



**A STUDY ON THE REACTION OF HOUSING PRICE AND  
MACROECONOMIC FACTOR: EVIDENCE FROM  
THAILAND.**

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(HONS) INVESTMENT MANAGEMENT  
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SEGAMAT, JOHOR.**

**JANUARY 2017**

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Of the Requirement for the  
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Management**

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**DECLARATION OF ORIGINAL WORK**

**AMIRUL AIMAN BIN ABD. HALIM**

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Hereby, declare that,

- ✓ This work has not previously been accepted in substance for any degree, locally or overseas and is not being concurrently submitted for this degree or any other degrees.
- ✓ This project paper is the result of my independent work and investigation, except where otherwise stated.
- ✓ All verbatim extracts have been distinguished by quotation marks and sources of my information have been specifically acknowledged.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

# LETTER OF SUBMISSION

7<sup>th</sup> January 2016

Madam Yuslizawati  
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Dear Madam,

## SUBMISSION OF PROJECT PAPER

Attached is the project paper titled “**A STUDY ON THE REACTION OF HOUSING PRICE AND MACROECONOMIC FACTOR: EVIDENCE FROM THAILAND**” to fulfill the requirement as needed by the Faculty of Business Management, Universiti Teknologi MARA.

Thank you.

Yours sincerely,

.....

AMIRUL AIMAN BIN ABD, HALIM

(2014955069)

Bachelor of Business Administration (Hons) Investment Management

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All praises and thanks to Allah (S.W.T), who has guided us to this, never could we have found guidance, were it not that Allah had guided us! (Q7:43)

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## LIST OF ABBREVIATIONS

HPI	Housing Price Index
GDP	Gross Domestic Product
P	Population
R	Interest Rate
I	Inflation Rate

## **ABSTRACT**

Over the few years, the price of the house in the Thailand has facing significant value expansion and it lead to worrying trend among the investors. Moreover, this study is conduct in order to determine the determinants of Housing Price Index (HPI) in Thailand. This study also will explain on the background of the study, the problems statement, research questions and objective, the significance of the study, and also limitations. Plus, the dependent and independent will be explained and also this study is to determine the relationship between the variables that been selected

Moreover, the research in this study will be discussed about dependent and independent variables. The dependent variables in this study are Housing Price Index (HPI) in Thailand. Meanwhile, the independent that been chosen which is macroeconomic factors which are Gross Domestic Product (GDP), Inflation Rate, Population, and Interest Rate. The selected independent variables is said to have a significant impact towards the dependent variables which is Housing Price Index (HPI) in Thailand. Furthermore, the relationship of the selected variables is to study the macroeconomics factors influence.

In this study will involving two types of the research questions. Firstly is main research questions while secondly is specific research questions. The main research questions are related to the dependent variables. For the specific research questions is to pointed to backing the possibilities of the outcome of the main research questions.

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.0 INTRODUCTION**

In this study, this research is conducted in Thailand in order to gain as much as information available and to have a better understanding on towards the macroeconomic factors that impact the housing price in Thailand. This research will give explanation about the selected dependent and independent variables. The dependent variables in this study will be Housing Price Index in Thailand while the independent variables will be the selected macroeconomics factor which is Gross Domestic Product (GDP), Inflation Rate (I), Population (P), and Interest Rate (R). This is because these selected macroeconomic factors have the relationship and gave influence towards the Housing Price Index in Thailand.

This research will include formulation of research questions that related to the theoretical framework of the research. There are two types of research questions. Firstly is the main research question and secondly are specific research questions. For the main research questions, it is related to the dependent variables which are the center of the research study. For the specific research questions is pointed to support the strength the result of the main research questions.



In addition, the objective of this study is separated into two which is main research objective and secondly is the specific research objective. Furthermore, in this chapter will explain the significance of the study and it will be highlighted so this could deliver a better understanding to the investors, speculators, buyers, policy makers towards the Housing Price Index in Thailand.

## **1.1 BACKGROUND OF THE STUDY**

‘Home sweet home.’ Everyone in this world once have a place that their call it as home. The place contains some of good recollections, the place where people groups relaxing their brain and body, as an asylum from rain around evening time, and as an image of wellbeing and extravagance. Like the familiar axiom, "Home is the place the heart is" demonstrates that individuals have a unique place that they a called it a home despite the fact that it is not huge or consummate. As like the old say, house get purchased and sold, yet home stays with you generally.

According to Cambridge Dictionary, house can be recognizing as a place that building the people, especially one family, live in there. Most of kids think that house is the place for them to grow up. But when they grow older, house is more to the place wherever they gathering with their family and friends. Home also is the place where you feel safe. In addition, to most individuals, housing represents as a largest investment of the lifetime.

## **1.2 PROBLEM STATEMENT**

Why do we require home? There are numerous reasons why home is critical to us. The most critical is home as safe house. Home is insurance since it kept us spares from

anything unsafe. Home additionally can give us an agreeable rest during the evening and live in the spots that we value the most.

Over the few years, housing price in Thailand has experienced significant price expansion and this became a worrying matter for buyers. Plus, the macroeconomic factors have showed that they are playing big role towards the changes in housing prices. Increases in house prices can lead to higher house price volatility, a significant determinant of default and the prepayment of housing loans (Miles, 2008). It is believed that in the future, started with Gen-Y in Thailand, future generation may not be able to buy their own houses due to the ridiculous house price that keep rising while their own salaries still remain the same.

Moreover, the banking industry in Thailand, increase their restrictions in lending guidelines in order to reduce their household debt. Due to this strict guideline, it increases difficulties for their citizens to buy properties such as houses. As their plan to reduce the household debt, property loan in Thailand is being capped and the personal loan is being limited to 10 years only. Thus, the young generations will face problems in order to buy their own dream houses.

The adjustments in the macroeconomic elements will likewise speedy the adjustments in housing cost in Thailand. Along these lines, in this study, we will concentrates on variables that affecting the housing cost in Thailand. Moreover the macroeconomics variables will be test and broke down to give better comprehension on the effect. With the outcomes, we expect it will give benefits for the financial specialists, theorists, purchasers furthermore approach investors in their decision making skills. Along these

lines this study is to explore the change in macroeconomic variables that have an effect towards the Housing Price Index in Thailand.

### **1.3 RESEARCH QUESTIONS**

The style in this research will involve some questions in order to determine the relationship of the macroeconomic variables as mentioned in problem statement.

There will be two main research questions in this study. Firstly are main research questions and secondly are specific research questions. Those research questions are prepared from the variables of the research on theoretical framework.

#### **1.3.1 Main Research**

What is the relationship between the macroeconomic factors toward Housing Price Index in Thailand?

#### **1.3.2 Specific Research Questions**

i) What is the relationship between the Inflation Rate (I) towards Housing Price Index in Thailand?

ii) What is the relationship between the Interest Rate (IR) towards Housing Price Index in Thailand?

iii) What is the relationship between the Gross Domestic Product (GDP) towards Housing Price Index in Thailand?

iv) What is the relationship between the Population (P) towards Housing Price Index in Thailand?

## **1.4 RESEARCH OBJECTIVE**

This research objective will be categorized into two type based on research questions. The research questions and research objective must be in the right line in order to obtain the final result in this research. The two type of research objective is main research objective and specific research objective.

### **1.4.1 Main Research Objective**

The main research objective in this study will be to determine the macroeconomic factors that give an impact towards the Housing Price Index in Thailand.

### **1.4.2 Specific Research Objective**

The specific research objective will be:

- i) To investigate if there is relationship between Inflation Rate (I) and Housing Price Index in Thailand
- ii) To investigate if there is relationship between Interest Rate and Housing Price Index in Thailand.
- iii) To investigate if there is relationship between Gross Domestic Product (GDP) and Housing Price Index in Thailand.
- iv) To investigate if there is relationship between Population (P) and Housing Price Index in Thailand.

## **1.5 SIGNIFICANCE OF STUDY**

This study is conducted to gain as much as information available in order to have better understanding towards the selected macroeconomics factor that have impact on Housing Price Index in Thailand. In this research, we presumed to have strong relationship between the selected macroeconomics factors towards the Housing Price Index in Thailand. To the public, we estimated to give them better understanding so it can improve their purchasing decision while for those in the supervision and governance, it would support them to make a better policy decisions in future.

## **1.6 SCOPE OF THE STUDY**

This study will focusing on the relationship of selected macroeconomics factors towards the Housing Price Index in Thailand. Plus, data selection will take based on their availability and consistency. All observation is available from year 1986 to 2015 which consists 30 years of observation and yearly data will be used.

## **1.7 LIMITATIONS**

While conducting this study, the researcher has facing some of the barriers that slow down their research which is:

### **1.7.1 Data Reliability and Period Constraint**

Data used in this study will be taken from the secondary sources like The Data Stream. Hence, the accuracy and the reliability of the data will fully depended on the published material and some of the data may not be available for longer period of time.

### **1.7.2 Time Constraint**

As the thesis is conducted during the researcher's internship program, time constraint has been a major problem here. Production of the comprehensive and scholastic study has to a certain extent been affected by the time constraint.

## **1.8 DEFINITION OF TERMS**

### **1.8.1 Housing Price Index (HPI)**

Housing Price Index provides an analytical tool for estimating the changes in the rates of mortgage defaults, prepayments and housing affordability. More than that, this index also can perform as an indicator of house price trends. It is a weighted, repeat-sales index which measures average price changes in repeat sales or refinancing the same properties.

### **1.8.2 Inflation Rate (I)**

Sustained increase in general price level of goods and services in an economy over a period of time. The value of currency decreases when the economy is facing inflation. Hence it means that each unit of currency buys the least amount of goods and services. In other words, purchasing power is lower.

### **1.8.3 Interest Rate (R)**

A minimum interest rate is calculated by the financial institution based on a formula which can be considered the institution's cost of funds and other administrative costs.

#### **1.8.4 Gross Domestic Product (GDP)**

Gross Domestic Product is the best method to measure a country's economy within a specific time periods. This will be including all of the private and public consumption, government outlays, investment and exports less imports that occur within a defined territory.

#### **1.8.5 Population**

Population can be defined as the number of peoples in a country or regions. In other hand, population also has a same meaning of the total of individuals occupying an area or making up a whole.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 LITERATURE REVIEW**

##### **2.1 INTRODUCTION**

The literature in this study began when the past researcher understand that the house is some valuable kind of advantage because of the twofold capacity of houses which is as utilization and as great investment in the future. This is because, in the short term, house price may differ from their fundamental values, depending, among other things, also as on individual characteristic of the real estate market. In the long term, the stability price of the household are willing to pay for a house must equal to the present discounted value for the future services provided by the property agencies. For example like the rent and future value. (Leung and Chen, 2006; Wheaton, 1999; Davis and Zhu, 2004).

In this literature review, we will discuss about the selected macroeconomic factors that have relationship towards Housing Price. To be more specific, the selected macroeconomic variables are Inflation Rate, Inflation Rate, Gross Domestic Product and Population that have been proved by the past researcher to have impact towards the Housing Price Index.



## **2.2 EMPIRICAL LITERATURE**

### **2.2.1 Overview of Housing Price Index**

The HPI is a wide measure of the development of single-family house costs. The HPI is a weighted, repeat sales index, implying that it measures average price changes in repeat sales or refinancing on similar properties. This data is gotten by evaluating the property transaction on single-family properties whose home loans have been buy or securitized by Fannie Mae or Freddie Mac since January 1975.

The HPI serves as a timely, accurate indicator of house value patterns at different geographic levels. Due to the broadness of the sample, it gives more data than is available in other house cost lists. It likewise furnishes housing financial analysts with an enhanced investigative device that is valuable for assessing changes in the rates of home loan defaults, prepayments and housing affordability in particular geographic areas.

During the year 1997 economic crisis, housing prices in Thailand have been increases and created a housing bubble and its eventual collapse and caused by the Asian financial crisis. In addition, for Thailand, the rise and fall of housing prices in Thailand have normally followed cyclical patterns and are highly dependent on economic factors. However, housing prices over the long term have risen in absolute terms.

### **2.2.2 Relationship between HPI and Inflation Rate**

The strong and dependable connection amongst inflation and housing price is appeared by Zhu (2004). One of the most common things facing by individuals in the economy is the increasing in the house price that happened during inflation. This can be shown when

there is increase in the raw material to build the house. Meanwhile Kearl, (1979) said that expanding in inflation serves will decrease the individuals motivators to invest in the real estate, which caused lower housing demand. As we know, during inflation, most things in the economy will increase in price including the cost of the raw material for building a house will increase. Piazzesi and Schneider (2009) said that higher desire inflation tends to lead an expansion in the cost –dividend ratio on the house. For Rogers, J. H. (2001) the value levels are at first unusual over the euro range, merging to a typical level of costs would imply that inflation will be higher in nations where costs are at first low. Tan, Y.K. (2011) likewise inspects that the financial aspects calculate connect with housing cost in Malaysia, for example, per capital wage, unemployment rate and inflation rate. He concluded that inflation rate is not a critical determinant of housing costs in Malaysia. Meanwhile for Glindro, E. T. Subhanij, J. Szeto and H. Zhu (2008), the researchers claim that China, Hong Kong and South Korea have seen extremely solid house value inflation in the previous past years. A cynical view contends that house costs have been overvalued where numerous nations will confront downwards remedy soon. In addition, Feldstein, M. (1982) claims that expanding in inflation serves will decrease people groups motivating and force them to put resources into land, which thusly brings down housing demand.

### **2.2.3 Relationship between HPI and Interest Rate**

Berger-Thomson and Ellis (2004) expressed that short run vacillation in house cost is driven by change in pay, the cost of the house including rent, enhance house quality and the cost of fund (interest rate). For the researchers name Himmelberg et al, 2005, Mishkin, 2007, Taylor, 2007: Favilukis, Ludvigson and Van Nieuwerburgh, 2010,

majority of the analysts guarantee that one of the normal explanations for the blast is effectively accessible credit and low interest rate considerably helped boost demand and price of the house. Dokko et al. (2010) and Glaeser et al. (2010) reported that outcomes proposing that the part of interest rate is much littler than frequently expected. For Hofmann (2004) and Tsatsaronis and Zhu (2004) concede that the determinants of house cost in various industrialized economies, and find that economic growth, inflation, interest rate, bank landing and equity price have critical informative power towards housing price. Plus, Apergis and Rezitis (2003) and Igan et al (2011) concur that when the interest rate are reduction, because of cash supply development, then the housing price is going down and the interest rate for house is rising. Meanwhile, Andrew (2010) contends that the connection between home price and the interest rate is negative and it is rely on upon the level of rivalry of the keeping money division. For Jud and Winkler (2002) and Painter and Redfearn (2002), they expressed that the impact of houses price on interest rate is a less significance. For Tsatsaronis and Zhu, 2004 Assenmacher-Wesche and Gerlach, 2008; kk Iacoviello, 2005; Iacoviello and Pavan, 2011; aa Goodhart and Hofmann, swe2008; Zan and Wang, 2012 expressed that the interest rate is the most critical macroeconomic elements on housing price and market. For Muellbauer, 1992; Muellbauer and Murphy, 1997; MacLennan et al. 1998 cases that when there is increase in interest rate, individuals are kept from purchasing the houses; in this way the interest for the house is decline. Lastly, Kuttner, K.N. (2013) says that Interest rate decreases do have a tendency to continue times of house price gratefulness and some indirect evidence on the commitment of interest rate to house price changes.

#### **2.2.4 Relationship between HPI and Gross Domestic Product**

Lacoviello and Neri (2008) claims that there has been a reaction of the GDP towards Housing Price change. Next, Mikhed and Zemcik (2009) expressed that the house price in USA is declined and this gives negative effect to GDP and consumption. Meanwhile, Piazzesi and Schneider (2009) find that when the inflation rates move, the GDP ratios will move a bit. Zhu,H. (2006) said that the structures of the housing business sector and house price in Asia is exceptionally significant as Asia has seen the fast development of private housing and market –based housing finance in past decade, despite the fact that improvement has been uneven crosswise over nations. Valadez, R.M. (2010) says that GDP is a mainstream pointer in light of the relationship between the macroeconomic activity and the housing price. In addition, Pettinger (2013), says that with higher economic growth and rising in income, individuals will have the capacity to spend more on houses so it will increase the demand and push up the housing prices. Furthermore, Paloma Paz (2003), the researcher said that at whatever point the level of Gross Domestic Product GDP increase, it will control the housing prices. The researcher also state that the interest for housing is regularly noted to be income versatile, rising in salaries will direct to a greater extent of salary being spent on houses.

#### **2.2.5 Relationship between HPI and Population**

Merete Myrmo (2012) presumes that positive population development prompts expanded in demand, which leads to higher house prices. Meanwhile for Takats, E, et al. (2012) claims that population maturing significantly impacts the housing prices from the theoretical and empirical viewpoints. It additionally a long term calculate that economic

development need to concentrate on. The author build the over-lapping era model to explore the impact of the population structure on the house price, considered that the declining in the kids reliance proportion will be one of the variable that caused the rising in the country housing price. For Zhou Yu et al. (2013) broke down the impact of population structure on housing prices in Beijing likely to be essential factors in the improvement of the real estate. Furthermore, Xiao, Z. and, Xu, Q. (2013) list down the impact of the population age structure on private section price said that the population dependency ratio and housing prices had significantly in negative relationship, and had the best impacts towards commercial housing market prices. (Joined Nation, Economic Commission of Europe, 2009) claims that population and housing is two-sided. On the one side, change in population leads a changing demand for a house. While on the opposite side, development in population which is a growth in the quantity of households will leads to growth in housing demand. While for Hui and Hon Chung (2010) say that for area of house that being develops would reflects the behavior of house prices in Malaysia and additionally being follow by a broad fluctuation in aggregate housing price.

## **CHAPTER 3**

### **RESEARCH METHADODOLOGY**

#### **3.0 INTRODUCTION**

In this chapter, we will focus on the methodology that used in this study. That will include the data collection, data sources, variables, theoretical research framework sampling design, research design and test consideration for data analysis, hypothesis statement and conclusion.

#### **3.1 DATA COLLECTION**

Data collection is the process of gathering as much as available information and data either in primary or secondary data used.

##### **3.1.1 Secondary Data**

Secondary data discusses about the statistical material and information from other or someone else research. The benefits of the secondary data is to help the researcher to have a better understanding about the problems hence they can define that problems, formulate research design, and interpret the result. In addition, this type of data generally taken from the sources likes newspaper, magazines, journals, reports and bulletin. However in this research, I only concentrate only in two sources that been taken in the secondary data. The reasons is some of the data is no longer available and cannot be obtain in only one sources. As the research is conducted using time series data, the

sample will be 30 years of the observation started from year period 1986 to 2015. For the quick reference, Table 1 below show the data sources.

VARIABLES	PROXY	EXPLANATIONS	UNITS	SOURCE DATA
Housing Price Index	HPI	Housing Price Index in Thailand	Index (%)	Trading Economics
Inflation Rate	I	Continual increase in the general price level of goods and services in the country	Inflation Rate (%)	Data Stream
Interest Rate	R	The amount that charged, expressed as the percentage of principal, by the lender to the borrower	Base Lending Rate (%)	Data Stream
Gross Domestic Product	GDP	Market value of the goods and services that produce by the country	GDP Growth (%)	Data Stream
Population	P	The total number of individuals living in	Population Growth (%)	Data Stream

		a country, city or any area of district		
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**Table 1: Data Sources**

### **3.2 VARIABLES**

Variables are something like characteristic, number, or quantity that changeable over time, or takes different values in different ways of situations. There are two basic types of variables which are independent and dependent variables.

#### **3.2.1 Dependent Variables**

The dependent variables can take different values and only in response towards the independent variables. In addition, the dependent variables can be mentions as a primary interest to the researcher because it provides the measurement of impact on independent variables. Hence, the Housing Price index that been selected as dependent variables in this research will shows the results obtain by changes in the independent variables.

#### **3.2.2 Independent Variables**

The independent variables can take different values and give an impact towards the other variables mostly to dependent variable. The independent variables will gave huge influence towards dependents variables as it explained the variance of the dependent



variables. For this research, the selected independent variables will be testing in order to see their impact on dependent variables so their final result can be obtain.

### **3.3 RESEARCH DESIGN**

Research design will including the arrangement of sensible basic leadership decisions together with the issues that identifying with choice concerning the motivation behind the study, sorts of the investigation, the measure of analyst impedance, about the study setting, unit of investigation furthermore the time horizon of the study (VeeraPandiyan & V.G.R Chandran 2011). This research involves in the hypothesis testing of the effect of macroeconomic factors towards Housing Price Index.

#### **3.3.1 Purpose of Study**

Most of the researches have a lot of purpose. There are three types of common but useful purpose of the research which is exploration, description, followed by causal/hypothesis testing. As other research generally have one or these reasons yet each have different implication for different parts of research design. In increments, the reason for this study is to examinations the causes furthermore the effect of the chose macroeconomic variables towards the Housing Price Index.

#### **3.3.2 Types of Investigation**

There are three types of investigation normally in the research which is clarification, correlational and causal. For the clarification, the purpose is to get a better knowledge of the concept include in the research problems. In other hand, the correlational relationship happened when there are two or more variables or idea move simultaneously. While for

the casual, the investigation is to see the impact of the variables on another by looking into their issues or topic. But unfortunately in this research, the causal investigation is unable to perform.

### **3.3.3 Researcher Interference**

Researcher interference can be defined as involvement amount of interference by the researcher towards the variables on their study and have a direct behavior on the research decisions. Along these lines, the theory testing is connected in this examination is based on the observation on the past information of macroeconomic factors that have a relationship on Housing Price Index. As the outcomes, there are slightest or no impedance at all gets by the researcher. Subsequently, this examination is intended to understand the relationship between the macroeconomic factors with the Housing Price Index by using casual investigation technique.

### **3.3.4 Study Setting**

By using secondary data that founded from the Trading Economics and Data Stream for this research, this research will carried out on a non-contrived setting and this is held in natural environment where the work will proceed normally.

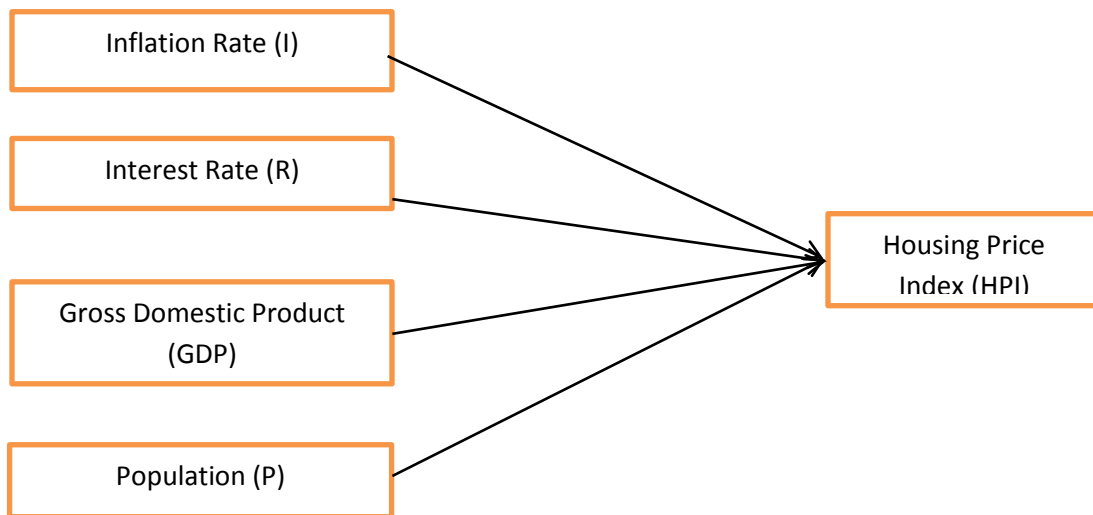
### **3.3.5 Time Horizon**

The time horizon in this study will be using the longitudinal studies. This study also is over long period of time with the purpose to meet the obligation of the research. Plus, the main of this research is to focus on the selected macroeconomics variables towards the

Housing Price Index in Thailand over the past 30 years of period which is starting from the year 1986 to 2015.

### 3.4 RESEARCH FRAMEWORK

Research framework is design in order to give a better understanding about the impact of the macroeconomics variables towards Housing Price Index in Thailand. This framework shown in the Figure 1 below:



**Figure 1: Framework of Factor Effecting Housing Price Index (HPI) from year 1986 to year 2015**

### 3.5 SAMPLING DESIGN

#### 3.5.1 Target Population – Housing Price Index

This research was targets on Housing Price Index (HPI) and the investigation of the relationship between the selected macroeconomic variables with the Housing Price Index (HPI) was being held. Plus, Housing Index is measured by the percent change in the Housing Price Index up to the value of 100 in 2000.

### **3.5.2 Sampling Size**

The observation of the study is over 30 years of period from year 1986 to year 2015. The total of 30 years observations of all variables were taken for the consideration of the study.

## **3.6 TESTS CONSIDERATION FOR DATA ANALYSIS**

In this study, the test that will be used should be Multiple Linear Regression with the time series data. There are several steps taken to investigate time series data by using multiple linear regressions which are:

Check if data is stationary or not

Check the assumptions

Performs the correlation matrix for all the variables (of the stationary data)

Perform the regression (using the stationary data)

### **3.6.1 Test for Stationary: Unit Root Test**

Stationary is happened when the mean, variance and auto covariance is in constant condition. False regression will happened if the selected data variables used in the research is not stationary. Meanwhile, unit root test is complete in order to stabilizing the order of integration of each variable to avoid bias results.

In this study, the ADF test will be applied as it is more commonly being used stationary test due to larger and more complicated set of time series model. This is because, according to Gan (2006), Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) methods is the most largely used to test the unit root test.

In order to test p-values, the ADF statistic will be used. In this study, if the p-value is below than 1%, 5% or 10% of significant level, the null hypothesis will be rejected and the data variable is stationary. The hypothesis behind these tests is:

Ho: Data is not stationary

H1: Data is stationary

### **3.6.2 Normality Test**

Normality test is used to investigate either the error term is normally distributed or not. Meanwhile, the Jarque-Bera is test is used as normality test. In order to get the final result for the test, the p-value of Jarque-Bera will be the only consideration in this test. This is because, if the p-value of Jarque-Bera is under 1%, 5% or 10% level of significant, this show that the null hypothesis is failed to reject and can conclude that the error term is normally distributed. The hypothesis for this normality test is shown below:

Ho: Error term is normally distributed

H1: Error term is not normally distributed

### **3.6.3 Autocorrelation – Serial Correlation Test**

The serial correlation test or autocorrelation test used to investigate either there are serial independence for the error term or vice versa. The function of this test is also to determine the correlation between two of the different time series data. Plus, the autocorrelation indicates that error term from one to another time period. Breusch-Godfrey Serial Correlation test meanwhile was applied in this research. Under the Eview9 this test is recognize as Breusch-Godfrey Serial Correlation LM test. This is because, as Stock and Watson (2006) said, autocorrelation can be defined as condition where the residuals is related to each other and this is supported by Probability of Chi-square of  $Obs \cdot R$ -squared statistic. The residual will not be correlated and there will be serial independent for the error term if the p-value of  $Obs \cdot R$ -squared is more than 1%, 5% or 10% significance of level. As the result, the null hypothesis is failed to be rejected. The hypothesis in this test is:

Ho: Error term is serially independent. (No autocorrelation problem)

H1: Error term is not serially independent. (Have autocorrelation problem)

### **3.6.4 Heteroscedasticity Test – Variance of Error Term Test**

Heteroscedasticity is the problem occurred when the error term do not have a constant variance of Y population varies with X. Moreover, the test was approaches under the heteroscedasticity test which include White Test by using Eview9. Heteroscedasticity can be seen from the probability of  $Obs \cdot R$ -squared.

The p-value is playing important role in the test. If the p-value of Obs\*R-squared obtain is higher than 1%, 5% or 10% level of significance, the null hypothesis is failed to be reject which is mean the residual are homoscedasticity. Meanwhile, if the p-value of Obs\*R-squared is higher than 1%, 5% or 10% level of significance, we reject the null hypothesis and it means that residual is heteroscedasticity. The hypothesis is shown below:

Ho: Error term is homoscedastic. (Error term have constant variance)

H1: Error term is heteroscedastic. (Error terms do not have constant variance)

### **3.6.5 Multicollinearity Test**

Multicollinearity can be defined as the existence of the perfect linear relationship among all explanatory variables of a regression model according to (Raynar Frisch, 1934). This is the best example where the independent variables are correlated with each other perfectly.

By using Centered Variance Inflation Factor (CVIF), the thoughtful Multicollinearity problems can be detected. A rank of VIF of 1 means that there is no correlation and if the VIF is surpass 10 then there are serious multicollinearity happened and serious action should be taken. The hypothesis is shown below:

Ho: There is no multicollinearity problem.

H1: There is multicollinearity problem.

### **3.6.6 Correlation Test: Covariance Analysis**

By using Eview9, it provides an indication to investigate whether there is correlation between the dependent variables with any of selected independent variables of the covariance analysis output. Thus, the objective of this research is to investigate the existence of any linear relationship or correlation of the dependent variables with any selected independent variables.

The indicator of Eview9 is to observe the t-statistic and the p-value for both of the dependent and independent variables. If the t-statistic and p-value is less than 1%, 5% or 10% level of significance, the null hypothesis is to reject hence there will be no correlation between both variables. The hypothesis is given below:

Ho: There is no correlation

H1: There is correlation

### **3.6.7 Multiple Linear Regression Model**

Multiple linear regressions are method of data analysis that used to examine the significant relationship of dependent variable to the selected independent variables. (Berger, 2003).

#### Economic Function

HPI = f (Interest Rate, Inflation Rate, Gross Domestic Product, Population)

#### Econometric Model

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \epsilon$$



Where  $Y_i$  is the dependent variables which is HPI,  $\beta_1$  is the coefficient to measure the change happening in HPI that change in macroeconomic factor,  $\varepsilon$  is the error term while  $X_i$  is the macroeconomic factor. For this study, the following factors are selected:

X1: Inflation Rate (I)

X2: Interest Rate (R)

X3: Gross Domestic Product (GDP)

X4: Population (P)

#### **3.6.7.1 F-test**

F-test is the measure of the overall significance of the estimated regression or overall fitness of the model. The f-test is implied as an indicator to detect whether any of the independent variables is well functioning in order to explain the variance of the dependent variable.

If the p-value of the F-test is below than 1%, 5% or 10% significance of level, the null hypothesis is rejected. It also can be consider that one of the independent variables is playing a big role in order to explain the dependent variable. The hypothesis is stated below:

Ho: No independent variable impact the dependent variable

H1: At least one of the independent variables has impact towards dependent variable.

### **3.6.7.2 Coefficient of Determination R-square**

The function of R-squared is to measure of overall fit of goodness. It is also to determine how good the regression fits the data. Generally R-squared is equal to 1 which is mean the regression fit the data perfectly while R-squared equal to 0 means that the regression is no better than guessing the sample mean (Richard Startz, 2007).

### **3.6.7.3 Durbin Watson Test**

The Durbin Watson test is the old school test for the serial correlation. It is to investigate whether there is serial independence in error term. If the amount of the Durbin Watson is closed enough to 2.0, it is consistent with no serial correlation. Meanwhile if the amount of Durbin Watson is closer to 0, that's mean it is serial correlation.

## **3.7 HYPOTHESIS STATEMENT**

Hypothesis can be defined as logical guess of statement of the relationship between two or more of selected variables. By testing the hypothesis, it is expected that solution could be identified to correct the problem encountered.

### **3.7.1 Hypothesis 1**

Ho: There is significant relationship between the Inflation rate and the Housing Price Index.

H1: There is no significant relationship between the Inflation rate and the Housing Price Index

### **3.7.2 Hypothesis 2**

Ho: There is significant relationship between the Interest rate and the Housing Price Index

H1: There is no significant relationship between the Interest rate and the Housing Price Index

### **3.7.3 Hypothesis 3**

Ho: There is significant relationship between Gross Domestic Product and the Housing Price Index.

H1: There is no significant relationship between Gross Domestic Product and the Housing Price Index

### **3.7.4 Hypothesis 4**

Ho: There is significant relationship between Population and Housing Price Index

H1: There is no significant relationship between Population and Housing Price Index.

## CHAPTER 4

### RESULTS AND DATA ANALYSIS

#### 4.0 INTRODUCTION

In this chapter, the empirical result of all test that been conducted is studied and interpreted. This is completed with the stated of the purpose to find the relationship between the dependent variables and independent variables. The results obtained by running the data using the Eview9 statically tools. The summary of the findings and the results will be presented at the end of the chapter.

#### 4.1 DESCRIPTIVE TEST

Descriptive analysis summarize about the mean, maximum, minimum and the standard deviation. Mean is used to measure the average value of series. At the other hand, maximum is the highest number of the series while the minimum is the lowest of the series. As for the skewness, the function is to measure of symmetry. Distributions of symmetric whether shift to the left or right from the centre point.

	POPULATION	INTEREST	INFLATION	HPI	GDP
Mean	2.673333	6.086667	4.230000	369.7200	2.596667
Median	2.800000	5.700000	4.600000	360.0000	2.700000
Maximum	5.400000	9.600000	7.200000	456.2000	4.700000

Minimum	-0.400000	4.000000	1.200000	300.0000	-2.800000
Std. Dev.	1.229223	1.477587	1.991040	38.92549	1.628937
Skewness	-0.265117	0.899306	-0.100514	0.586941	-1.370305
Kurtosis	3.570919	3.081008	1.531713	2.679823	5.312870
Jarque-Bera	0.758870	4.051962	2.745347	1.850639	16.07538
Probability	0.684248	0.131864	0.253429	0.396405	0.000323
Sum	80.20000	182.6000	126.9000	11091.60	77.90000
Sum Sq. Dev.	43.81867	63.31467	114.9630	43940.63	76.94967
Observations	30	30	30	30	30

**Table 2: Descriptive Analysis**

Table 1 shows the summary of descriptive analysis for this research. All data for the study covers period from 1986 until 2015 based on annually basis and make it overall observations for this study 30. According to above table, the lowest mean is 2.596667 which is variable GDP while the highest mean goes to variable INTEREST with the value 6.086667. The lowest median for this study is 2.700000 which is variable GDP while the highest median goes to variable INTEREST with the value 5.700000. Next, the maximum number of series in this study goes to variable INTEREST with the value 9.600000 while the minimum of series is -0.400000 for the variable POPULATION.

Standard deviation measure the spread of a set of observations. The larger the standard deviation is the more spread out of the observations are. In the above table, the larger standard deviation is 1.991040 goes to variable INFLATION and the lowest standard deviation goes to variable POPULATION with the value 1.229223. In this study, skewness measures the degree and direction of symmetry. A normal distribution which had a skewness of 0 is example of a symmetric distribution. Table above showed only INTERSRT has positively skewed while others variable has negatively skewed. Other than that, table 1 also showed the Kurtosis results. All the variables in this study have positive kurtosis which means that the tails of the distribution are heavier than for a normal distribution.

Lastly is about the summary of the Jarque-Bera Test. The p-value of all variables in above table was more than five percent significant level. Thus, it can be concluded that all variables are normally distributed.

#### 4.2 CORRELATION MATRIX

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Correlation

t-Statistic

Probability	HPI	GDP	POPULATION	INTEREST	INFLATION
HPI	1.000000				
	-----				
	-----				

GDP	-0.144397	1.000000			
	-0.772168	-----			
	0.4465	-----			
POPULATION	-0.204810	0.220559	1.000000		
	-1.107227	1.196558	-----		
	0.2776	0.2415	-----		
INTEREST	-0.281501	-0.488844	-0.303968	1.000000	
	-1.552338	-2.965160	-1.688335	-----	
	0.1318	0.0061	0.1025	-----	
INFLATION	-0.244019	0.445409	0.413297	-0.592362	1.000000
	-1.331476	2.632427	2.401684	-3.890518	-----
	0.1938	0.0136	0.0232	0.0006	-----

**Table 3: Correlation Matrix**

Based the above table, the p-value for the first correlation matrix is (HPI, GDP) is 0.4465 which is higher than 5% significant level. Thus, the null hypothesis failed to reject and it can be conclude that there is no correlation between HPI and GDP. The p-value for the second correlation matrix (HPI, POPULATION) is 0.2776 which is more than 5% significance level. Thus, the null hypothesis is failed to reject and it can be concluded that there is no correlation between HPI and POPULATION. The p-value for the third

correlation matrix (HPI, INTEREST) is 0.91318 which is more than the 5% significance level. Thus, the null hypothesis is failed to reject and it can be concluded that there is no correlation between HPI and INTEREST. The p-value for the forth correlation matrix (HPI, INFLATION) is 0.1938. Thus, the null hypothesis failed to reject and it can be conclude that there is no correlation between HPI and INFLATION.

### 4.3 UNIT ROOT TEST

	GDP	POPULATION	INTEREST	INFLATION	HPI
ADF	-9.588718	-4.014269	-4.836908	-5.826710	-8.107452
Level 1%	-4.339330	-4.440739	-4.339330	-4.339330	-4.339330
Level 5%	-3.587527	-3.632896	-3.587527	-3.587527	-3.587527
Level 10%	-3.229230	-3.254671	-3.229230	-3.229230	-3.229230
Second Different	0.0000	0.0238	0.0032	0.0003	0.000

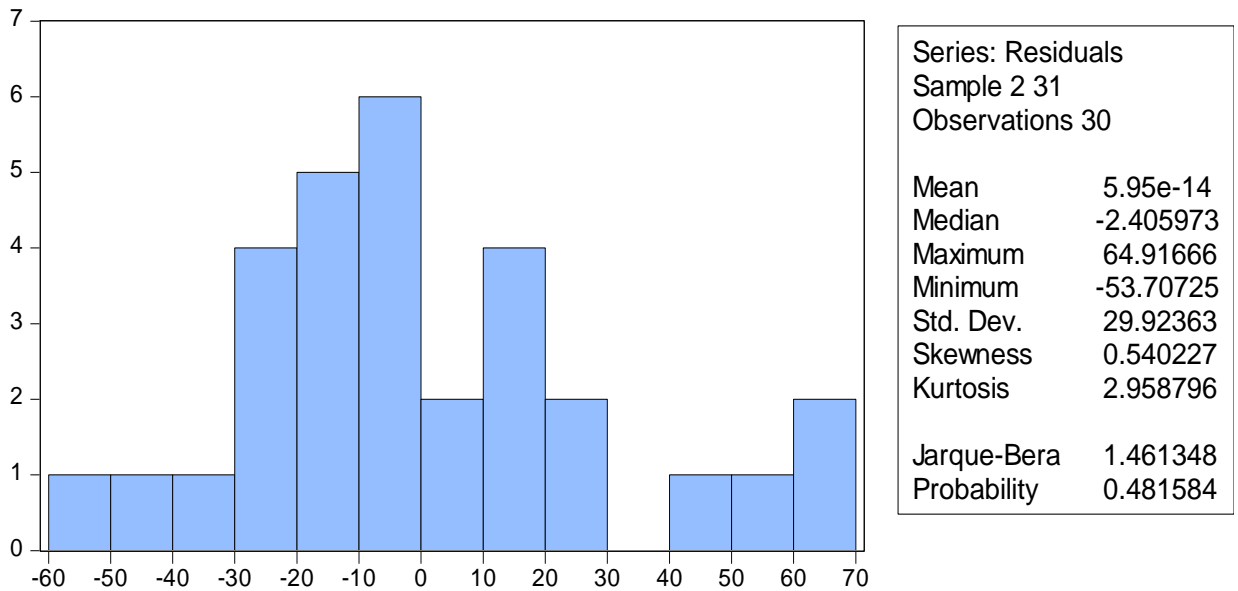
**Table 4: Summary of Unit Root Test**

Table 3 above shows the result of the unit root test that has been carried out. The p-value of all variables are less than the significant level and at second different. Thus, the null hypothesis of non-stationarity is rejected and therefore the data for the Y variable is now stationary.



## 4.4 TESTS ON ASSUMPTION

### 4.4.1 Normality Test



**Table 5: Normality Test**

Diagram shows the Jarque –Bera test which is to test the normality of the error term. From the output above it can see that the Jarque Bera test statistic for the sample data is 1.461348 and the p-value is 0.481584. Since the p-value is less than 5%, level of significant, the null hypothesis is rejected. Therefore, the conclusion is that the error term is not normally distributed which is not fulfils the assumption as a good assumption.

### 4.4.2 Autocorrelation Test – Serial Correlation Test

In testing the serial or autocorrelation problem Breusch–Godfrey Serial Correlation LM Test is used.

Breusch – Godfrey Serial Correlation LM Test:

Breusch-Godfrey Serial Correlation LM Test:

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F-statistic	7.427082	Prob. F(2,23)	0.0032
Obs*R-squared	11.77215	Prob. Chi-Square(2)	0.0028

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**Table 6: Breusch – Godfrey Serial Correlation LM Test**

As the result show above, the probability value to be used here is that “Obs\*R – Squared”. P–value (presented by Prob. Chi–Square (2)) is 0.0028 which is less than 5% level of significance. Therefore the alternate hypothesis is not rejected. In other words, the data used are not serially independent for the error term.

#### **4.4.3 Heteroscedasticity Test – Variance Of Error Term Test**

Heteroscedasticity Test: White

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F-statistic	6.093666	Prob. F(14,15)	0.0006
Obs*R-squared	25.51397	Prob. Chi-Square(14)	0.0298

Scaled explained SS	17.35301	Prob. Chi-Square(14)	0.2379
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**Table 7: Heteroscedasticity Test: White**

Heteroscedasticity White Test is used to test for heteroscedasticity problem. The probability to be used here is the ‘Obs\*R-squared’ p-value (presented by Prob. Chi – Square (4)) which is 0.0298. The p-value is 0.0298 which is less than 5% significance level. In conclusion, the sample indicates there are a heteroscedastic problem which is the error term has no constant variance.

#### 4.4.4 Multicollinearity Test

	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
C	2234.798	64.54654	NA
GDP	18.66191	5.016856	1.382535
POPULATION	28.78682	7.156439	1.214413
INTEREST	16.01394	10.04830	1.772433
INFLATION	28.13631	31.82162	1.715082

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**Table 8: Multicollinearity Test**

The centered VIF is used to identify if there exist a serious multicollinearity problem. In the table above, VIF values are all below 10 and close to 1. This indicates that none of the independent variables show serious collinearity. Therefore, T-test and the F-test can be used to make inferences on the regression coefficient. This confirms that the t-test and the f-test can be used without any doubt to make inference towards the regressions coefficients.

#### 4.5 MULTIPLE LINEAR REGRESSION MODEL

The Multiple Linear Regression Model is used in specific as:

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \varepsilon$$

Where,  $Y_i$  is the dependent variable of HPI,  $\beta_i$  is the coefficient measuring the change in HPI for the change in macroeconomic factors  $\varepsilon$  is the error term while  $X_i$  is the macroeconomic factor. In this study, the following factors are used:

$X_1$ : Inflation Rate (I)

$X_2$ : Interest Rate

$X_3$ : Gross Domestic Product (GDP)

$X_4$ : Population (P)

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Variable	Coefficient	Std. Error	t-Statistic	Prob.
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C	563.4328	47.27365	11.91854	0.0000
GDP	-5.967287	4.319944	-1.381335	0.1794
POPULATION	-5.335142	5.365335	-0.994372	0.3296
INTEREST	-10.01626	4.001743	-2.502974	0.0192
INFLATION	-19.97586	5.304367	-3.765926	0.0009
<hr/>				
R-squared	0.409037	Mean dependent var	369.7200	
Adjusted R-squared	0.314483	S.D. dependent var	38.92549	
S.E. of regression	32.22874	Akaike info criterion	9.934606	
Sum squared resid	25967.29	Schwarz criterion	10.16814	
Log likelihood	-144.0191	Hannan-Quinn criter.	10.00932	
F-statistic	4.325957	Durbin-Watson stat	0.875383	
Prob(F-statistic)	0.008526			
<hr/>				

**Table 9: Least Square Method**

#### **4.5.1 Coefficients**

Method used to identify the independent variables that could be dropped from the model. This method is to observe the p-value of the t-test statistic for the coefficient of each variable. If the result obtains shows that the p-value and t-statistic is lower than the 10% significance level, the variables should be retained in the regression model.

Moreover, the result obtain from the regression table can be explained by entering the results into the econometric equations.

$$Y_i = 563.4328 - 5.967287 X_{i1} - 5.335142 X_{i2} - 10.01626 X_{i3} - 19.97586 X_{i4}$$

Based on the equations, Inflation rate, Interest rate, gross domestic product and population shows the negative relationship towards the housing price index.

#### **4.5.2 Inflation Rate**

For the Inflation rate, the coefficient value is – 19.97586. This shows that 1% decrease in inflation rate, Housing Price Index will decrease by -19.97586 while assuming others variable were constant. The p-value of I is 0.0005, which is less than 10% level of significance. Hence, this finding rejects the null hypothesis and concludes that there is relationship between Inflation rate and Housing Price Index.

#### **4.5.3 Interest Rate**

The coefficient value for Interest rate as shown in the result is -10.01626. This value explains that 1% of increase in interest, the Housing Price Index will decrease by -

10.01626, while assuming that other variables are constant. The p-value of R is 0.0192, which is less than 10% level of significance. Hence, this finding is failed to reject the null hypothesis and can be said that there is no relationship between interest Rate with the Housing Price index.

#### **4.5.4 Gross Domestic Product**

The coefficient of GDP is -5.967287. This value state that for 1% increase in GDP, the Housing Price Index will decrease by -5.967287, while assuming that other variables is remain constant. The p-value of GDP is 0.1794. The p-value of GDP is more than 10% level of significance which means that there is no relationship between Gross Domestic product and Housing price Index.

#### **4.5.5 Population**

The coefficient of Population is -5.335142. This value indicates that 1% increasing in Population, the Housing Price Index will decrease by -5.335142, while assuming other variables is remaining unchanged. The p-value of P is 0.3296, which is less than 10% level of significant. Hence, this finding is fail to reject the null hypothesis and can concluded that there is no relationship between Population and Housing Price Index.

#### **4.5.6 F-Test**

The test statistic here is the F-test which the value obtains is 4.325957. The p-value of the F-test is 0.008526. Therefore, the null hypothesis can be rejected and can be conclude that at least one of the independent variables is useful in predicting Housing Price index.

#### **4.5.7 Coefficient of Determination ( $R^2$ )**

The value of  $R^2$  obtained is 0.409037 which means that 40.93% of the Housing Price Index is explain by the chosen macroeconomic variables which is Inflation Rate, Interest Rate, Gross Domestic Product and Population. Therefore, the others 59.07% of the variation is determine by the other factors.

#### **4.5.8 Adjusted $R^2$**

As the results of the adjusted  $R^2$  shows that the result obtain was 0.314483. This indicates that 31.45% of variation in Housing Price Index (HPI) is explained by the selected macroeconomic variables which are Inflation Rate, Interest Rate, Gross domestic Product and Population.

#### **4.5.9 Durbin Watson Test**

The result obtains for the regressions shows that Durbin Watson statistic of 0.875383 which means that it is consistent with no serial correlation.

### **4.6 SUMMARY OF HYPOTHESIS STATEMENT**

#### **4.6.1 Main Hypothesis Statement**

The Prob (F-test) obtain is 0.008526, means that it is less than 5% significance level. Therefore, the finding failed to reject the null hypothesis statement and can be concluded that there is significant influence by those selected macroeconomic variables.



## **4.6.2 Specific Hypothesis Statement**

### **4.6.2.1 Gross Domestic Product (GDP)**

The p-value of GDP is 0.1794. The finding fails to reject the null hypothesis and concludes that there is no significant relationship between GDP and Housing Price Index in Thailand.

### **4.6.2.2 Population**

The p-value of Population is 0.3296. This finding fails to reject the null hypothesis and concludes that there is no relationship (significant) between Population and Housing Price Index in Thailand.

### **4.6.2.3 Interest Rate**

The p-value of R is 0.0192. This finding rejects the null hypothesis and concludes that there is a significant relationship between Interest Rate and Housing Price Index in Thailand.

### **4.6.2.4 Inflation Rate**

The p-value of I is 0.0009. This finding rejects the null hypothesis and concludes that there is a significant relationship between Inflation Rate and Housing Price Index in Thailand.

## **4.7 SUMMARY**

All the empirical results from this study have been shown clearly in this chapter. In our research, the result obtained is based on the recommendation test by treating and analyzing

Multiple Linear Regression. Based on the results, it is shown Inflation Rate (I) and Interest Rate (R) have a significant relationship while other selected macroeconomic variables which is gross Domestic Product (GDP) and Population(P) found to be no significant relationship at all to the dependent variable which is HPI. In accordance to testing a regression model with time series data, we have tested the regression model for econometric problems. Except for heteroscedasticity test, all other test have fulfil the underlying assumptions for a time series multiple regression model. However, as multicollinearity test indicate that the independent variable does not show serious collinearity, this confirm that the t-test and F-test can be used without any doubt to make inferences on the regression coefficients. The results obtained from this chapter will give a clear view for the researcher to make conclusion and recommendations which is the basis of the next chapter.

## CHAPTER 5

### CONCLUSION AND RECOMENDATION

#### 5.0 CONCLUSION

In this research study, the time series data has been used and been applied to the selected test to get the result. There were total of 30 secondary data of each variable that available from year 1986 until year 2015 in yearly basis. The objective is to find the relationship between the selected macroeconomic variables namely Inflation rate, Interest Rate, Gross Domestic Product and Population that been applied to Housing Price Index has been achieved. Out of the four variables, there are only two variables were found positively significant with HPI which is Inflation Rate and Interest Rate.

Inflation Rate happens to have a relationship with the Housing Price Index in Thailand. This is because, as the inflation rate is increase, every penny that we own can buys a smaller percentage of a good product or service. Thus, when inflation happens, the housing price will raise. Moreover, during inflation crisis, buying the house will be the right decision for the buyer and seller. But remember that inflation also will impact the live and this will lead peoples to sell their house as the value is less than previously worth. In this case, the real state buyer should wait until the right time to buy the house.

Apart from that, the next variables tend to have relationship with the House Price Index is Interest Rate . This is due to base lending rate that has been set by the Central Bank of Thailand and this will cause the commercial bank to obey the state rate or lower than that.

In addition, when the interest rate is increase, the house price movement will rise. Even though the interest rate is set by the Central bank, peoples still apply for the loan to buy the house as it is something necessary for people to live and also providing the valuable future investment.

Meanwhile, for the variable Gross Domestic Product, the result obtain is not significant to the Housing Price Index. One of the factors is because of the condition of the economy in Thailand that is not in good conditions. As the gross domestic product tends to decrease, it will directly impact the employment to be decrease, the wage to be lower since the demand for the workers is lower. Thus, when this is happened, it will make the effort to buy the house decrease so it will lead to decreasing in housing price in Thailand.

Last but not least is population. As the result obtain showed the negative relationship of population growth towards housing price in Thailand. Based on the common theory, when the population is at the growing rate, it will trigger for more demand to buy the house. However, it will depend on the supply of the house. If the demand for the house is greater than the supply, it will lead to higher price as there are excessive demands for the house.

In the result, it showed that only 48.16% of housing price can be explained by the selected macroeconomic variables. Hence, more research need to be conduct in order to identify the others variable that impact the house price for the remaining balance of 51.84%. This is important towards the speculators, investors, buyers and also decision making policy as it will help them to make the right choice and decisions making process.

## **5.1 RECOMMENDATION**

### **5.1.1 Use Different Data Structure**

For the future researcher are able to perform with other types of data structure. For example, panel data. By using different types of data structure, it can helps the researcher to gain new and more perspective on their research study which ease them to make more comparison with the existing studies for the purpose of knowledge expansion. In addition, by using different frequency of data set such as daily, weekly or monthly can be used instead of annual data set to test search the findings as well as to test the reliability of the study.

### **5.1.2 Have More Comprehensive Test**

It is advisable for the future researcher to have more comprehensive test in order to get consistency and reliability of results. Some of the tests that can be considered are Johansen Cointegration Test, Granger Causality test, variance Decomposition and Impulse Response Function.

### **5.1.3 Add More Macroeconomic Variables**

As the result of the study, it showed that four of the macroeconomic data only gave 45.03% of explanation toward the dependent variables. Therefore, more variables can be added and considered such as investment, cost of construction, urbanization and employment rate. Addition of others variable will give future researcher a better and broader base of understanding.

#### **5.1.4 Research on Other Countries**

The future researcher should conduct the study on the other countries. This is because, the results of the studies will provide the tremendous benefits which show the trend in different countries and it could be separated into regional, developed and emerging countries. Therefore, the information collected from the research study would be beneficial and valuable to all of concerned parties.

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## APPENDICES

### Descriptive Test Analysis

	POPULATION	INTEREST	INFLATION	HPI	GDP
Mean	2.673333	6.086667	4.230000	369.7200	2.596667
Median	2.800000	5.700000	4.600000	360.0000	2.700000
Maximum	5.400000	9.600000	7.200000	456.2000	4.700000
Minimum	-0.400000	4.000000	1.200000	300.0000	-2.800000
Std. Dev.	1.229223	1.477587	1.991040	38.92549	1.628937
Skewness	-0.265117	0.899306	-0.100514	0.586941	-1.370305
Kurtosis	3.570919	3.081008	1.531713	2.679823	5.312870
Jarque-Bera	0.758870	4.051962	2.745347	1.850639	16.07538
Probability	0.684248	0.131864	0.253429	0.396405	0.000323
Sum	80.20000	182.6000	126.9000	11091.60	77.90000
Sum Sq. Dev.	43.81867	63.31467	114.9630	43940.63	76.94967
Observations	30	30	30	30	30

### Correlation Matrix

Covariance Analysis: Ordinary  
 Date: 12/23/16 Time: 16:19  
 Sample: 1 30  
 Included observations: 30

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Correlation t-Statistic Probability	HPI	GDP	POPULATION	INTEREST	INFLATION
HPI	1.000000 ----- -----				
GDP	-0.144397 -0.772168 0.4465	1.000000 ----- -----			
POPULATION	-0.204810 -1.107227 0.2776	0.220559 1.196558 0.2415	1.000000 ----- -----		
INTEREST	-0.281501 -1.552338 0.1318	-0.488844 -2.965160 0.0061	-0.303968 -1.688335 0.1025	1.000000 ----- -----	

INFLATION	-0.244019	0.445409	0.413297	-0.592362	1.000000
	-1.331476	2.632427	2.401684	-3.890518	-----
	0.1938	0.0136	0.0232	0.0006	-----

### Unit Root Test (Second Difference)

#### HPI

Null Hypothesis: D(HPI,2) has a unit root  
 Exogenous: Constant, Linear Trend  
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.107452	0.0000
Test critical values:		
1% level	-4.339330	
5% level	-3.587527	
10% level	-3.229230	

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

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(HPI,3)  
 Method: Least Squares  
 Date: 12/23/16 Time: 15:51  
 Sample (adjusted): 4 30  
 Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HPI(-1),2)	-1.464750	0.180667	-8.107452	0.0000
C	-5.848712	13.96870	-0.418701	0.6792
@TREND("1")	0.398664	0.785707	0.507395	0.6165
R-squared	0.732533	Mean dependent var		-0.766667
Adjusted R-squared	0.710245	S.D. dependent var		58.96223
S.E. of regression	31.73874	Akaike info criterion		9.857392
Sum squared resid	24176.35	Schwarz criterion		10.00137
Log likelihood	-130.0748	Hannan-Quinn criter.		9.900206
F-statistic	32.86542	Durbin-Watson stat		2.224943
Prob(F-statistic)	0.000000			

#### GDP

Null Hypothesis: D(GDP,2) has a unit root  
 Exogenous: Constant, Linear Trend  
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-9.588718	0.0000
Test critical values:		
1% level	-4.339330	
5% level	-3.587527	
10% level	-3.229230	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GDP,3)

Method: Least Squares

Date: 12/23/16 Time: 15:35

Sample (adjusted): 4 30

Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1),2)	-1.586906	0.165497	-9.588718	0.0000
C	-0.191374	1.048395	-0.182540	0.8567
@TREND("1")	0.011563	0.058924	0.196242	0.8461

R-squared	0.793004	Mean dependent var	-0.059259
Adjusted R-squared	0.775754	S.D. dependent var	5.034593
S.E. of regression	2.384110	Akaike info criterion	4.679968
Sum squared resid	136.4155	Schwarz criterion	4.823950
Log likelihood	-60.17956	Hannan-Quinn criter.	4.722781
F-statistic	45.97217	Durbin-Watson stat	2.302001
Prob(F-statistic)	0.000000		

## POPULATION

Null hypothesis: D(POPULATION,2) has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 5 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.014269	0.0238
Test critical values:		
1% level	-4.440739	
5% level	-3.632896	
10% level	-3.254671	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POPULATION,3)

Method: Least Squares

Date: 12/23/16 Time: 15:39

Sample (adjusted): 9 30  
 Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(POPULATION(-1),2)	-7.398048	1.842938	-4.014269	0.0013
D(POPULATION(-1),3)	5.107059	1.686947	3.027397	0.0090
D(POPULATION(-2),3)	3.590488	1.406616	2.552572	0.0230
D(POPULATION(-3),3)	2.322260	1.060025	2.190760	0.0459
D(POPULATION(-4),3)	1.229229	0.690982	1.778959	0.0970
D(POPULATION(-5),3)	0.424106	0.344272	1.231892	0.2383
C	0.217140	0.958211	0.226610	0.8240
@TREND("1")	-0.015102	0.049024	-0.308044	0.7626
R-squared	0.896823	Mean dependent var		-0.127273
Adjusted R-squared	0.845234	S.D. dependent var		3.525983
S.E. of regression	1.387131	Akaike info criterion		3.767640
Sum squared resid	26.93785	Schwarz criterion		4.164382
Log likelihood	-33.44403	Hannan-Quinn criter.		3.861100
F-statistic	17.38415	Durbin-Watson stat		2.183382
Prob(F-statistic)	0.000007			

## INTEREST

Null Hypothesis: D(INTEREST,2) has a unit root  
 Exogenous: Constant, Linear Trend  
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.836908	0.0032
Test critical values:		
1% level	-4.339330	
5% level	-3.587527	
10% level	-3.229230	

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

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(INTEREST,3)  
 Method: Least Squares  
 Date: 12/23/16 Time: 15:42  
 Sample (adjusted): 4 30  
 Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INTEREST(-1),2)	-0.992506	0.205194	-4.836908	0.0001
C	0.200725	0.445185	0.450879	0.6561
@TREND("1")	-0.013001	0.025082	-0.518353	0.6090

R-squared	0.493834	Mean dependent var	0.007407
Adjusted R-squared	0.451654	S.D. dependent var	1.358145
S.E. of regression	1.005712	Akaike info criterion	2.953708
Sum squared resid	24.27497	Schwarz criterion	3.097690
Log likelihood	-36.87506	Hannan-Quinn criter.	2.996521
F-statistic	11.70764	Durbin-Watson stat	1.979752
Prob(F-statistic)	0.000283		

## INFLATION

Null Hypothesis: D(INFLATION,2) has a unit root  
 Exogenous: Constant, Linear Trend  
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.826710	0.0003
Test critical values:		
1% level	-4.339330	
5% level	-3.587527	
10% level	-3.229230	

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

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(INFLATION,3)  
 Method: Least Squares  
 Date: 12/23/16 Time: 15:45  
 Sample (adjusted): 4 30  
 Included observations: 27 after adjustments

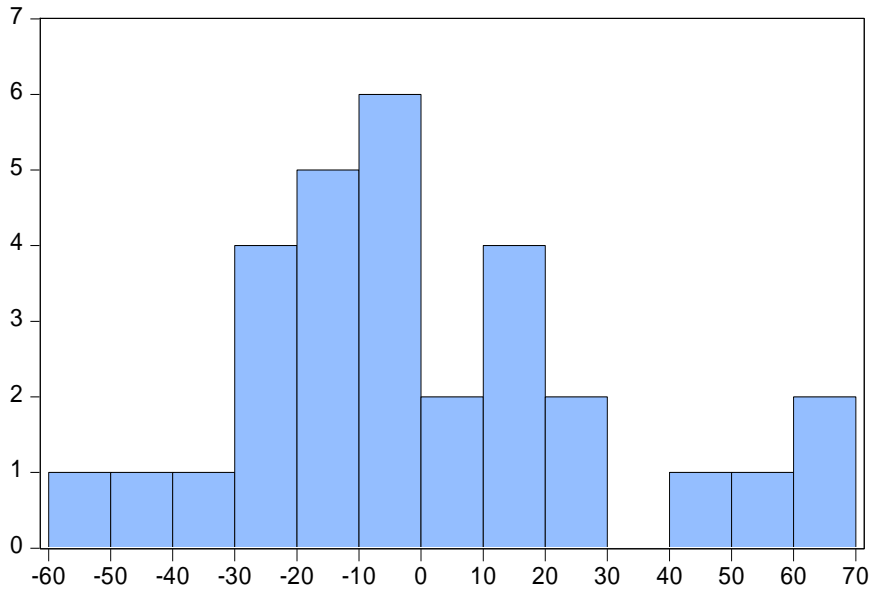
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INFLATION(-1),2)	-1.167291	0.200334	-5.826710	0.0000
C	-0.096608	0.563093	-0.171567	0.8652
@TREND("1")	0.007466	0.031638	0.236000	0.8154

R-squared	0.586743	Mean dependent var	-0.007407
Adjusted R-squared	0.552305	S.D. dependent var	1.913299
S.E. of regression	1.280188	Akaike info criterion	3.436330
Sum squared resid	39.33315	Schwarz criterion	3.580312
Log likelihood	-43.39046	Hannan-Quinn criter.	3.479143
F-statistic	17.03765	Durbin-Watson stat	2.087992
Prob(F-statistic)	0.000025		

## Test on Assumption

### Normality Test



Series: Residuals	
Sample 2 31	
Observations 30	
Mean	5.95e-14
Median	-2.405973
Maximum	64.91666
Minimum	-53.70725
Std. Dev.	29.92363
Skewness	0.540227
Kurtosis	2.958796
Jarque-Bera	1.461348
Probability	0.481584

### Auto Correlation Test (Breusch – Godfrey Serial Correlation LM Test)

Breusch-Godfrey Serial Correlation LM Test:

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F-statistic	7.427082	Prob. F(2,23)	0.0032
Obs*R-squared	11.77215	Prob. Chi-Square(2)	0.0028

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Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 12/17/16 Time: 23:15

Sample: 2 31

Included observations: 30

Presample missing value lagged residuals set to zero.

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Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.614780	39.30216	0.066530	0.9475
GDP	5.838864	3.925988	1.487234	0.1505
POPULATION	-3.677358	4.474076	-0.821926	0.4196
INTEREST	-1.454070	3.358559	-0.432945	0.6691
INFLATION	-0.299371	4.519318	-0.066242	0.9478
RESID(-1)	0.681787	0.207450	3.286512	0.0032
RESID(-2)	0.032614	0.219831	0.148359	0.8834

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R-squared	0.392405	Mean dependent var	5.95E-14
Adjusted R-squared	0.233902	S.D. dependent var	29.92363
S.E. of regression	26.19127	Akaike info criterion	9.569693
Sum squared resid	15777.59	Schwarz criterion	9.896639
Log likelihood	-136.5454	Hannan-Quinn criter.	9.674285
F-statistic	2.475694	Durbin-Watson stat	1.827801
Prob(F-statistic)	0.053846		

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#### HETEROSKEDASTICITY TEST – VARIANCE OF ERROR TERM TEST

Heteroskedasticity Test: White

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F-statistic	6.093666	Prob. F(14,15)	0.0006
Obs*R-squared	25.51397	Prob. Chi-Square(14)	0.0298
Scaled explained SS	17.35301	Prob. Chi-Square(14)	0.2379

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 12/17/16 Time: 18:24

Sample: 2 31

Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2145.986	12732.15	0.168549	0.8684
GDP^2	-209.8254	109.1934	-1.921593	0.0739
GDP*POPULATION	-243.1887	113.7799	-2.137360	0.0494
GDP*INTEREST	-142.3277	131.5596	-1.081849	0.2964
GDP*INFLATION	-290.2453	158.8051	-1.827683	0.0876
GDP	3704.333	1430.548	2.589450	0.0205
POPULATION^2	-131.5978	136.4385	-0.964521	0.3501
POPULATION*INTEREST	55.83980	141.1696	0.395551	0.6980
POPULATION*INFLATION	-270.4787	160.6649	-1.683496	0.1130
POPULATION	2610.770	1195.861	2.183172	0.0453
INTEREST^2	-251.9844	77.04904	-3.270442	0.0052
INTEREST*INFLATION	83.61569	187.4700	0.446022	0.6620
INTEREST	1921.195	1898.220	1.012104	0.3275
INFLATION^2	355.8021	148.2604	2.399846	0.0298

INFLATION	-3615.746	2710.767	-1.333846	0.2022
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R-squared	0.850466	Mean dependent var	865.5763
Adjusted R-squared	0.710900	S.D. dependent var	1232.144
S.E. of regression	662.4996	Akaike info criterion	16.13677
Sum squared resid	6583586.	Schwarz criterion	16.83737
Log likelihood	-227.0515	Hannan-Quinn criter.	16.36090
F-statistic	6.093666	Durbin-Watson stat	2.066250
Prob(F-statistic)	0.000635		

### Multicollinearity Test

Variance Inflation Factors

Date: 12/17/16 Time: 22:31

Sample: 1 31

Included observations: 30

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Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	2234.798	64.54654	NA
GDP	18.66191	5.016856	1.382535
POPULATION	28.78682	7.156439	1.214413
INTEREST	16.01394	10.04830	1.772433
INFLATION	28.13631	31.82162	1.715082

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### OLS (Regression)

Dependent Variable: HPI

Method: Least Squares

Date: 12/17/16 Time: 18:16

Sample (adjusted): 2 31

Included observations: 30 after adjustments

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Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	563.4328	47.27365	11.91854	0.0000
GDP	-5.967287	4.319944	-1.381335	0.1794
POPULATION	-5.335142	5.365335	-0.994372	0.3296
INTEREST	-10.01626	4.001743	-2.502974	0.0192
INFLATION	-19.97586	5.304367	-3.765926	0.0009

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R-squared	0.409037	Mean dependent var	369.7200
Adjusted R-squared	0.314483	S.D. dependent var	38.92549
S.E. of regression	32.22874	Akaike info criterion	9.934606
Sum squared resid	25967.29	Schwarz criterion	10.16814
Log likelihood	-144.0191	Hannan-Quinn criter.	10.00932
F-statistic	4.325957	Durbin-Watson stat	0.875383
Prob(F-statistic)	0.008526		

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