARDL approach is able to identify the cointegrating vectors when there are multiple cointegrating vectors exist in the model.

3.6.3 Granger Causality Test

Granger causality is a test to investigate the causality between 2 variables in a time series. This method uses empirical data to find the pattern of correlation as it is a probabilistic account of the causality. Causality is an idea of cause and effect although it is not exactly the same. For example, a variable X is causal to variable Y if X is the cause of Y or Y caused X. By using Granger causality, it does not depict a true cause and effect relationship but the user is able to know if a particular variable occurs before another in the time series.

Granger causality test is useful to exclude the lags term of variables from a multiple equation (Sims, 1980). Besides, Lutkepohl (1982) state that its Granger Causality test is a useful application of VARs. This test helps to avoid spurious correlations and aid in testing the general validity of causation test.

H_0: The lagged x-values do not explain the variation in y.

H_1: The lagged x-values explain the variation in y.

3.6.4 Impulse Response Function

According to Koop, Pesaran and Potter (1996), impulse response function is applicable for both linear and non-linear models by measuring the shock persistence. Impulse response function is also known as multiplier analysis. Besides, the shocks of the system can be impulsed by tracking the responses of a system's variables (Sims, 1980). This method reveals how variables response when there is a shock.

Impulse response function is used to investigate the interaction between variables whether is positive or negative impact in the long run or short run. Thus, the sign of the relationship between variables can be identified. In this situation, a complete interaction between variables which response to an exogenous shock on current and future values of all variables in the system can be determined (Lau, Yii, Lee, Chong & Lee, 2018). According to Hristov, Hülsewig and

Wollmershäuser (2014), the use of impulse response function ensures that there is comparability between models and sub-samples if the structural shocks becomes unit shocks through normalization.

3.6.5 Variance Decomposition Analysis

According to Anderson (2003), the variance decomposition analysis refers to a statistical method that reveals the simplifying structures from a large set of variables. Based on the study of Stock and Watson (2002), they used the principal component or factor analysis, which is one of the most widely used tools of variance decomposition analysis, to forecast the economic from a macroeconomic perspective. The variance decomposition is also used to measure the contribution of each innovation to the variance of the forecast error associated with the forecast of each variable. Since the variance decomposition can explain the variation in the dependent variable, it can reveal the relative importance of the shocks. When the variables are within the same particular groupings, it tends to be collinear, which might lead to the multicollinearity problems within the group. Therefore, variance decomposition analysis is important because it can avoid the consequences of within-group multicollinearity problems (Cherry & Rickman, 2009).

3.6.6 Non-linear Autoregressive Distributed Lag (NARDL) Model

In contrast to the ARDL model which assumes linearity in the model, the Non-linear Autoregressive Distributed Lag (NARDL) model which was developed by Shin, Yu and Greenwood-Nimmo (2014) assumes that there is no linearity so the effects of the variables are expected to be same. This model is widely used to confirm the long-run relationship and also deemed to be the most appropriate way to estimate the symmetric and asymmetric effects (Kwasi Obeng, 2018).

Yeap and Lean (2017) mention that the NARDL approach allows researchers to examine the asymmetry and non-linear relationship between dependent and independent variables simultaneously, in both the long run and short run. They also state that the variables in the NARDL are not required to have a same integration order, which means the long run relationship between variables can be estimated despite the stationarity of the variables. Furthermore, the asymmetric adjustment patterns can be observed by using the dynamic multipliers given that the NARDL does not model the asymmetric error correction directly (Yeap & Lean, 2017).

3.7 Diagnostic Checking

3.7.1 Multicollinearity

According to Jayakumar and Sulthan (2014), multicollinearity exists when the independent variables are highly correlated with each other in multiple models. In this case, it is very difficult to determine which independent variables are having impact on the dependent variable. Hence, this will lead to a failure valid results for the regression model. There are 3 indicators to detect multicollinearity problem as following:

1. High R^2 but with few significant t-ratio.

-If R^2 exceeds 0.8 which is consider high, F test will reject Ho. This indicates that the model exists multicollinearity problem.

2. High pair-wise correlation among independent variables

-This method also based on the R^2. There is multicollinearity problem when R2 exceeds 0.8 during pair-wise correlation between two independent variables.

3. Variance Inflation Factor (VIF) and Tolerance Factor (TOL)

- Variance inflation factor (VIF) formula = $\frac{1}{1-R^2}$, if the VIFs exceeds 10 by using this formula, it indicates the model has multicollinearity problem.

-Tolerance factor (TOL) formula= $\frac{1}{VIF}$, the closer to zero, the higher the degree of collinearity between the variables in the model.

Multicollinearity problem can be eliminated as it works with the 3 indicators above and also able to investigate which independent variables are influencing the dependent variable clearly.

H_0: There is no multicollinearity problem.

H_1: There is multicollinearity problem.

3.7.2 Heteroscedasticity

Heteroscedasticity refers to unequal variability (scatter). In specific, there is a heteroscedasticity problem due to inconsistency variance of error term (Williams, 2015). Under Classical Linear Regression Model (CLRM) assumptions, the ordinary least square (OLS) estimator assumed to be "BLUE" which means there is a constant variance (homoscedasticity) for all residuals drawn from the population. There are few tests for detecting the heteroscedasticity problem such as Breusch-Pagan Test, White's General Test and others. It is more preferable to use White's General Test because it is able to test the pure heteroscedasticity error. According to White (1980), white test is easier to use compared to other tests and it do not rely on the normality assumptions.

H_0: There is no heteroscedasticity problem.

H_1: There is heteroscedasticity problem.

3.7.3 Autocorrelation

Autocorrelation, also known as serial correlation where the error terms are correlated with each other. There are several reasons for the existence of

autocorrelation such as omitted variable, model misspecification and systematic error of measurement. There are several tests using to measure autocorrelation such as The Runs test, Durbin-Watson d Test and Breush-Godfrey Test.

According to Gujarati and Porter (2004), Durbin-Watson d Test is the most popular test to measure of autocorrelation (serial correlation). It is based on the estimated residuals from regression analysis and able to diagnose the first order autocorrelation.

H_0: There is no autocorrelation problem.

H_1: There is autocorrelation problem.

3.7.4 Normality Test

The normality assumption is used to determine whether the sample data is drawn from normally distributed. If the test is significant, it concludes that the error term is not normally distributed. There are several methods can be conducted to test normality such as Jarque-Bera test, histogram of residual and normal probability plot (NPP) which is a graphical device.

Jacque-Bera test is the most common test for testing normality in larger data of sample. It is used of kurtosis and skewness as indicators which ease to get the goodness of fit. In the case of normality, the kurtosis coefficient is 3 and skewness coefficient is 0 (Bai & Ng, 2005). The formula of JB test as following:

$$JB = n\left[\frac{skeweness^2}{6} + \frac{(kurtosis - 3)^2}{24}\right]$$

H_0: Error term is normally distributed.

H_1: Error term is not normally distributed.

3.7.5 Stability Test

According to Ramsey (1969), stability test used to detect the general specification in the linear regression model. There are several mistakes such as including irrelevant variables, omitting an important variable or using wrong functional form will lead to the model specification error or bias. Regression Specification Error Test (RESET) and Lagrange multiplier (LM) test are tests that are able to detect the specification error in the regression model.

Ramsey's RESET test is a purely functional form which designed to test whether there are any neglected nonlinearities in the model, so that the model can be specified correctly after the test.

H_0: Model specification is correct.

H_1: Model specification is incorrect.

3.8 Conclusion

This chapter highlights the methodology used in the study. There are 51 quarters observation in China and the source of data are taken from Federal Reserve Bank of St. Louis, International Monetary Fund (IMF) and National Bureau of Statistics of China (NBS) from 2005 second quarter until 2017 fourth quarter. Throughout this chapter, the definition of each variable are explained in details. A research framework is constructed to illustrate whether the determinants are able to affect housing prices. Besides, the extended model was built by including land availability into the model. In the extended model, it involves dependent variable which is housing price as well as the independent variables including economic growth, inflation, interest rate and land availability. In addition, analysis methods and diagnostic tests are explained in details and the data analysis will be presented in next chapter.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

The relationship between the housing price and its determinants which are inflation, economic growth (GDP), interest rate and land availability will be examined. Several tests will be conducted to investigate the relationship between all variables such as correlation matrix to test the collinearity between different variables, Unit Root test to examine the stationarity of the variables, Autoregressive Distributed-lagged (ARDL) Model to examine long run relationship, Non-linear Autoregressive Distributed-lagged (NARDL) Model to test the possibility of asymmetric effects of positive and negative changes in independent variables on dependent variable, Granger causality test to investigate and determine whether the variables are useful to forecast in another variable. However, the logarithms function was inserted into dependent variable and independent variables except for the inflation rate and interest rate in the process of generating the results.

4.1 Data and Descriptive Statistics

Table 4.1 Descriptive Statistics

	LNHP	**LNGDP**	**INF**	**IR**	**LNLS**
Mean	4.5667	9.3160	2.6333	5.6796	11.1141
Median	4.5608	9.3897	2.1333	5.5800	11.2685
Maximum	4.6623	10.0630	8.0333	7.4700	12.5648
Minimum	4.4747	8.4072	-1.5333	4.3500	9.1244
Std. Dev.	0.0452	0.4617	2.0146	0.8860	0.9045

Skewness	0.1661	-0.3638	0.8051	0.1606	-0.2353
Kurtosis	2.4557	1.9750	3.7448	2.5216	2.2574

Descriptive statistics are commonly used to show the summarization and organization of data in the study. Table 4.1 illustrates the descriptive statistics of LNHP, LNGDP, INF, IR and LNLS in China from the second quarter of 2005 to the fourth quarter of 2017.

Table 4.1 shows the mean for LNHP, LNGDP, INF, IR and LNLS are recorded as 4.5667, 9.3160, 2.6333, 5.6796 and 11.1141 respectively. It shows that the highest average change in the data is LNLS. Furthermore, the standard deviation for INF is the highest among the variables, recorded as 2.0146, followed by LNLS, IR, LNGDP and LNHP with the values of 0.9045, 0.8860, 0.4617 and 0.0452 respectively. The high variation in land availability and inflation may greatly influence the volatility of housing prices. Moreover, among the variables, there is the greatest difference (9.5666) in INF between the maximum value (8.0333) and minimum value (-1.5333). On the other hand, the least difference between the maximum value (4.6623) and minimum value (4.4747) is LNHP, recorded as 0.1876.

Furthermore, the descriptive statistics show that LNGDP and LNLS skewed to the left, while LNHP, INF and IR have the right-side skewness. On the other hand, among the variables, INF recorded as the highest kurtosis value (3.7448), followed by IR (2.5216), LNHP (2.4557), LNLS (2.2574) and LNGDP (1.9750) respectively.

4.2 Results of Analysis

4.2.1 Unit Root Test

Table 4.2: Unit Root Test Results

Augmented Dickey-Fuller				
	Level		1st Difference	
	Intercept	T & I	Intercept	T & I
InHP	-1.3355 (5)	-2.2270 (5)	-5.0471*** (4)	-4.9827*** (4)
InGDP	-3.4614** (5)	-1.9498 (5)	-	-4.1486** (4)
INF	-4.3672*** (1)	-5.1060*** (2)	-	-
IR	-0.9437 (0)	-2.5361(1)	-5.0823*** (0)	-5.1165*** (0)
InLS	-1.9427 (4)	-0.1928 (4)	-149.3365*** (2)	-190.5679*** (2)
Phillips-Perron				
	Level		1st Difference	
	Intercept	T & I	Intercept	T & I
InHP	-1.5399 (3)	-2.2765 (3)	-5.1637*** (4)	-5.1150*** (4)
InGDP	-1.3834 (11)	-4.8924*** (3)	-18.0248*** (12)	-
INF	-2.6682* (3)	-2.7352 (3)	-	-3.5601** (2)
IR	-1.5173 (4)	-2.2713 (3)	-5.1418*** (3)	-5.1233*** (2)
InLS	-6.0781*** (3)	-18.4998*** (11)	-	-

*Notes: ***, **, and * denotes significance at 1%, 5% and 10% respectively; ( ) lag selection; information criteria: ADF is used SIC, PP is used Newey West.*

Table 4.2 presents the results of ADF and PP unit root test for five variables both at level and first difference of the natural log values.

For the ADF test, the housing price, interest rate and land availability appear to be non-stationarity for both intercept and trend & intercept at level. However, the housing price,

interest rate and land availability turn into stationary when they are first differenced at 1% significance level for both intercept and trend & intercept. Interestingly, the GDP is stationary for intercept at level with 5% significance level but it is non-stationarity for trend & intercept at level. However, it turns to be stationary when it is first differenced at 1% significance level for intercept and at 5% significance level for trend & intercept. Besides that, the inflation rate appears to be stationary for both intercept and trend & intercept at level as well as at first difference with different significance level.

For PP test, it produces similar result with ADF test as the housing price and interest rate are still non-stationarity for both intercept and trend & intercept at level but they also turn into stationary when they are first differenced at 1% significance level for both intercept and trend & intercept. Besides that, the GDP is stationary for trend & intercept at level with 1% significance level but it is non-stationarity for intercept at level. However, it turns to be stationary when it is first differenced at 1% significance level for both intercept and trend & intercept. In contrast to the GDP, the inflation rate is non-stationarity for trend & intercept at level but it is stationary for intercept at 10% significance level. Meanwhile, the inflation rate still turns into stationary when it is first differenced at 1% significance level for both intercept and trend & intercept. Lastly, the land availability appears to be stationary for both intercept and trend & intercept at level as well as stationary at first difference with 1% significance level.

As all the variables are found to have the order of *I(1),* ARDL bound test is employed to examine the long-run relationship and co-integration between housing price, GDP, interest rate, inflation rate and land availability in China. Moreover, the Granger Causality test is also applicable with the order of *I(1).*

4.2.2 ARDL Bound Test

Table 4.3 ARDL Bound Test

Model	**F-statistic**	**Conclusion**
lnHP = *f (lnGDP, INF, IR, lnLS)*	7.2467	Cointegrated
Optimal Lag	(4,1,2,2,3)	
Critical Value	***I(0)***	***I(1)***
1% significance level	4.244	5.726
5% significance level	3.068	4.334
10% significance level	2.578	3.710

Notes: *Critical values: case III (Narayan table): unrestricted intercept and no trend (k=4, T=55).*

The relationship of the time series variables in the long run can be examined by employing Autoregressive Distributed Lag (ARDL) bound test. The optimal lag for this ARDL model is (4, 1, 2, 2, 3) which is selected based on Akaike Information Criterion (AIC) tests. A long run relationship is proven if F-statistics is greater than the lower critical value bound. On the other hand, if F-statistics fall between upper critical value bound and lower critical value bound, the conclusion cannot be drawn. The computed F-statistics in ARDL bound test is 7.2467 which is greater than the upper critical value of 5.726 at 1% significance level. Based on the Narayan table, a significance level of 1% shows that lower critical value following *I(0)* is 4.244 and 5.726 at upper critical value following *I(1)*. At 5% significance level, the *I(0)* for lower critical value is 3.068 and *I(1)* of upper critical value is 4.334. It shows 2.578 in the lower critical value following *I(0)* while 3.710 is the upper critical value following *I(1*) at significance level of 10%.

Table 4.4 Long-run coefficient of Housing price index using ARDL approach

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.3763	0.0745	5.0515	0.0000***
INF	-0.0093	0.0036	-2.6136	0.0139**
IR	0.0061	0.0084	0.7223	0.4757
LNLS	-0.2810	0.0656	-4.2839	0.0002***
C	4.1770	0.1725	24.2129	0.0000***
Diagnostic Test				
Breusch-Godfrey LM test		0.1654 (0.8484)		
Heteroscedasticity test		0.0165 (0.8977)		
Normality Jarque-Bera test		1.3573 (0.5073)		
Ramsey RESET		0.4910 (0.4891)		

*Notes: ***, **, and * denotes significance at 1%, 5% and 10% respectively.*

Table 4.4 indicates the relationship between housing prices and four independent variables including economic growth (GDP), inflation, interest rates and land availability in China. GDP is positively significant related with housing price in the long run at the significance level of 1%, 5% and 10%. This could be explained by 1% increase of GDP would increase the housing price index by 0.3763%, ceteris paribus.

Besides, there is significant relationship between housing price and inflation in the long run at 1%, 5% and 10% significance level. Each 1 percentage point rises in inflation, the housing price index will decrease by 0.0093%, ceteris paribus. Hence, the coefficient's value of inflation indicates negative relationship exists with housing price.

Apart from that, the result shows that interest rates have an insignificant impact on housing price in China at 1%, 5% and 10% significant level in the long run. Thus, it indicates that there is non-significant relationship between these two variables. The housing price index is increased by 0.0061% with 1 percentage point increase of interest rates, ceteris paribus which displays a positive related with each variable.

In addition, the result shows there is negatively significant relationship between land availability and housing price at 1%, 5% and 10% significant level. When land availability increased by 1%, the housing price index will decrease by 0.2810%, ceteris paribus.

Apart from that, there are diagnostic tests undergone in the study such as Breusch-Godfrey serial correlation Lagrange multiplier (LM), autoregressive conditional heteroscedasticity (ARCH), Normality test (Jarque-Bera) and Ramsey RESET. The purpose of conducting these tests is to determine the robustness of the model which allowed requirements of Best Linear Unbiased Estimators (BLUE) fits in the model. Based on correlation matrix from appendix, it shows that the model is free from multicollinearity problem since it is below 0.8. There is no serial correlation problem existed in the model by using Breusch-Godfrey LM test to detect it. ARCH test indicates that the model is free from heteroscedasticity problem. In addition, the implication of Jarque-Bera test is to check whether the model meet normality assumption of error terms. As a result, the model in this study met the assumption of normality at significance level of 5%. By detecting whether there is problem of model specification, Ramsey RESET test will be used to check the reliability of the model. The model specification assumption can be made as the p-value of F-statistic (0.4891) is greater than the 5% significance level. Based on the diagnostic tests carried out in this chapter, no econometric problems exist in the model which concluded that the model fulfilled the assumption of Classical Normal Linear Regression Model (CNLRM).

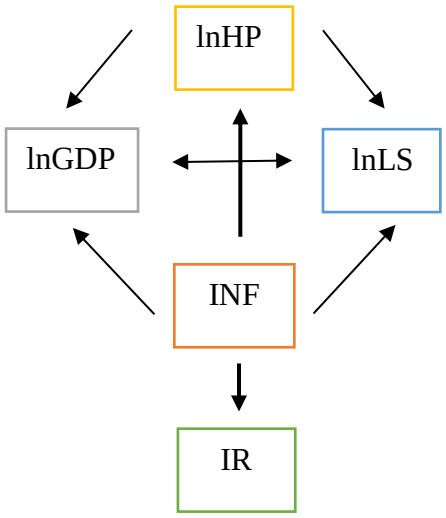
4.2.3 Granger Causality Test

Table 4.5 Granger causality

Dependent Variable	D(lnHP)	D(lnGDP)	D(INF)	D(IR)	D(lnLS)
D(lnHP)	-	1.8934	4.7726*	3.2900	2.2307
D(lnGDP)	21.9230***	-	9.5594***	2.3497	182.5706***
D(INF)	3.2773	0.7935	-	1.6947	0.8521
D(IR)	1.1976	0.9894	4.6315*	-	2.2912
D(lnLS)	28.6621***	25.0301***	23.6866***	3.06554	-

*Notes: ***, **, and * denotes significance at 1%, 5% and 10% respectively.*

Figure 4.1: Granger Causality between these variables



Based on Table 4.5, housing price has a unidirectional relationship with the inflation at 10% significance level. Besides, most of the variables do Granger-cause GDP and land availability except for interest rate. Housing price, inflation and land availability have a unidirectional relationship with GDP at 1% significance level. Furthermore, the result indicates that inflation do granger-cause on interest rate at 10% significance level. Additionally, there is causality relationship between housing price and land availability. Land availability will be affected by housing price in a unidirectional way at 1% significance level. Moreover, there is a unidirectional relationship from

inflation to land availability at 1% significance level. Last but not least, there is bidirectional relationship between GDP and land availability at 1% significance level.

4.2.4 Impulse Response Function

Figure 4.2: Impulse response functions

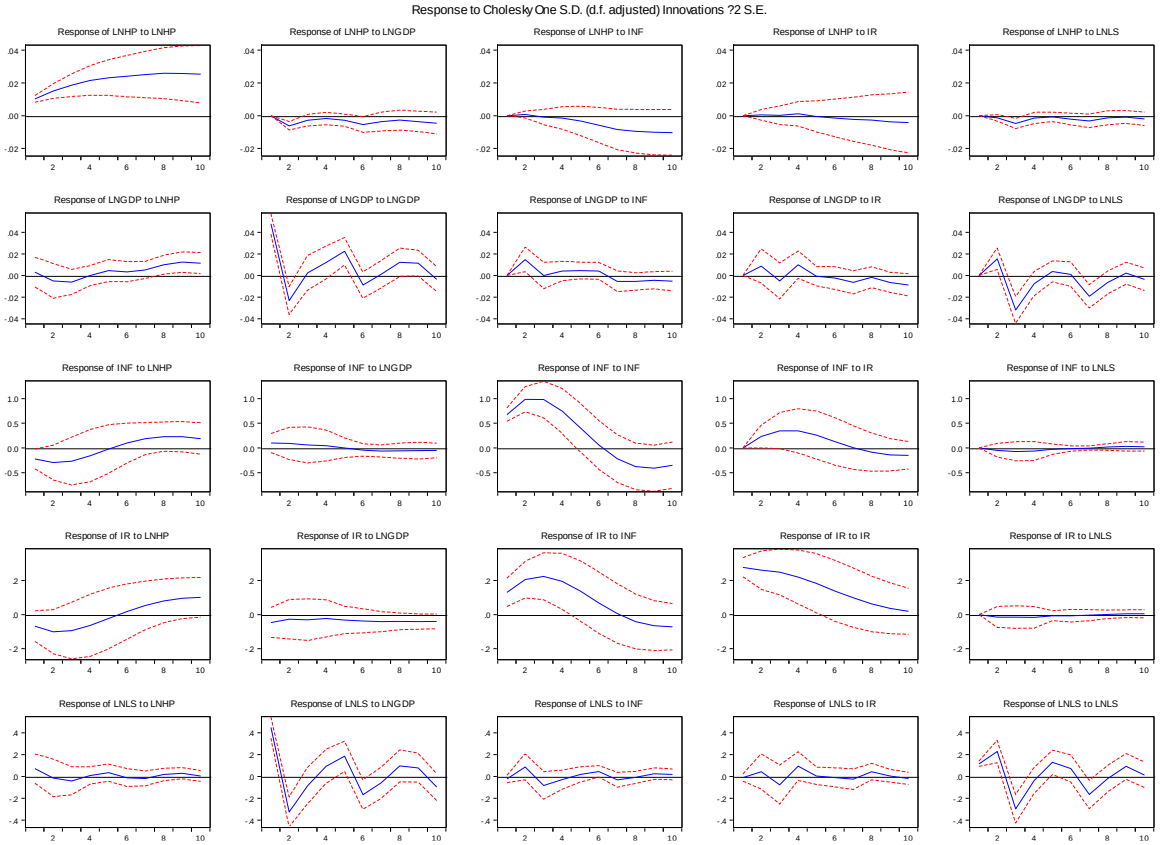


Figure 4.2 stipulates the results of impulse response function that conceptualize the destabilization experienced by the endogenous variables (housing price, economic growth (GDP), interest rate, inflation and land availability) in response to one external standard deviation (SD) shock within one variable. In other words, it shows that the response of a particular variable to a shock of its own or another variable.

Based on Figure 4.2, both the responses of housing prices due to the shock of GDP and land availability illustrates the same trend. The responses are negative and move marginally over the period. Furthermore, there is an upward trend on

the response of housing price due to its own shock. The response begins with positive response and increases gradually to fourth quarter, then rises minimally to the end of period.

Moreover, a shock of inflation towards housing price starts with a positive response. The response moves with marginal effect until the fourth quarter, then it decreases dramatically until the sixth quarter, and moves marginally until the end of period. Furthermore, a shock of inflation towards housing price begins with positive response. It moves marginally and turns to negative response over the period.

4.2.5 Variance Decomposition Analysis

Table 4.6: Variance Decomposition Analysis

Variance Decomposition of LNHP:						
Period	S.E.	LNHP	LNGDP	INF	IR	LNLS
1	0.010210	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.019235	88.90176	10.37647	0.151160	0.065432	0.505173
3	0.027310	90.25042	6.200634	0.180008	0.036502	3.332436
4	0.034847	93.30357	4.069323	0.282612	0.125906	2.218590
5	0.042074	94.33452	3.231030	0.782642	0.100872	1.550933
6	0.049178	92.98529	3.588468	1.947660	0.158304	1.320277
7	0.056095	91.42769	3.178413	3.767350	0.282562	1.343987
8	0.062610	90.38537	2.737854	5.348267	0.409238	1.119275
9	0.068656	89.26618	2.552956	6.594636	0.640420	0.945806
10	0.074170	88.11166	2.561011	7.581579	0.863665	0.882089

Table 4.6 shows the results of variance decomposition analysis (VDC) that separate the variation for each independent variable into the component shocks to the VDC. The VDC of housing price indicates that the inflation rate is the variable that is vitally explaining the innovation to housing price as compared to other three variables. In other words, the shocks to housing price in response to one standard deviation innovation in inflation rate is ranging from 0% to 7.58%. Meanwhile, the GDP, interest rate and land availability are found to contribute slightly minor effects as compared to inflation rate. For instances, in response to one standard deviation innovation in GDP, interest rate and land availability, the shocks to housing price are ranging from only 0% to 2.56%, 0.86% and 0.88% respectively.

4.2.6 NARDL

Table 4.7: Long-run coefficient of NARDL

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	1.3642	0.2744	3.4490	0.0024***
LNLS_P	-0.1341	0.0420	-2.2168	0.0378**
LNLS_N	-0.1258	0.0424	-2.0580	0.0522*
LNGDP	0.3631	0.0703	3.5825	0.0018***
INF	-0.0017	0.0025	-0.4613	0.6493
IR	-0.0010	0.0058	-0.1230	0.9033
		F-statistic		**p-value**
Cointegration Test		7.5930		0.0002***
Wald Test		7.3811		0.0129**

*Notes: ***, **, and * denotes significance at 1%, 5% and 10% respectively.*

Table 4.7 shows land availability has a significant positive effect on housing price. Thus, this study extends the analysis to check whether the changes in land availability will have the same effect to the changes in housing price by using NARDL. Refer to Table 4.8, there is a positive significant relationship between housing price and GDP at the significance level of 1%, 5% and 10%. Refer to the coefficient, it indicates that in the long run, when the GDP in China increase by 1%, on average, housing price index in China will increase by 0.3631%, ceteris paribus. Besides, inflation has an insignificant negative impact on housing price at significance level of 5% and 10%. The coefficient shows that in the long run inflation rate in China increase by 1 percentage point, on average, housing price index in China will decrease by 0.0017%, ceteris paribus. Furthermore, the results show that there is insignificant negative relationship between housing price and interest rate at significance level of 1%, 5%, and 10%. From Table 4.7 shows the long run coefficient of interest rate is -0.0010, this indicates that when the interest rate in China increase by 1 percentage point, on average, housing price index in China will decrease by 0.2509%, ceteris paribus in the long run.

Last but not least, the results show that there is significant negative relationship between housing price and land availability at significance level of 5% and 10%. The coefficient of land availability positive indicates that 1% increase in land availability in China leads to 0.1341% decrease in housing price index in China. While for the land availability negative indicates that 1% decrease in land availability in China leads to 0.1258% increase in housing price index in China.

As shown in the Table 4.7, the result indicates that all the variables are cointegrated at the significance level of 1%, 5%, and 10%. Based on Table 4.7, the p-value of Wald test is 0.0129 which is less than α=0.05. Therefore, there is asymmetry effect of land availability on housing price in China.

In conclusion, this study found that increase in land availability or decrease in land availability will have an effect on housing price and both of the results show a negative effect on housing price. Thus, there is asymmetric effect of land availability to housing price in China.

4.3 Conclusion

In this chapter, some testes and methods have been conducted. For instances, Unit root test, Autoregressive Distributed Lag (ARDL) bound test, Non-linear Autoregressive Distributed-lagged (NARDL) Model, Granger Causality Test, Impulse Response Function and Variance Decomposition Analysis to examine the relationship between housing price and independent variables which consists of economic growth, inflation, interest rate and land availability. From the ARDL bound test's result, economic growth, inflation rate and land availability have significant relationship with housing price. Besides, some of the diagnostic checking have been conducted to detect whether there is any existence of econometric problems. The results show that the model is free from any econometric problems. This indicates that the model fits the requirements of Best Linear Unbiased Estimators (BLUE) which included property of linear, unbiasedness and less variance.

Also, the summarization of all the chapters through this research will be included in following chapter. The discussion of major findings, policy implications, limitations of this study as well as the recommendations for future studies will be discussed in the next chapter.

CHAPTER 5: DISCUSSION, CONCLUSION AND IMPLICATIONS

5.0 Introduction

An overall outline from Chapter 1 to Chapter 4 will be presented in this chapter. As compared the expected results with the computed actual results, economic growth, inflation rate and land availability have statistically significant relationship with housing price. Hence, there are suggestions on policy implications which will be further discussed. Additionally, limitations of this research the recommendations for future studies will be included in this chapter.

5.1 Summary

A change in housing price is able to affect the ability of individuals in purchasing a house. People, especially with medium and low income, cannot afford to buy a house if there is an increase in housing prices. China's housing prices increase rapidly these days and this study is conducted to discover the factors that are able to affect China's housing prices. The data are collected from the second quarter of 2005 until the fourth quarter of 2017.

The first chapter of the study illustrates the real condition of housing prices in China. China's housing prices increase spontaneously until individuals with normal household are not able to own a house these days. Also, foreign buyers demand China's houses because foreign currency is stronger than China's currency (RMB). Hence, foreign buyers will purchase assets with low prices and bid over domestic buyers. This is a cause of concern to study on the factors that are actually affect China's housing price.

Furthermore, the second chapter illustrates the relationship between the housing price and its determinants according to past studies. There are conflicts on the relationship between the dependent variable and independent variables in the past studies. In other words, some researchers agreed that these two variables have a positive relationship while others argued that there is negative relationship. It may due to their research locations were different and leads to differ in results. Hence, it is essential to conduct this research paper in order to figure out the exact results as compared to past studies. Also, there are theories to brace the relationship between the independent variables and dependent variable. For example, demand and supply theory as well as housing cycle theory.

Moreover, the third chapter shows the methods that will be used to investigate the relationship between housing prices and its determinants by relying on China's data. The methodologies include Granger Causality Test, Autoregressive Distributed Lag Model, Non-linear Autoregressive Distributed Lag Model, Unit Root Test that contains Augmented Dickey-Fuller and Phillips-Perron, Impulse Response Function and Variance Decomposition Analysis. The diagnostic tests will be tested to ensure that the model is free from errors.

In brief, the next chapter discusses the empirical results of this research paper by applying all the methodologies. The results imply that economic growth has significant positive relationship with housing price. Inflation have negatively significant relationship with housing price. However, interest rate has positively insignificant impact on housing price. Land availability, which is the new contribution of the study, has significant and negative effect on housing price.

5.2 Discussions of Major Findings

Table 5.1: Summary of Results and Theories

Dependent Variable	Independent Variable	Significance Level	Expected Sign (Theoretical)	Actual Sign (Result)
Housing Price Index	Economic Growth	5%	Positive and Significant	Positive and Significant
Housing Price Index	Inflation rate	5%	Positive and Significant	Negative and Significant
Housing Price Index	Interest Rate	5%	Negative and Significant	Positive and Insignificant
Housing Price Index	Land Availability	5%	Negative and Significant	Negative and Significant

By comparing both expected and actual result, economic growth, inflation rate and land availability are significantly affect the housing price exception of interest rate. According to Table 5.1, economic growth is positively significant to housing price in China while there is a negatively significant relationship exists between land availability and housing price. The impact of inflation rate on housing price contrasts with past researches' expectation. Inflation rate shows a negative and significant relationship with housing price from the results in Chapter 4. According to the results, a positively insignificant relationship between interest rate and housing price was inconsistent with the expectation sign. Among all the independent variables, interest rate is the only insignificant variable to affect housing price.

This study expects that there is positive relationship between economic growth and housing price in China and this is consistent with the result obtained in Chapter 4. This is supported by the previous studies of Chang, Simo-Kengne and Gupta (2014) who states that average GDP per capita increased from 1 to 2.3% and the housing price had a rise of 5% within year 1996 to 2011. Also, the positive impact of GDP on housing price supported by researches such as Égert and Mihaljek (2007); Cheng and Fung

(2015). The growth of GDP will lead to higher income growth and thus, the demand for housing will increase and in turn increase the housing price. This situation shows that GDP and housing price are positively associated (Cheng & Fung, 2015).

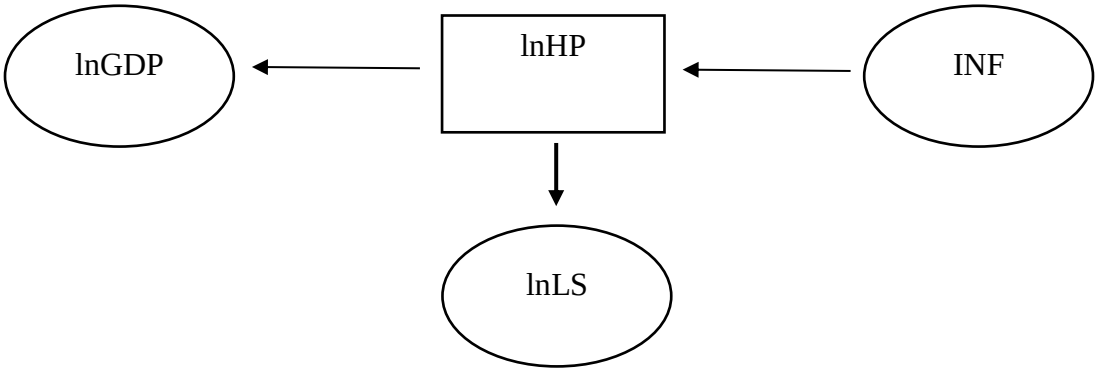
Theoretically, Apergis and Rezitis (2003) find that inflation rate has positive impact on housing price by using Vector Autoregression (VAR) model. The result shows that when consumer price index (CPI) increases by 1, the housing price index will increase by 0.82. This could be explained by Kearl (1979) that highlights that an increase in housing price due to high inflation which resulting in lower housing demand. The expectation is different from actual results because the result indicates that inflation rate is negatively significant associated with housing price. This is supported by Tsatsaronis and Zhu (2004) that state that higher inflation tends to increase nominal interest rate, in turn household will reduce amount of mortgage loan. As a result, the housing demand will decrease and there will be a drop of housing price.

In addition, both expected sign and the result obtained are not in line between interest rate and housing price. The expected relationship of interest rate and housing price is negatively related whereas the actual result obtained in Chapter 4 was contrast with the expectation. A positive relationship between interest rate and housing price is supported by past researchers who highlights that when the economy overheating, the government try to decrease the money supply which having indirect effect on inflation to reduce and interest rate will increase; thus, demand for housing increase and leads to a rise of housing price. Furthermore, due to the purchaser and speculator feel confident enough to purchase house with their own opinion, interest rate was not taking into consideration (Ong, 2013). Thus, it indicates an insignificant relationship between interest rate and housing price.

Moreover, the result obtained is in line with the expected relationship between land availability and housing price in China. The result indicates that land availability is negatively correlated with housing price. This result is consistent with Aura and Davidoff (2008) who claim that negatively associated relationship exists between land availability and housing price. They state that the housing price will drop as the housing supply for residential buildings increase. Due to higher availability of land supply provided resulting to additional residential buildings to be constructed and in turns

decrease the housing price. The studies of Yu and Hui (2018) also in line with the actual result as they examined the long-run relationship between land availability and housing price by using Vector Error Correction Model (VECM).

Figure 5.1: Granger Causality between the variables



Note: ⟶ Unidirectional causality effect

Secondly, Granger causality test is conducted to meet the objective stated in this study as this test is applicable to examine whether there is causality between dependent variable and independent variables. There are several researchers applied Granger causality test in their past studies in order to determine two-ways causality between variables (Yang, Yu & Deng, 2018; Kim & Min, 2011; Shi et al., 2014; Xu, 2017; Oikarinen, 2008).

Based on Figure 5.1, the relationship between GDP and housing price is in a unidirectional way. However, this is inconsistent with the finding from Xu (2017) which revealed that a bidirectional cause link between them as they are positively related.

By applying Granger causality test, a unidirectional causality exists between housing price and inflation rate according to Figure 5.1. Zhang (2012) states that changes in housing price will result to a change of consumer price inflation (CPI) in China. This is in line with the findings from Zhang (2012) who presents that there is a unilateral cause linkage between inflation rate and housing price.

Lastly, a unidirectional granger caused effect between land availability and housing price can be observed in Figure 5.1. This indicates that the impact of land availability depends on housing price. For example, housing price is affected by changes of land supply in Hong Kong through government land sale programme (Li, Wong & Cheung, 2016).

The third objective of the study is the investigation of asymmetric effects between land availability and housing price. According to Katrakilidis and Trachanas (2012), asymmetric effect is essential to be identified which resulting in forecasting the Greek house market more efficiently. This importance of examining asymmetric effect between variables is beneficial for the housing market to be more favorable. Asymmetric effect can be explained where the positive or negative performance will contribute to different effect on the output. From the findings of past researchers, agriculture land supply and housing price show asymmetric effect in the study of Uzuner and Adewale (2019). In this case, asymmetric effect had been applied in two situations: the first situation whereby a growth of land availability or land to build residential will result to a decline in housing price since there is high availability of land space; whereas the second situation possess the changes of housing price is not consistent to increase when respond to fewer land availability. Additionally, Aura and Davidoff (2008) proved that land availability is adversely related to housing price as mentioned in first situation but it contradicts with the findings of Rowley and Costello (2010). Extending the study of Rowley and Costello (2010), the strong demand pushing up prices for suburbs associated with newly development and more attractive infrastructure of developing areas are the reasons for housing price acceleration associated with an increase of land supply. Unsurprisingly, this past study matches with the second situation of asymmetric effect. Indeed, the asymmetric effect acknowledged the relationship between land availability and housing price.

5.3 Policy Implication of the Study

Knowing that the housing price is affected by economic growth (GDP), inflation rate and land availability in this research paper, the government policymakers can build appropriate policies to reduce the housing price in China based on these three factors. Besides, an increase in the land availability, which is the housing supply for residential building, will lead to a reduction in the housing price in China (Aura & Davidoff, 2008). Due to the fact that the lack of supply of land resource will lead to the conflicts between the supply and demand, this caused to the rapid growth of housing price. In order to increase the supply of land resource, the policymaker can allocate more land for residential purpose by deforestation or restoring derelict land (Yao, 2015). For instance, the restoration of derelict land can be done by adding some fertilizers to restore over the cultivated land. Besides, the land that was damaged by mining can be repaired by filling large holes and also by treating contaminated soil in order for the land to be used for housing.

5.4 Limitations of the Study

When doing this research, there are some limitations in this study that needed to optimize in order to become a more ideal research.

The limitation in this research is that the aggregate data is used due to there is a constraint in getting disaggregate data in China as there are many rural and small state in China. Therefore, it may not precise if the investors use this study to predict the housing price in a certain area or state in China.

5.5 Recommendations for Future Research Study

This study recommends that the future study may include political condition, policy implication, historical background and economic condition of other countries into the account. The reason is these factors might bring significant effect on the housing price. Also, the future study may use panel data to carry out research because time series data only focus on specified country but panel data is able to emphasize few dimension. At last, this study also suggest that the future study may test for the disaggregate results if it is able to obtain data for different state in China.

5.6 Conclusion

In a nutshell, this chapter summarizes all the details in every chapter and overall conclusion will be provided. After did diagnostic checking for the model, there is free from econometric problems. Hence, this study can be considered as high reliability. Furthermore, according to the specific objectives in the first chapter of this research, it is important to highlight the discussion of major findings to provide a specific, concrete and achievable goals for the sake of investigation in the determinants of housing price in this study. According to the results carried out from previous chapter, economic growth has positively significant relationship with housing price while inflation rate has a negative significant impact on housing price. Interest rate is the only variable that has a positively insignificant relationship with housing price. Also, the result for the new contribution of this study which is land availability shows that there is a negatively significant effect on housing price.

In addition, the limitations are included in this study to ensure a more ideal research to be presented. Besides, this chapter also includes policy implications as well as recommendations for future studies. The reason to emphasis on recommendations for the researches is to ensure a proper outcome will be presented in the future study. This study recommends that the future study may use panel data and include political

condition, policy implication, historical background as well as economic condition of other countries into the account in order to present a better research study.

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APPENDICES

Appendix 1: Descriptive Data

	LNHP	LNGDP	INF	IR	LNLS
Mean	4.566688	9.315954	2.633333	5.679608	11.11407
Median	4.560800	9.389678	2.133333	5.580000	11.26854
Maximum	4.662306	10.06298	8.033333	7.470000	12.56477
Minimum	4.474720	8.407224	-1.533333	4.350000	9.124401
Std. Dev.	0.045215	0.461710	2.014558	0.886007	0.904497
Skewness	0.166119	-0.363778	0.805132	0.160569	-0.235294
Kurtosis	2.455694	1.974966	3.744832	2.521594	2.257435
Jarque-Bera	0.864134	3.357571	6.688915	0.705503	1.642317
Probability	0.649166	0.186600	0.035279	0.702752	0.439922
Sum	232.9011	475.1136	134.3000	289.6600	566.8178
Sum Sq. Dev.	0.102221	10.65882	202.9222	39.25039	40.90578
Observations	51	51	51	51	51

Appendix 2: Unit Root Results

Level Form: Intercept

Housing Price

Null Hypothesis: LNHP has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.335520	0.6049
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

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

Null Hypothesis: LNHP has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.539864	0.5054
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

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

Economic Growth

Null Hypothesis: LNGDP has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.461369	0.0138
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

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

Null Hypothesis: LNGDP has a unit root
Exogenous: Constant
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.383434	0.5830
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

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

Inflation

Null Hypothesis: INF has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.367220	0.0010
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

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

Null Hypothesis: INF has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.668244	0.0867
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

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

Interest Rate

Null Hypothesis: IR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.943690	0.7659
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

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

Null Hypothesis: IR has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.517294	0.5168
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

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

Land Availability

Null Hypothesis: LNLS has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.942712	0.3105
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

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

Null Hypothesis: LNLS has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.078089	0.0000
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

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

Level Form: Intercept and Trend

Housing Price

Null Hypothesis: LNHP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.227041	0.4636
Test critical values:	1% level	-4.175640	
	5% level	-3.513075	
	10% level	-3.186854	

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

Null Hypothesis: LNHP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.276489	0.4385
Test critical values:	1% level	-4.152511	
	5% level	-3.502373	
	10% level	-3.180699	

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

Economic Growth

Null Hypothesis: LNGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.949775	0.6121
Test critical values:	1% level	-4.175640	
	5% level	-3.513075	
	10% level	-3.186854	

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

Null Hypothesis: LNGDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.892426	0.0012
Test critical values:	1% level	-4.152511	
	5% level	-3.502373	
	10% level	-3.180699	

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

Inflation

Null Hypothesis: INF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.106028	0.0007
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

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

Null Hypothesis: INF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.735190	0.2276
Test critical values:	1% level	-4.152511	
	5% level	-3.502373	
	10% level	-3.180699	

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

Interest Rate

Null Hypothesis: IR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.536092	0.3103
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

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

Null Hypothesis: IR has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.271307	0.4412
Test critical values:	1% level	-4.152511	
	5% level	-3.502373	
	10% level	-3.180699	

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

Land Availability

Null Hypothesis: LNLS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.192836	0.9914
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

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

Null Hypothesis: LNLS has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-18.49978	0.0000
Test critical values:	1% level	-4.152511	
	5% level	-3.502373	
	10% level	-3.180699	

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

1st Difference Form: Intercept

Housing Price

Null Hypothesis: D(LNHP) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.047063	0.0001
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

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

Null Hypothesis: D(LNHP) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.163704	0.0001
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

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

Economic Growth

Null Hypothesis: D(LNGDP) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-18.46855	0.0000
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

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

Null Hypothesis: D(LNGDP) has a unit root
Exogenous: Constant
Bandwidth: 12 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-18.02482	0.0000
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

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

Inflation

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.335819	0.0001
Test critical values:	1% level	-3.596616	
	5% level	-2.933158	
	10% level	-2.604867	

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

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.579128	0.0098
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

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

Interest Rate

Null Hypothesis: D(IR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.082269	0.0001
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

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

Null Hypothesis: D(IR) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.141836	0.0001
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

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

Land Availability

Null Hypothesis: D(LNLS) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-149.3365	0.0001
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

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

Null Hypothesis: D(LNLS) has a unit root
Exogenous: Constant
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-24.18566	0.0001
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

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

1st Difference Form: Intercept and Trend

Housing Price

Null Hypothesis: D(LNHP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.982710	0.0011
Test critical values:	1% level	-4.175640	
	5% level	-3.513075	
	10% level	-3.186854	

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

Null Hypothesis: D(LNHP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.115039	0.0006
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

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

Economic Growth

Null Hypothesis: D(LNGDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.148631	0.0107
Test critical values:	1% level	-4.175640	
	5% level	-3.513075	
	10% level	-3.186854	

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

Null Hypothesis: D(LNGDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-28.20567	0.0000
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

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

Inflation

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 7 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.296132	0.0005
Test critical values:	1% level	-4.192337	
	5% level	-3.520787	
	10% level	-3.191277	

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

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.560109	0.0440
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

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

Interest Rate

Null Hypothesis: D(IR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.116451	0.0006
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

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

Null Hypothesis: D(IR) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.123271	0.0006
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

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

Land Availability

Null Hypothesis: D(LNLS) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-190.5679	0.0000
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

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

Null Hypothesis: D(LNLS) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-23.72631	0.0000
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

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

Appendix 3: Autoregressive Distributed Lag (ARDL) Bound Test Cointegration Result

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	7.246652	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual Sample Size	47	Finite Sample: n=50		
		10%	2.372	3.32
		5%	2.823	3.872
		1%	3.845	5.15
		Finite Sample: n=45		
		10%	2.402	3.345
		5%	2.85	3.905
		1%	3.892	5.173

Appendix 4: Autoregressive Distributed Lag (ARDL) Long-run and Short-run Estimation

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNHP)
Selected Model: ARDL(4, 1, 2, 2, 3)
Case 2: Restricted Constant and No Trend
Date: 02/28/19 Time: 23:48
Sample: 2005Q2 2017Q4
Included observations: 47

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.467863	0.306062	4.795959	0.0000
LNHP(-1)*	-0.351415	0.080252	-4.378915	0.0001
LNGDP(-1)	0.132228	0.038446	3.439327	0.0017
INF(-1)	-0.003280	0.001208	-2.715345	0.0109
IR(-1)	0.002139	0.003149	0.679173	0.5022
LNLS(-1)	-0.098751	0.029409	-3.357893	0.0021
D(LNHP(-1))	0.689938	0.122403	5.636628	0.0000
D(LNHP(-2))	0.116580	0.155416	0.750113	0.4590
D(LNHP(-3))	0.205193	0.158144	1.297511	0.2043
D(LNGDP)	-0.132914	0.105089	-1.264769	0.2157
D(INF)	-0.002897	0.002043	-1.418088	0.1665
D(INF(-1))	0.004775	0.001783	2.677809	0.0119
D(IR)	-0.000786	0.004498	-0.174809	0.8624
D(IR(-1))	0.006378	0.005039	1.265572	0.2154
D(LNLS)	-0.004554	0.011617	-0.391987	0.6978
D(LNLS(-1))	0.037644	0.013632	2.761520	0.0097
D(LNLS(-2))	0.023616	0.007020	3.363966	0.0021

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.376273	0.074488	5.051491	0.0000
INF	-0.009333	0.003571	-2.613585	0.0139
IR	0.006087	0.008427	0.722308	0.4757
LNLS	-0.281009	0.065596	-4.283948	0.0002
C	4.177003	0.172511	24.21293	0.0000

EC = LNHP - (0.3763*LNGDP -0.0093*INF + 0.0061*IR -0.2810*LNLS + 4.1770)

Appendix 5: Correlation Matrix Table

	LNLS	LNGDP	LNHP	INF	IR
LNLS	1.000000	0.670488	0.506331	-0.082713	-0.298257
LNGDP	0.670488	1.000000	0.772354	-0.104644	-0.477630
LNHP	0.506331	0.772354	1.000000	0.025127	-0.344133
INF	-0.082713	-0.104644	0.025127	1.000000	0.709021
IR	-0.298257	-0.477630	-0.344133	0.709021	1.000000

Appendix 6: Breusch-Godfrey LM Test Result

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

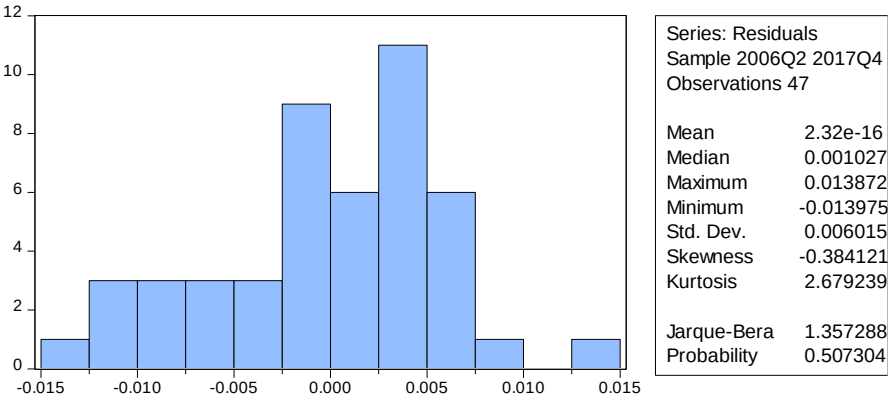
F-statistic	0.165429	Prob. F(2,28)	0.8484
Obs*R-squared	0.548881	Prob. Chi-Square(2)	0.7600

Appendix 7: Heteroscedasticity Test Result

Heteroskedasticity Test: ARCH

F-statistic	0.015807	Prob. F(1,44)	0.9005
Obs*R-squared	0.016519	Prob. Chi-Square(1)	0.8977

Appendix 8: Normality Test Result



Appendix 9: Ramsey RESET Test Result

Ramsey RESET Test
Equation: UNTITLED
Specification: LNHP LNHP(-1) LNHP(-2) LNHP(-3) LNHP(-4) LNGDP LNGDP(-1) INF INF(-1) INF(-2) IR IR(-1) IR(-2) LNLS LNLS(-1) LNLS(-2) LNLS(-3) C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.700728	29	0.4891
F-statistic	0.491019	(1, 29)	0.4891
Likelihood ratio	0.789128	1	0.3744

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	2.77E-05	1	2.77E-05
Restricted SSR	0.001664	30	5.55E-05
Unrestricted SSR	0.001636	29	5.64E-05

Appendix 10: Granger Causality Test Estimation

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 03/01/19 Time: 00:28
Sample: 2005Q2 2017Q4
Included observations: 48

Dependent variable: D(LNHP)

Excluded	Chi-sq	df	Prob.
D(LNGDP)	1.893434	2	0.3880
D(INF)	4.772563	2	0.0920
D(IR)	3.290016	2	0.1930
D(LNLS)	2.230684	2	0.3278
All	18.13622	8	0.0202

Dependent variable: D(LNGDP)

Excluded	Chi-sq	df	Prob.
D(LNHP)	21.92299	2	0.0000
D(INF)	9.559445	2	0.0084
D(IR)	2.349733	2	0.3089
D(LNLS)	182.5706	2	0.0000
All	233.8790	8	0.0000

Dependent variable: D(INF)

Excluded	Chi-sq	df	Prob.
D(LNHP)	3.277297	2	0.1942
D(LNGDP)	0.793489	2	0.6725
D(IR)	1.694686	2	0.4286
D(LNLS)	0.852134	2	0.6531
All	5.459544	8	0.7075

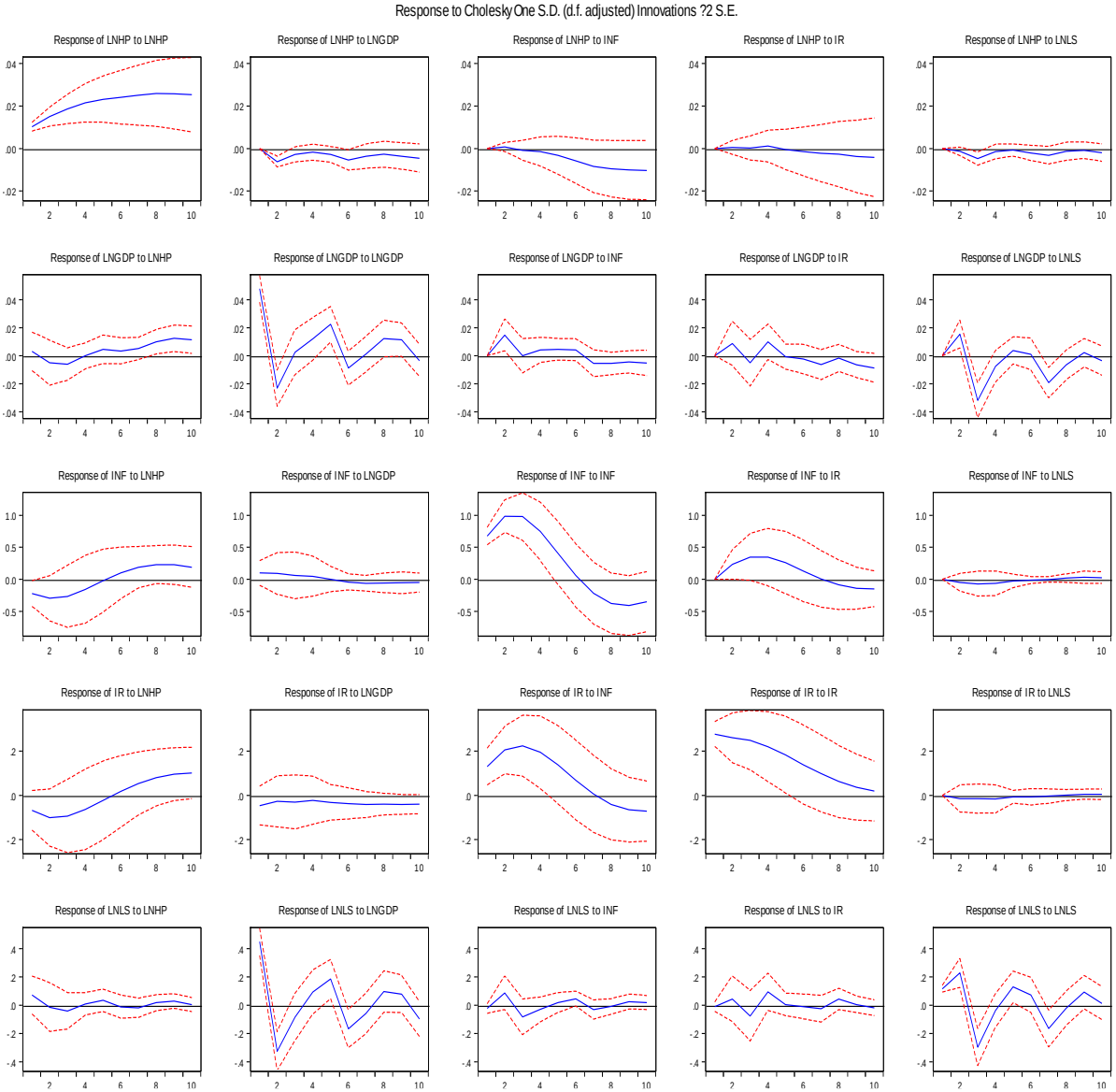
Dependent variable: D(IR)

Excluded	Chi-sq	df	Prob.
D(LNHP)	1.197599	2	0.5495
D(LNGDP)	0.989422	2	0.6097
D(INF)	4.631477	2	0.0987
D(LNLS)	2.291194	2	0.3180
All	9.782146	8	0.2807

Dependent variable: D(LNLS)

Excluded	Chi-sq	df	Prob.
D(LNHP)	28.66214	2	0.0000
D(LNGDP)	25.03010	2	0.0000
D(INF)	23.68662	2	0.0000
D(IR)	3.065539	2	0.2159
All	89.80006	8	0.0000

Appendix 11: Impulse Response Function



Appendix 12: Variance Decomposition Analysis

Variance Decomposition of LNHP:

Period	S.E.	LNHP	LNGDP	INF	IR	LNLS
1	0.010210	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.019235	88.90176	10.37647	0.151160	0.065432	0.505173
3	0.027310	90.25042	6.200634	0.180008	0.036502	3.332436
4	0.034847	93.30357	4.069323	0.282612	0.125906	2.218590
5	0.042074	94.33452	3.231030	0.782642	0.100872	1.550933
6	0.049178	92.98529	3.588468	1.947660	0.158304	1.320277
7	0.056095	91.42769	3.178413	3.767350	0.282562	1.343987
8	0.062610	90.38537	2.737854	5.348267	0.409238	1.119275
9	0.068656	89.26618	2.552956	6.594636	0.640420	0.945806
10	0.074170	88.11166	2.561011	7.581579	0.863665	0.882089

Variance Decomposition of LNGDP:

Period	S.E.	LNHP	LNGDP	INF	IR	LNLS
1	0.047966	0.422360	99.57764	0.000000	0.000000	0.000000
2	0.058259	1.019605	83.17873	6.491786	2.251654	7.058221
3	0.066879	1.577568	63.25742	4.926381	2.277261	27.96137
4	0.069205	1.473471	62.08698	4.958014	4.198425	27.28311
5	0.073144	1.712050	65.01787	4.812681	3.765499	24.69190
6	0.073920	1.887529	65.07924	5.042464	3.791863	24.19890
7	0.077001	2.188914	60.00104	5.137733	4.174005	28.49830
8	0.079080	3.683688	59.27736	5.357579	3.997453	27.68392
9	0.081261	5.823475	58.12574	5.360351	4.399896	26.29054
10	0.082831	7.506664	56.11786	5.554831	5.327349	25.49330

Variance Decomposition of INF:

Period	S.E.	LNHP	LNGDP	INF	IR	LNLS
1	0.717031	9.502978	1.908532	88.58849	0.000000	0.000000
2	1.278054	8.395695	1.105779	87.07752	3.279171	0.141831
3	1.670695	7.441112	0.776109	85.25659	6.258800	0.267388
4	1.870376	6.640936	0.686137	83.95501	8.393713	0.324205
5	1.932346	6.234599	0.642964	83.12424	9.676426	0.321768
6	1.940639	6.446078	0.685803	82.50507	10.03972	0.323331
7	1.962876	7.208042	0.774839	81.88611	9.814892	0.316114
8	2.014443	8.144955	0.816225	81.22839	9.503152	0.307280
9	2.073678	8.878995	0.842946	80.54780	9.416489	0.313766
10	2.117466	9.310281	0.865955	79.97902	9.529554	0.315188

Variance Decomposition of IR:

Period	S.E.	LNHP	LNGDP	INF	IR	LNLS
1	0.317162	4.583289	2.122767	16.84262	76.45133	0.000000
2	0.470832	6.685477	1.302597	26.59435	65.31932	0.098249
3	0.587077	6.903532	1.108862	31.74284	60.11616	0.128598
4	0.660011	6.396627	0.996024	33.79031	58.65520	0.161847
5	0.700074	5.794327	1.093829	33.93647	59.02067	0.154708
6	0.718220	5.567652	1.306380	33.15800	59.81143	0.156542
7	0.728165	5.953731	1.603316	32.26469	60.02388	0.154385
8	0.737423	6.977269	1.856022	31.76616	59.24995	0.150602
9	0.748493	8.396484	2.107908	31.59828	57.74644	0.150883
10	0.760060	9.926306	2.326009	31.53512	56.06322	0.149350

Variance Decomposition of LNLS:

Period	S.E.	LNHP	LNGDP	INF	IR	LNLS
1	0.470164	2.336176	91.22789	0.257428	0.046414	6.132089
2	0.623627	1.379045	79.08103	2.114489	0.529085	16.89635
3	0.706017	1.407748	63.11044	3.020983	1.560867	30.89996
4	0.719936	1.369499	62.35077	3.073534	3.221326	29.98487
5	0.755749	1.445230	62.63547	2.853582	2.927698	30.13802
6	0.778693	1.384130	63.56792	3.039085	2.774266	29.23460
7	0.799450	1.371390	60.82931	3.033305	2.733019	32.03298
8	0.807043	1.393858	61.13479	2.989261	2.981981	31.50011
9	0.816956	1.484043	60.58323	3.011906	2.913751	32.00707
10	0.823158	1.463884	61.04739	3.016907	2.919527	31.55229

Cholesky Ordering: LNHP LNGDP INF IR LNLS

Appendix 13: Non-linear Autoregressive Distributed Lag (NARDL) Estimation

Dependent Variable: D(LNHP)
Method: Stepwise Regression
Date: 03/01/19 Time: 00:52
Sample (adjusted): 2006Q3 2017Q4
Included observations: 46 after adjustments
Number of always included regressors: 7
Number of search regressors: 29
Selection method: Uni-directional
Stopping criterion: p-value = 0.5

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.946557	0.274446	3.448978	0.0024
LNHP(-1)	-0.693841	0.137311	-5.053075	0.0001
LNLS_P(-1)	-0.093012	0.041958	-2.216761	0.0378
LNLS_N(-1)	-0.087310	0.042424	-2.058027	0.0522
LNGDP(-1)	0.251909	0.070317	3.582465	0.0018
INF(-1)	-0.001171	0.002538	-0.461273	0.6493
IR(-1)	-0.000717	0.005832	-0.122983	0.9033

Appendix 14: Non-linear Autoregressive Distributed Lag (NARDL) Cointegration Test

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	7.592985	(6, 21)	0.0002
Chi-square	45.55791	6	0.0000

Appendix 15: Non-linear Autoregressive Distributed Lag (NARDL) Wald Test

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-2.716819	21	0.0129
F-statistic	7.381105	(1, 21)	0.0129
Chi-square	7.381105	1	0.0066