A Study of Factors Affecting the Gold Price in Thailand During 2005-2015

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by

Ms. Natjaphak Jaraskunlanat

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ABSTRACT

The objective of this study is to determine the factors that affect Gold Price in Thailand during 2005 to 2015. The correlations among the variables are also determined.

The influencing factors used in this study are World Gold Price, Oil Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, Interest Rate, Exchange Rate, and Time Lag. They are hypothesized to have impact on the Gold Price in Thailand. Multiple Regression analysis was used to find the impact of these variables.

The data tested are made stationary based on ADF unit root test. The model is significant to predict the Gold Price in Thailand; the F test significant is equal to 0.0000. The adjusted $R^2$ is equal to 0.3893 which implies that model can explain 38.93% of the changes in the Gold Price in Thailand. The autocorrelation was identified and corrected by using Newey-West method. The findings show that the Gold Price in Thailand is significantly negative correlated with Dow Jones Industrial Average, USD Index, and SET Index; only Oil Price was found to have insignificant impact on the Gold Price in Thailand. On the other hand, the Gold Price in Thailand is significantly positive correlated with World Gold Price, Consumer Price Index, and Time Lag; Interest Rate and Exchange Rate were found to have insignificant impact on the Gold Price in Thailand.

The results of this study can be useful to investors, individual buyers, and sellers for their analysis and decision making on trading gold profitably. The results of this study could be useful for academics in constructing a better model to predict the Gold Price in Thailand.
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December 3, 2015
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Chapter 1

Introduction

In this chapter, the researcher discusses about the generalities of this research including the introduction for this research, overview of global gold market, overview of gold market in Thailand, and the trends of variables affecting the gold prices in Thailand are studied in this research. This chapter also explains about the research objectives, statement of the problem, scope of the research, limitation of the research, significance of the study, and definitions of the terms.

1.1 Introduction

Gold, a precious metal people all over the world value is not only used for the jewelry purpose but for investment as well. Particularly, the new investors who don’t have knowledge about investment or the investors who do not have much time to monitor the assets they invest in, gold provides the opportunity for these investors as it is an asset that has high liquidity so the investors can sell it whenever they want and they don’t have to monitor the price frequently like stock. However, in the case of the experienced investors, adding gold into their portfolios would be another way to diversify the risk during the crisis and increasing return in the ordinary situation. Moreover, gold is an asset with high liquidity as it can be sold to anyone anytime and anywhere. People around the world value gold the same way and are willing to hold it for any circumstances. Aside from cash, gold has the highest liquidity as it can be exchanged for cash at once. Further, its value of money does not reduce much like other assets when they are sold. In addition, gold itself is a special commodity that has a currency value as it is mainly reserved by most central banks (Raktin, 2009).
Currently in Thailand, the economy is moving slow as it is now in a recession period and the stock market in Thailand does not move much plus many investors are hesitating in investing in the stock due to the nature of the stocks that can be affected by the rumor and news especially during the coup period. Moreover, the price of gold has dropped a lot from its peak at $1,895 in 2011 to $1,184 in December 2014 which is approximately 37% drop. The following graph shows 5-year trend of World Gold Price. However, investors and individual buyers and sellers do not know for sure about the factors that affect the Gold Price in Thailand; therefore, this study seeks for the answer so that investors and individual buyers and sellers can gain from trading gold.

![5-Year Gold London Fix PM](www.kitco.com)

**Figure 1.1** World Gold Price trend in 2010-2015

Source: www.kitco.com
According to the graph, the gold price has dropped dramatically since 2011 until now. However, it is expected to increase regarding to its life cycle that it reached its peak and now drop then it is expected to rise again. In addition, the current situation does not give much choice in saving money in the bank account as the interest rate is relatively low referring to Table 1.1. Therefore, in order to gain more return with less risk, gold is a recommended choice for an investor to hold and to hedge against risky short-term securities.

Table 1.1 Deposit Interest Rate in March 2015

<table>
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<th>Deposit</th>
<th>Rate (%)</th>
</tr>
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<tr>
<td>Saving</td>
<td>0.50</td>
</tr>
<tr>
<td>Fixed 3 Months</td>
<td>1.00</td>
</tr>
<tr>
<td>Fixed 6 Months</td>
<td>1.25</td>
</tr>
<tr>
<td>Fixed 12 Months</td>
<td>1.50</td>
</tr>
<tr>
<td>Fixed 24 Months</td>
<td>1.75</td>
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</table>

Source: Bangkok Bank

1.1.1 Overview of Global Gold Market

There are many markets available for gold but the important ones are London, Zurich, Paris, New York, Chicago, Frankfurt, Hong Kong, Singapore, and China markets. In addition, the oldest and most important market for gold trading is London market which London has Bullion Market Association (LBMA) as a central trading center to distribute gold to other countries all over the world. Moreover, World Gold Price is quoted by London Bullion Market Association and the unit used is troy ounce (Raktin, 2009).
There are many studies on the determinants of World Gold Price (Wei et al., 2014 & Toraman et al., 2011) which the common determinants include Oil Price, USD Index, and Dow Jones Industrial Average. Toraman et al. (2011) explained the relationship between Oil Price and World Gold Price to be positive, that is, when the Oil Price increases, World Gold Price will also increase. The rationale behind this is assumed that Oil Price is the one of the production cost of producing gold, therefore, once the Oil Price increases, the cost of producing gold will also increase, such that causes the World Gold Price to increase. Further, Wei et al. (2014) and Toraman et al. (2011) found negative relationship between USD Index and World Gold Price. To explain further, when USD Index increases, World Gold Price will decrease and vice versa. Such relationship happens because gold is used to hedge against US dollar. Moreover, Toraman et al. (2011) also found the negative relationship between Dow Jones Industrial Average and World Gold Price, that is, when Dow Jones Industrial Average increases, World Gold Price will decrease. This relationship falls into the investors point of view to diversify risk and maximize the profit in the portfolio, that is, investors invest in stock and gold but they weight these two assets differently, if the stock appreciates, investors switch to invest more in stock, as a result, they sell gold and World Gold Price drops. On the other hand, if stock depreciates, investors sell stock and buy gold so that World Gold Price increases as the demand increases.

Gold is one of the most important and popular commodities traded in the market. Gold has become more in demand since the financial crisis in 2007 or the subprime crisis and eventually, the price of gold rose to its peak at $1,895 per troy ounce in 2011. The rise of gold price is not only the matter of the volatility of the market but the insecure feeling of investors with the economic uncertainty and the increasing demand on gold for the investors caused the increase in gold price as well.
There are limited number of studies done which show the relationship between stock price and gold price. However, the prior empirical studies like that of Herbst (1983) immensely recommended that stock indices and gold price moved and are uncorrelated to each other (see also Smith, 2001; Smith, 2002). Furthermore, movements of gold price and stock index have a tendency of reacting to the external factors such as economic factors, news, oil shocks, etc.

Nevertheless, most of the current investors believe that gold is a safe asset for holding when the stock market faces short fall in value. Specifically, in the early 2008 when financial crisis erupted, the investors all around the world began to seek for an alternative investment asset to lower the loss of their portfolios. In the developed countries, gold has been broadly used as a hedge against stock but not so popular in emerging market. Currently, World Gold Price is still fluctuated due to many factors involved such as the reveal of gold reserved of China and the meeting of Federal Open Market Committee (FOMC) to hike the rates. World Gold Price is now climbing up yet fluctuated.

1.1.2 Overview of Gold Market in Thailand

Before Gold Traders Association was formed, gold traders made gold according to their preferences without considering the percentage of gold they used, some used 99% while some used 97% as well as the business hour and the fee they charged varied among different traders. Such activities caused problems, thus, gold traders gathered together and made a decision to form a club called “11 Gold Traders Club” which included 11 gold traders in order to set a standard for gold and they resolved that gold in Thailand would use 96.5% from 1983 and onward on regarding
the nature of the gold itself and the use of gold so that it would be best for the customers.

After some times, the club performed well and was widely recognized, the members increased, therefore, on August 8, 1983, 11 Gold Traders Club was granted the authorization to be an association and renamed as “Gold Traders Association”, and the name has been used until now. The roles of Gold Traders Association are not only setting the standard for percentage of gold used in producing and representing the gold traders but it is also authorized to set the Gold Price in Thailand which is used as a standard price for the whole country.

According to Gold Traders Association (2012), there are many factors to consider in order to set the Gold Price in Thailand and the price setting process is under supervision of Gold Traders Association based on the democratic primary, that is, three out of five votes of the committees from 5 different major traders will be accepted as a conclusion to set the price. In order to set Gold Price in Thailand, World Gold Price is used as a reference price plus or minus the premium from the oversea gold traders (depending on whether it’s a case of import or export) then convert it into Thai baht and finally, convert the unit from troy ounce to Baht. Gold Traders Association always considers the demand and supply of gold before setting Gold Price in Thailand too. The demand and supply of gold in Thailand is based on the 6 following factors:

a. Gold importers or exporters

b. Gold traders in China Town where it is the center gold market in Thailand

c. Gold wholesalers
d. Gold retailers  
e. Major gold investors  
f. Minor gold investors

In the current situation, Thailand imports of gold ranks third in Asia after China and India and ranks sixth in the world. Thailand is also the largest gold market in ASEAN. Thai Chamber of Commerce (2009) stated that the demand for bullion increased from 10% of total demand for gold in Thailand in 2006 to 95% of total demand for gold in Thailand in 2009. According to the survey of Gold Research Center in July, 2015, among 310 investors and 120 traders, 40.18% of them wanted to purchase gold in the next month. This shows the uptrend of the gold demand in Thailand. Moreover, the gold confidence index also increased 4.41 in July, 2015.

The trend of Exchange Rate during the period of study is declining as well as World Gold Price. To explain further, it had been increasing over the period until 2011 that it reached its peak at over THB 25,738.46 per baht and then it started to decline yet still fluctuated. Gold Price in Thailand was below THB 10,000 per baht in 2005 and increased to THB 18,272 per baht in 2015. Therefore, even Gold Price in Thailand has been fluctuating, the trend is increasing over time. The following graph illustrates the trend of Exchange Rate during the period of study.
1.1.3 Trends of Variables Affecting Gold Price in Thailand

This part will be discussed about the current trends of variables affecting Gold Price in Thailand in order to compare the trends of each variable to Gold Price in Thailand.

World Gold Price

The trend of World Gold Price during the period of study, January 2005 – March 2015, had increased until 2013 that the World Gold Price continues to drop until 2015. To explain further, World Gold Price was in the range of $450 per troy ounce had increased to reach its peak at $1,895 per troy ounce in 2011 then started to drop to $1,656 per troy ounce in January 2012. Although, World Gold Price increased again in the second half of 2012 to $1,747 per troy ounce, it dropped to $1,411.23 per troy ounce in 2013 and the trend is still declining until 2015 as it reached $1,251.85 per troy ounce in January. The following graph illustrates the trend of World Gold Price during the period of study.
The trend of Oil Price during the period of study has been fluctuating especially in June 2008 that it reached its peak at $147 per barrel then dropped dramatically to $30.28 in December 2008. However, it started to rise again until June 2009 that it reached $69.6 per barrel. After June 2009, Oil Price has been fluctuating, moving up and down along the range of $80-$100 per barrel even though it peaked at $110 in April 2011, it eventually dropped to $48 in March 2015. The following graph illustrates the trend of Oil Price during the period of study.
Dow Jones Industrial Average

The trend of Dow Jones Industrial Average during the period of study has been increasing after it dropped lower than 8,000 during the subprime crisis in February 2009. Dow Jones Industrial Average continues to rise yet it fluctuates over the period as well. However, it rose back to the highest in February 2015 at 18,244.38. The following graph illustrates the trend of Dow Jones Industrial Average during the period of study.
The trend of USD Index during the period of study slightly increases since 2011 from 77.86 to 100.38 in March 2015 which it actually started to increase steeply since July 2014. However, USD Index changed dramatically from 73.42 to 86.70 during Subprime crisis in July – November 2008. Although, it started to decline in March 2009 to 74.94 in November 2009, it then bounced back and continued to be fluctuated until 2014. The following graph illustrates the trend of USD Index during the period of study.

**Figure 1.5** Dow Jones Industrial Average trend in 2005 – 2015

Source: www.macrotrends.net
Figure 1.6 USD Index trend in 2005 – 2015

Source: www.macrotrends.net

Consumer Price Index in Thailand

The trend of Consumer Price Index in Thailand during the period of study has been slightly increasing since 2005 to 2015. However, it increased significantly in 2008 and dropped to the same level it was before the increasing at 94.84. After that Consumer Price Index in Thailand continued to increase slightly over years to over 105 at the end of 2013 and still in the range of 105 – 110 until 2015 but never reached 110. The following graph illustrates the trend of Consumer Price Index in Thailand during the period of study.
Figure 1.7 Consumer Price Index in Thailand trend in 2005 – 2015

Source: www.ycharts.com

SET Index

The trend of SET Index during the period of study has been slightly increasing from the slump in 2009 at 413.09 then SET Index rebounded and continued to increase. However, it was fluctuated, that is, increased significantly in 2013 then dropped significantly again. After dropping close to 1,200 in 2014, SET Index bounced back and reached 1,597.76 eventually. Although, SET Index trend is increasing, it’s fluctuated. The following graph illustrates the trend of SET Index during the period of study.
Interest Rate

The trend of Interest Rate during the period of study was fluctuated, that is, it was increasing until 2006 then it was steady at 5% until 2007. After that, it declined to 3.25% in 2009 and kept steady at the same rate until the beginning of 2010. Interest Rate rose again to reach 3.5% in 2011, however, it declined again in the next month and the rate continued to decline until 2015. The following graph illustrates the trend of Interest Rate during the period of study.

Figure 1.8 SET Index trend in 2005 – 2015
Source: www.tradingeconomics.com
The trend of Exchange Rate during the period of study is increasing. Although, its peak was in 2005 that USD 1 was equal THB 42.18, the Exchange Rate dropped to THB 29.30 in 2007. The Exchange Rate kept rising and falling over the past 7 years until it dropped again at the lowest point in 2013 at THB 28.54 per USD1. However, the Exchange Rate rose back and continued to rise until 2015. The following graph illustrates the trend of Exchange Rate during the period of study.

**Figure 1.9 Interest Rate trend in 2005 – 2015**

Source: www.ycharts.com
1.2 Research Objectives

Gold has been an alternative for investors to invest for various investment purposes including saving, hedging against inflation, and diversifying risk of the portfolio. Recently, investors in Thailand invest more in gold than in the past and the Gold Price in Thailand has fluctuated more. Therefore, this research is conducted and the objectives of this research are as follows:

1. To determine factors affecting Gold Price in Thailand.
2. To determine the correlation between the determining factors and Gold Price in Thailand.
1.3 Statement of the Problems

Investors in Thailand who are interested in gold investment but they lack knowledge and information regarding what makes the price fluctuate which causes loss from the investment since they cannot predict the Gold Price in Thailand. In other words, they may not know why the Gold Price in Thailand changes. Moreover, the individual buyers who buy gold, buy at the high price and the individual seller who sell gold, sell at low price because they don’t know the right direction to execute their trades. Further, the previous studies are either insufficient or do not cover all significant variables.

The research questions for this study are as follows:

1. What are the factors determining the Gold Price in Thailand?
2. What is the impact between the determining factors and the Gold Price in Thailand?

1.4 Scope of the Research

In this study, the researcher explores the relationship between the independent variables – World Gold Price, Oil Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, Interest Rate, Exchange Rate, and Time Lag, and the dependent variable – Gold Price in Thailand. The sample period selected for this study starts from January 2005 to March 2015 because the longer period studied, the better the model can be used to predict the Gold Price in Thailand; monthly data are used for this research and Gold Price in Thailand are the bullion average selling price in each month.
1.5 Limitations of the Research

The limitations are that there are only 10 research papers used as major references which most of them are in Thai language, and the monthly frequency of available data – using daily data would be more detailed and provide more reliable results but daily frequency data was not available for the variables considered in this study. This study is based on information available until March 2015 and does not consider the update on determinants. Although, this research shows the effect of the determinants in Gold Price in Thailand, it does not apply on gold price in other countries because most variables used are based on Thai data and the formula to calculate Gold Price in Thailand is different from other countries.

1.6 Significance of the Study

This research does not only include the fundamental variables considered in previous studies but also the variable that has statistical implication on Gold Price in Thailand which is Time Lag, Gold Price in Thailand of last month. Moreover, it is using available data from the most recent years in order to test the theory. Since this research studies the influence of determining variables on Gold Price in Thailand, it can be useful to investors and individual buyers and sellers. That is, they can make use of the factors significant in causing the fluctuation of Gold Price in Thailand in order to make a decision to buy or sell gold at the right time for the sake of their investment. It’s also beneficial for individual buyers and sellers, in the case of buyers who would like to buy gold, they can buy gold at the low price and in the case of sellers, they can sell gold at the high price. The model of this study can also predict the Gold Price in Thailand in the long period of time as it is tested by using the data
range of 10 years. In addition, it can be used for future studies for the academic purpose.

1.7 Definitions of terms

**Consumer Price Index** – It is a measure of the price level of goods and services on average that consumers paid for the set goods and services (Praphaphak, 2012).

**Dow Jones Industrial Average** – It is one of the most intensively observed stock market indexes and a price-weighted index of 30 big companies that are representatives of various sectors of the U.S. economy (Samanta & Zadeh, 2012).

**Exchange Rate** – It is the exchange rate of Thai baht to US dollar determined by Ministry of Finance for using as a tool to convert other currencies into the same standard (Praphaphak, 2012).

**Gold Price in Thailand** – It is the price used to determine the price of 96.5% gold bullion per Baht (15.244 gram) in Thai market which is quoted by Gold Traders Association (Raktin, 2009).

**Interest Rate** – It is 3-month fixed deposits rate announced by Bank of Thailand (Teerasan, 2010).

**MLR** – It stands for multiple linear regression. It is the study of how dependent variable \( y \) is related to two or independent variables (Anderson *et al*., 2002, p.616).

**Oil Price** – It is the price of West Texas Intermediate (WTI) crude oil traded in New York Mercantile Exchange, NYMEX (Praphaphak, 2012).
**SET Index** – It is a compound market capitalization-weighted price index which compares the current market value (CMV) of all listed common stocks with its market value on the base (Praphaphak, 2012).

**Time Lag** – It is the time path of the dependent variable in relation to its past value (Gujarati, 2003). Time Lag in this case is the t-1 value of Gold Price in Thailand.

**USD Index** – It is a calculation of six currencies that have been averaged against the US dollar. USD Index consists of 6 component currencies: Euro, Japanese yen, Pound sterling, Canadian dollar, Swedish krona, and Swiss franc (Wei et al., 2014).

**World Gold Price** – It is the standard price for 99.99% gold per troy ounce (31.1034 gram) quoted by London Bullion Market Association which the price is used to determine the gold price in the different markets around the world (Praphaphak, 2012).
Chapter 2

Review of Related Literature and Empirical Studies

In this chapter, the researcher would discuss about the related literature of this research including the theoretical support for this research and the empirical studies relating the various independent variables applied in the research and how each variable affects the dependent variable, gold price. The research also discusses the methodologies applied in the previous research that are linked to the topic.

2.1 Review of Related Theories

Relationship between World Gold Price and Gold Price in Thailand

World Gold Price is the standard price for 99.99% gold per troy ounce (31.1034 gram) quoted by London Bullion Market Association which the price is used to determine the gold price in the different markets around the world (Praphapahk, 2012). In addition, Gold Price in Thailand is the price used to determine the price of 96.5% gold bullion per Baht (15.244 gram) in Thai market which is quoted by Gold Traders Association (Raktin, 2009).

According to Chansuwan (2010), World Gold Price directly affects Gold Price in Thailand because World Gold Price is used in the formula to calculate Gold Price in Thailand which the formula is written as follow:

\[
\text{Gold Price in Thailand} = \frac{(World\ Gold\ Price +\ Premium) \times 32.1507 \times \text{Exchange\ Rate} \times 0.965}{65.6}
\]
Where:

Exchange Rate are the exchange rate of Thai baht to US dollar,

Premium are the expenses of importing gold including transportation, risk premium, interest, and insurance.

32.1507 troy ounces = 1 kilogram,

0.965 = Gold percentage in Thailand which is equal to 96.5%,

65.6 Baht = 1 kilogram.

Teerasan (2010) suggested the positive relationship between World Gold Price and Gold Price in Thailand by explaining that when World Gold Price changes $1, it will affect Gold Price in Thailand by 15.9117 baht. Moreover, Boonsri (2012) also gave support for the positive relationship between World Gold Price and Gold Price in Thailand by tested the hypothesis and found the coefficient value of 0.963. The coefficient value can be explained that while the other variables are constant if World Gold Price increases by 1%, it will cause Gold Price in Thailand to increase 0.963%. On the other hand, when World Gold Price decreases by 1%, it will also cause Gold Price in Thailand to decrease 0.963%. Raktin (2009) stated that World Gold Price is used to calculated Gold Price in Thailand, therefore, World Gold Price is positively related to Gold Price in Thailand.

Relationship between Oil Price and Gold Price in Thailand

Oil Price or crude oil price, is the price of West Texas Intermediate (WTI) also known as Texas light sweet. Crude oil market is the biggest commodity market in the world. The global consumption in 2013 was around 90 million barrels (World Crude
Oil Consumption by Year, (n.d.)). Prices of 3 types of crude oil; Brent, West Texas Intermediate, and Dubai, serve as a benchmark for other types of crude oil. Price of oil depends on two important things: sulfur content and density. Oil has low sulfur content is also known as “sweet” and low density is also known as “light” while oil that has high sulfur content is also known as “sour” and high density is also known as “heavy”.

West Texas Intermediate (WTI) is a grade of crude oil used as a benchmark in oil pricing. It is underlying commodity of New York Mercantile Exchange (NYMEX)’s oil future contracts. The price of WTI is often provided in the news reports on oil prices, together with the price of Brent Crude from the North Sea. Other key oil producers are Dubai Crude, Oman Crude, Urals oil and the OPEC Reference Basket. WTI is sweeter and lighter than Brent, and significantly lighter and sweeter than Dubai and Oman.

Aunyakovit (2010) stated that Oil Price reflects the production cost of gold and inflation, therefore, the increase in Oil Price causes Gold Price in Thailand to increase. Moreover, M. Murenbeeld and associated Inc., (2001) concluded that Oil Price has strong relationship with World Gold Price by saying that the production cost of gold mining goes along with the World Gold Price. In other word, if the production cost of gold mining rises, World Gold Price should rise as well. Since Oil Price is one of the production cost of gold (Aunyakovit, 2010), Oil Price is related to World Gold Price. Therefore, it can be concluded that Oil Price affects Gold Price in Thailand as Oil Price affects World Gold Price and in the formula to calculate Gold Price in Thailand, World Gold Price is used as a reference price to calculate. Moreover, Praphaphak (2012) stated that the increases in Oil Price causes inflation and when the
inflation rises, people will buy assets that are not affected by inflation which including gold, therefore, when Oil Price increases, World Gold Price will also increase.

Aunyankovit (2010) suggested positive relationship between Oil Price and Gold Price in Thailand. To explain further, Gold Price in Thailand is a function of Oil Price by 0.4655% which means when Oil Price changes 1%, it will cause Gold Price in Thailand to change 0.4655% as Oil Price increases the production cost for gold. Further, Innoi (2009) also suggested positive relationship between Oil Price and Gold Price in Thailand. In addition, Praphaphak (2012) also found that Oil Price is positively related to Gold Price in Thailand. However, Boonsri (2012) and Sanphechudayan (2008) found negative relationship between Oil Price and Gold Price in Thailand.

**Relationship between Dow Jones Industrial Average and Gold Price in Thailand**

Dow Jones Industrial Average (DJIA) or Dow Jones Industrial Average is one of the most intensively observed stock market indexes. The DJIA is a price-weighted index of 30 big companies that are representatives of various sectors of the U.S. economy such as financial services, manufacturing, and information technology.

According to Portfolio Theory, investors are holding different assets by considering two benefits which are diversified risk and expected return (Markowitz, 1999). Investors invest in stock market, Dow Jones Industrial Average and gold in the same time in order to diversify the risk of holding only one asset and to maximize the return from the investment, therefore, World Gold Price increases when Dow Jones Industrial Average falls or vice versa (Khamjring, 2009). To explain further, when Dow Jones Industrial Average falls (stock market crashes), investors will sell the stock they hold and buy more gold in order to keep them safe from losing more
money, as a result, the demand for gold will increase and it causes World Gold Price to increase. On the other hand, if the stock market performs well (Dow Jones Industrial Average rises), investors invest more in stock and hold less gold, thus, the demand for gold decreases as well as World Gold Price. According to the relationship between World Gold Price and Gold Price in Thailand, the relationship between Dow Jones Industrial Average and Gold Price in Thailand can then be assumed.

Raktin (2009) found that Dow Jones Industrial Average has no relationship with Gold Price in Thailand since there is a possibility that even though Dow Jones Industrial Average falls and investors switch to invest in other assets including gold, it also shows the sign of bad economic situation, thus, the demand of gold falls. As a result, the fall of Dow Jones Industrial Average doesn’t affect Gold Price in Thailand. However, Yingpakdee (2004) found positive relationship between Dow Jones Industrial Average and Gold Price in Thailand. Yet Toraman et al. (2011) found the negative relationship between Dow Jones Industrial Average and World Gold Price which can be the sign of relationship between Dow Jones Industrial Average and Gold Price in Thailand since World Gold Price and Gold Price in Thailand are positively related (Chansuwan, 2010).

**Relationship between USD Index and Gold Price in Thailand**

USD Index is a calculation of six currencies that have been averaged against the US dollar. USD Index consists of 6 component currencies: Euro, Japanese yen, Pound sterling, Canadian dollar, Swedish krona, and Swiss franc. It was listed on November 20th, 1985 as futures contract. The formula of USD Index is as follows (U.S. Dollar Index Contracts, 2015):
USD Index = 50.14348112 × EURUSD $^{-0.576}$ × USDJPY $^{0.136}$ × GBPUSD $^{-0.119}$
× USDCAD $^{0.091}$ × USDSEK $^{0.042}$ × USDCHF $^{0.036}$

Note that in the formula, when the U.S. dollar is the base currency, the value is positive; and when the U.S. dollar is the quote currency, the value is negative. The above value is compared against the U.S. dollar relative to March 1973, when the world’s major trading nations allowed their currencies to float freely against each other. The weights of each currency are as follows:

**Table 2.1 The Weights of Currencies**

<table>
<thead>
<tr>
<th>Currency</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro (EUR)</td>
<td>0.576</td>
</tr>
<tr>
<td>Japanese Yen (JPY)</td>
<td>0.136</td>
</tr>
<tr>
<td>British Pound (GBP)</td>
<td>0.119</td>
</tr>
<tr>
<td>Canadian Dollar (CAD)</td>
<td>0.091</td>
</tr>
<tr>
<td>Swedish Krona (SEK)</td>
<td>0.042</td>
</tr>
<tr>
<td>Swiss Franc (CHF)</td>
<td>0.036</td>
</tr>
</tbody>
</table>

As gold being priced in US dollar, the fluctuation of US dollar exchange rate will have significant effect on the World Gold Price (Wei *et al.*, 2014). USD Index reflects the US dollar exchange rate level and provides a fair value of US dollar to a “basket of currencies” in the international foreign exchange market. Once USD Index changes, it will reflect the implicit currency value in the World Gold Price based on the exchange rate (currency basket). Further, the USD Index gauges the relationship between the implicit currency value of gold and the US dollar in the modern currency system. As a result, Wei *et al.* (2014) concluded that USD Index is negatively related
to World Gold Price. Therefore, USD Index is related to Gold Price in Thailand based on the relationship between World Gold Price and Gold Price in Thailand. 

Raktin (2009) suggested negative relationship with Gold Price in Thailand. It can be described as when USD Index increases by 1%, Gold Price in Thailand will decrease by 0.9% according to the coefficient of the hypothesis testing. On the other hand, if USD Index decreases by 1%, Gold Price in Thailand will rise by 0.9% as USD Index is correlated with World Gold Price that is used to calculate Gold Price in Thailand. Moreover, Wei et al. (2014) found negative relationship between USD Index and World Gold Price. Further, Toraman et al. (2011) also found strong correlation between USD Index and World Gold Price.

**Relationship between Consumer Price Index and Gold Price in Thailand**

Consumer Price Index (CPI) is a measure of the price level of goods and services on average that consumers paid for the set goods and services.

Praphaphak (2012) stated that Consumer Price Index directly affect inflation which causes the money value or purchasing power to decline then people will turn to buy assets that are not affected by inflation which includes gold, gold can prevent the decline in money value, in other word, gold is used to hedge against inflation, therefore, when Consumer Price Index increases, Gold Price in Thailand will also increase as its demand increases.

Sanphechudayan (2008) suggested positive relationship between Consumer Price Index and Gold Price in Thailand. To explain further, the study found that the coefficient after testing was 53.92408 which means that when Consumer Price Index rises by 1 point, Gold Price in Thailand will increase 53.92408 baht. Sanphechudayan
concluded that if Consumer Price Index increases, Gold Price in Thailand will also increase due to Consumer Price Index is the measurement of inflation. Moreover, Boonsri (2012) also support Sanphechudayan’s statement as the study also found positive relationship between Consumer Price Index and Gold Price in Thailand.

**Relationship between SET Index and Gold Price in Thailand**

SET Index is a compound market capitalization-weighted price index which compares the current market value (CMV) of all listed common stocks with its market value on the base date of April 30, 1975 (Base Market Value or BMV), which was when the stock market was established. The initial value of the SET Index on the base date was set at 100 points. The formula of the SET Index calculation is as follows:

\[
\text{SET Index} = \frac{\text{Current Market Value} \times 100}{\text{Base Market Value}}
\]

Praphaphak (2012) stated that investors choose to invest in different assets such as stock and gold by considering the return and risk, if the asset yield higher return, investor will invest in that asset more than other assets which applied to the choice of investing in stock and gold, in this case, if SET Index perform well, stock price rises, investors will invest more in stock which causes the decline in the demand for gold, as a result, Gold Price in Thailand will fall. On the other hand, if SET Index doesn’t perform well, investors will invest more in gold that provide more return, therefore, the demand for gold rises as well as its price.

Aunyankovit (2010) concluded that SET Index has positive relationship with Gold Price in Thailand. Moreover, Raktin (2009) also found positive relationship between SET Index and Gold Price in Thailand. However, Innoi (2009) found no significant relationship between SET Index and Gold Price in Thailand.
Relationship between Interest Rate and Gold Price in Thailand

Interest Rate is 3-month fixed deposits rate announced by Bank of Thailand (Teerasan, 2010). Innoi (2009) stated that Interest Rate in Thailand is announced by Bank of Thailand which is one of the factors affecting Gold Price in Thailand as the change in Interest Rate affects investors by causing them to adjust the investment pattern which the increase in Interest Rate will reduce the opportunity for investors to hold gold as investors switch to invest in other assets that yield high return and have lower risk which in this case is money; investors will deposit money to the bank with the fixed rate for a better return than holding gold.

Innoi (2009) suggested that Interest Rate and Gold Price in Thailand are positively related because if the interest increases, people will save money in the bank, however, considering the increase of 3-month fixed deposits rate that reflects the inflation in Thailand. Therefore, when the inflation rises, Gold Price in Thailand will also rise as well (Innoi, 2009). However, Teerasan (2010) found Interest Rate is negatively related to Gold Price in Thailand. He stated that when Interest Rate increases, people will save money in the saving account in order to avoid risk of holding other assets including gold but when the Interest Rate drops, people will switch from saving money to buy gold as it provides a higher return. Therefore, the demand for gold rises as Interest Rate drops.

Relationship between Exchange Rate and Gold Price in Thailand

Exchange Rate means the exchange rate of Thai baht to US dollar determined by Ministry of Finance for using as a tool to convert other currencies into the same standard (Praphaphak, 2012). There are two rates of Exchange Rate which are buying
rate and selling rate, buying rate is the rate commercial banks buy and selling rate is the rate commercial banks sell which normally is higher than buying rate.

Exchange Rate and Gold Price in Thailand has positive relationship as when Thai baht depreciates and US dollar appreciates, Gold Price in Thailand will increase as gold is an import product so that the cost of gold will increase once Thai baht depreciate or vice versa, thus, Exchange Rate directly affects Gold Price in Thailand (Praphapahk, 2012). Moreover, Boonsri, (2012); Raktin, (2009); and Sanphechudayan, (2008), also suggested the same relationship as Praphapahk (2012).

**Relationship between Time Lag and Gold Price in Thailand**

Time Lag is the lapse time, that is, it portrays the time path of the dependent variable in relation to its past value (Gujarati, 2003). Time Lag, in other word, is the value of \( Y_{t-1} \) which in this case is the Gold Price in Thailand at the time \( t-1 \).

Time Lag and Gold Price in Thailand is expected to have positive relationship since it represents the speculation of the Gold Price in Thailand in the current month based on the Gold Price in Thailand of last month. Moreover, the study of Wei et al. (2014) shown the relationship between the Time Lag and World Gold Price, that is, if the daily return of gold price is positive, then the possibility of the followed trading day’s return to be positive is higher than that to be negative. Moreover, they also found that the previous price of the CRB index and the USDX can explain the following day’s gold price.

**2.2 Review of Empirical Studies**

There are numerous researches that studied about the factors affecting gold price both domestically and internationally such as the relationship between oil price
and gold price or the relationship between USD index and gold price and so on. In this part, empirical studies on factors affecting gold price will be discussed.

Wei et al. (2014) conducted a research on macro factors that had impact on World Gold Price during the financial crisis during 2007 - 2009. The research objectives were to determine that macro factors and how they are correlated with the World Gold Price. The macro factors they used to determine the World Gold Price were USD index, CRB index (Commodity Research Bureau Futures Price Index), and US treasury CDS spread. The data used were monthly data from August 2007 to June 2009 which were during the subprime crisis. The method used in this research was Vector Autoregression (VAR). The findings show that USD index is negatively correlated with gold price; while CRB index and CDS spreads are positively correlated with gold price. Moreover, the study shows that CRB index and USD index have one lagged relationship; while CDS spread has two lagged relationship with World Gold Price.

Boonsri (2012) studied factors affecting Gold Price in Thailand and gold future price forecast to advance by ARIMA method. The objectives of the study were to study the economic factors affecting the Gold Price in Thailand and to forecast the Gold Price in Thailand by using ARIMA method. The independent variables used in this study were World Gold Price, Consumer Price Index, Oil Price, Exchange Rate of USD/THB, and three-month fixed deposits Interest Rate while the dependent variable was Gold Price in Thailand. The secondary data used in this study was collected monthly from January 2007 to December 2011. The study has found that World Gold Price, Exchange Rate, Consumer Price Index, and Gold Price in Thailand were positively correlated while the Interest Rate and Oil Price are negatively correlated.
Praphaphak (2012) studied factors affecting the gold bullion price in Thailand before and after the economic crisis of the USA. The research objective was to study the factors affecting the bullion price in Thailand before and after the economic crisis of the USA. There are many independent variables taken in this study which include Consumer Price Index, Oil Price, World Gold Price, Interest Rate, Exchange Rate USD/THB, SET Index, and Thailand industrial index to determine the dependent variable which is the bullion price in Thailand. The method used in this study was ARIMAX. The data were collected monthly from January 2002 to December 2010. As a result, the findings show that the Exchange Rate USD/THB, Thailand industrial index and World Gold Price are positively correlated with the bullion price in Thailand. However, Consumer Price Index and Oil Price have no significant correlation with the bullion price in Thailand. Further, Interest Rate and SET Index don’t directly affect the bullion price in Thailand.

Kusolpalalert (2012) investigated the relationships of various assets in the different markets in Thailand during the recovery period and the subprime crisis. He studied the relationship among SET Index, World Gold Price, government bond yields, and Treasury bill rates in Thailand. The variables he used to investigate the relationships of the various assets in this study were SET Index, World Gold Price, 1-year government bond yield, 2-year government bond yield, 10-year government bond yield, 1-month Treasury bill rate, and 3-month Treasury bill rate. In order to perform the investigation, he adopted 2 statistical models which are Johansen’s cointegration and Vector Error Correction. He found that SET Index has a positive relationship with World Gold Price, 2-year government bond yield, and 3-month Treasury bill rate but has an inverse movement with 1-year, 10-year government bond yield, and 1-month Treasury bill rate in the recovery period. Meanwhile SET Index
has a positive relationship with World Gold Price, 1-year, 10-year government bond
yield and 1-month Treasury bill rate during the economic crisis.

Toraman et al. (2011) studied the determination of factors affecting the World
Gold Price. The research aimed to determine the factors affecting World Gold Price
with MGARCH model. The variables researchers used in order to determine the
World Gold Price were USD Index, US inflation rate, US real interest rate, Oil Price
and Dow Jones Industrial Average. The data were collected monthly from January
1992 to March 2010. The result shows that the highest correlation is between World
Gold Price and USD Index but it is a negative correlation. Moreover, Dow Jones
Industrial Average also have a negative relationship with World Gold Price. However,
there is positive correlation between World Gold Price and Oil Price, US inflation
rate, and US real interest rate.

Teerasan (2010) conducted a research on an analysis of economic factors
affecting Gold Price in Thailand. The researcher aimed to study the economic factors
affecting the Gold Price in Thailand and forecast the Gold Price in Thailand. The
variables involved in this study include Gold Price in Thailand as a dependent
variable and World Gold Price, Exchange Rate USD/THB, Consumer Price Index,
three-month fixed deposits Interest Rate, per capita income, Oil Price, and gold tax as
independent variables. The data were collected monthly from January 1997 to
December 2007. The researcher employed 2 statistical models in analyzing the data
which were regression and ARIMA. The research findings show that all of the
independent variables have significant effect on the Gold Price in Thailand and the
forecasting shows high tendency of increasing Gold Price in Thailand.
Kampiew (2010) studied an analysis of the relationship between World Gold Price and the US exchange rate using cointegration method. This research objective was to analyze the relationship between World Gold Price and EUR/USD and USD/JPY. The statistical models used to analyze the relationship were cointegration and Error correction model. EUR/USD and USD/JPY were used as independent variables while World Gold Price was used as a dependent variable. The researcher collected the data daily from January 4, 1999 to May 11, 2010. The result shows that EUR/USD has a bi-directional causality relationship while USD/JPY has one causality relationship with the World Gold Price.

Aunyankovit (2010) conducted a research on factor determination of Gold Price in Thailand. The research aimed to study the relationship between Gold Price in Thailand and domestic interest rate, Oil Price, and SET Index. The study used real interest rate, Oil Price, and SET Index as independent variables and Gold Price in Thailand as a dependent variable which the data were collected from January 1998 to December 2008. The statistical models used in the study were simple regression and multiple regression. The study found that Oil Price is the best explainable factor to Gold Price in Thailand with the positive relationship. SET Index also has a positive relationship with the Gold Price in Thailand while real interest rate has a negative relationship with the Gold Price in Thailand.

Raktin (2009) studied factors affecting Gold Price in Thailand. The research objectives were to study the factors affecting Gold Price in Thailand and to compare whether the factors affecting Gold Price in Thailand will be different in the period that the price is fluctuated and in the period that the price is quite stable. The statistical model used in the study in multiple regression. The dependent variable was Gold Price in Thailand while the independent variables were the Exchange Rate USD/THB,
World Gold Price, Dow Jones Industrial Average, SET Index, USD Index, Interest rate, Consumer Price Index, and Oil Price. The research collected the data monthly from January 1999 to June 2008. The research finds show that the Exchange Rate USD/THB and World Gold Price affect Gold Price in Thailand positively. The effect of both factors are different during the fluctuated period and stable period.

Innoi (2009) conducted a research on an essential element of Gold Price in Thailand gold market. The objective of the study was to study the Gold Price in Thailand determinants in Thailand gold market. The statistical model used in this research was multiple regression. The independent variables include the Exchange Rate USD/THB, World Gold Price, diesel price in Thailand, SET Index, Silver Price, and three-month fixed deposits Interest Rate. The data were collected monthly from January 2004 to October 2008. The researcher found that the factors determined Gold Price in Thailand are the World Gold Price, diesel price in Thailand, three-month Interest Rate and Silver Price. However, the fluctuation of Gold Price in Thailand, SET Index, and the Exchange Rate USD/THB cannot explain the behavior of Gold Price in Thailand.

Sanphechudayan (2008) studied factors determining gold bullion price in Thailand. The study aimed to analyze the factors affecting changes in the price of gold bullion sold in Thailand. The statistical model employed in this study is regression by ordinary least square (OLS). The independent variables used in this study consist of the Exchange Rate USD/THB, World Gold Price, real interest rate, Consumer Price Index, and Oil Price. The data were collected quarterly from the second quarter of 2002 to the third quarter of 2008. The result shows that the Exchange Rate USD/THB, World Gold Price, and Consumer Price Index are
positively correlated with Gold Price in Thailand while the real interest rate and Oil Price are negatively correlated with the Gold Price in Thailand.

To summarize the empirical studies, in order to study the factors affecting Gold Price in Thailand, the most common variable used to test the relationship is World Gold Price, it is used by 6 researchers (Boonsri, 2012; Praphaphak, 2012; Teerasan, 2010; Raktin, 2009; Innoi, 2009; and Sanpheapchudayan, 2008) and the findings are the same that there is positive relationship between World Gold Price and Gold Price in Thailand. Another common variable used in the study of Gold Price in Thailand is Oil Price, Boonsri (2012) and Sanpheapchudayan (2008) found negative relationship between Oil Price and Gold Price in Thailand, however, Aunyakovit (2010) found positive relationship between Oil Price and Gold Price in Thailand.

Moreover, Dow Jones Industrial Average was also used to study the fluctuation of World Gold Price and Gold Price in Thailand. Toraman et al. (2011) found negative relationship between Dow Jones Industrial Average and World Gold Price while Raktin (2009) found no relationship between Dow Jones Industrial Average and Gold Price in Thailand. In addition, USD Index shows negative correlation with World Gold Price (Wei et al., 2014 & Toraman et al., 2011).

Further, Boonsri (2012); Praphaphak (2012); Teerasan (2010); Raktin (2009); and Sanpheapchudayan (2008) studied the relationship between Consumer Price Index and Gold Price in Thailand which they found these two variables to be positively related. Moreover, SET Index is used to study the fluctuation of Gold Price in Thailand. Aunyankovit (2010) found positive relationship between SET Index and Gold Price in Thailand, however, Praphaphak (2012) and Innoi (2009) found no relationship between SET Index and Gold Price in Thailand.
Innoi (2009) found that Interest Rate is a determinant of Gold Price in Thailand and Boonsri (2012) also found positive relationship between Interest Rate and Gold Price in Thailand. Furthermore, Exchange Rate was found to be positively correlated with Gold Price in Thailand (Boonsri, 2012; Praphaphak, 2012; Teerasan, 2010; Raktin, 2009; and Sanphechudayan, 2008) yet Innoi (2009) found that Exchange Rate is not significant to explain the behavior of Gold Price in Thailand.

To conclude, Table 2.2 summarizes the effects of fundamental variables on gold price observed in the previous studies. These studies are used by the researcher as basis to choose the relevant variables for this research.
Table 2.2 Review of previous research

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Objectives</th>
<th>Methodology</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wei et al. (2014)</td>
<td>To determine which macro-factors and how the macro-factors impact on the gold price.</td>
<td>VAR (Vector Auto Regression)</td>
<td>USD is negatively correlated with gold. CRB and CDS are positively correlated with gold. The one lagged CRB index, one lagged USD index, and two lagged CDS have significant impact on the gold price.</td>
</tr>
</tbody>
</table>
| Boonsri (2012) | 1. To study the economic factors affecting the gold price.  
                        2. To forecast the gold price in Thailand by using ARIMA method. | ARIMA                  | Gold price, USD/THB, CPI and gold price in Thailand are correlated in the same direction while the interest rate and oil price are correlated in the opposite direction. |
<table>
<thead>
<tr>
<th>Praphaphak (2012)</th>
<th>To study the factors affecting the gold bullion price in Thailand before and after the economic crisis of the USA.</th>
<th>ARIMAX USD/THB, Thailand industrial index, and gold price have a positive correlation with the gold price in Thailand.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kusolpalalert (2012)</td>
<td>To investigate the relationships of various assets in the different markets in Thailand during the recovery period and the subprime crisis.</td>
<td>1. Johansen's cointegration 2. Vector Error Correction SET index has a positive relationship with gold price, 2-year GB yield, and 3-month T-bill rate but has an inverse movement with 1-year, 10-year GB yield, and 1-month T-bill rate in the recovery period. Meanwhile, SET index has a positive relationship with gold price, 1-year, 10-year GB yield and 1-month T-bill rate during economic crisis.</td>
</tr>
<tr>
<td></td>
<td>To determine factors affecting the gold price.</td>
<td>MGARCH</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------</td>
<td>--------</td>
</tr>
</tbody>
</table>
| Toraman et al. (2011) | 1. To study the economic factors affecting the gold price in Thailand.  
2. To forecast the gold price in Thailand. | 1. Multiple Regression  
2. ARIMA | 1. All of the factors have significant effect on the gold price.  
2. The forecasting shows high tendency of increasing gold price in Thailand. |
| Teerasan (2010) | To analyze the relationship between gold price and USD/EUR and USD/JPY by using cointegration and ECM. | 1. Cointegration  
2. Error correction model | USD/EUR has a bi-directional causality relationship while USD/JPY has one causality relationship. |
| Kampiew (2010) | | | |
**Table 2.2 Review of previous research (Con’t)**

| Aunyankovit (2010) | To study the relationship between gold price and domestic interest rate, crude oil price, and SET index. | 1. Simple regression  
2. Multiple regression | Crude oil is the best explanation factor to gold price with the positive relationship.  
SET index has a positive relationship with the gold price while interest rate has a negative relationship. |
|--------------------|-------------------------------------------------|----------------------------|-----------------------------------------------------------------|
Table 2.2 Review of previous research (Con’t)

| Raktin (2009) | 1. To study the factors affecting Thai gold price by applying multiple regression analysis.  
                 2. To compare whether the factors affecting Thai gold price will be different in the period that the price is fluctuated and in the period that the price is quite stable. | Multiple regression USD/THB and gold price affect the price of Thai gold positively. The effects of both factors are different during the fluctuated period and stable period. |
### Table 2.2 Review of previous research (Con’t)

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Objective</th>
<th>Methodology</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innoi (2009)</td>
<td>To study the gold price determinants in Thailand gold market.</td>
<td>Multiple regression</td>
<td>The factors determined gold prices in Thailand are the gold price, diesel price, three-month interest rate and silver price. However, the differential of gold price in Thailand, SET index, and USD/THB cannot explain the behavior of gold price.</td>
</tr>
<tr>
<td>Sanphechudayan (2008)</td>
<td>To analyze the factors affecting changes in the price of gold bullion sold in Thailand.</td>
<td>Regression by ordinary lease square (OLS)</td>
<td>USD/THB, gold price, and CPI are positively correlated with the gold price in Thailand while the real interest rate and oil price are negatively correlated with the gold price.</td>
</tr>
</tbody>
</table>
Chapter 3

Theoretical and Conceptual Framework

This chapter discusses the theoretical framework, conceptual framework, hypotheses, and the adjustment of variables. The theoretical frameworks from Praphaphak (2012), Teerasan (2010), and Raktin (2009) discussed firstly, they were retrieved from the previous studies related to the gold price in Thailand. The next part is the discussion of the conceptual framework constructed by the researcher based on the theoretical frameworks in the previous part. The hypotheses developed base one the conceptual framework in the second part are discussed in the later part. Finally, the last part is the discussion of the operationalization of variables used in the conceptual framework.

3.1 Theoretical Framework

According to Anfara and Mertz (2014), a theoretical framework explains the hypotheses regarding the relationship between independent and dependent variables of the research. Thus, the researchers must evaluate the various theoretical frameworks to develop the conceptual framework for their study.

Based on that, the researcher will use the theoretical frameworks in the previous studies as models in developing the conceptual framework in this study. These models provide useful and sound basis for this research. Hence, relevant theoretical frameworks are chosen for this research. The researcher has adapted 3 frameworks to develop the model for this research as shown in the following part with the methodologies and findings.
Figure 3.1: The research model of “Factors Affecting the Gold Bullion Price in Thailand Before and After the Economic Crisis of the USA”.


Praphaphak (2012) studied the factors that affected gold price in Thailand. The factors treated as independent variables in the model are world gold price, oil price, consumer price index, interest rate, exchange rate, SET index, and Thailand Industrial index. The study applied monthly data from January 2007 to December 2011. This quantitative analysis was done by applying unit root test to find order of integration then use the result to apply in ARIMAX to predict the gold price in Thailand. The study found that the exchange rate, Thailand Industrial index, and gold price have a significant and positive correlation with the gold price in Thailand; while other variables do not show significant correlation with the gold price in Thailand.

From Praphaphak’s model in 2012, this study chooses world gold price, oil price, consumer price index, interest rate, exchange rate, and SET index that show significant impact on Thai gold price included to be in the conceptual framework to predict gold price in Thailand. They are considered relevant and useful factors.
Teerasan (2010) studied the economic factors affecting the gold price in Thailand. The factors studied as independent variables in the model are world gold price, oil price, consumer price index, per capita income, exchange rate, gold tax, and 3-month fixed deposits interest rate. The researcher collected monthly data from January 1997 to December 2007 and apply in the research. The analysis of this study was divided into 2 types including descriptive analysis and quantitative analysis. In quantitative analysis, ARIMA technique was used to analyze the impact of the independent variables on Thai gold price. The findings show that all of the factors have significant impact on the gold price in Thailand. World gold price, oil price, consumer price index, per capita income, and gold tax has positive correlation with the gold price in Thailand; while exchange rate and 3-month fixed deposits interest rate have negative correlation with the gold price in Thailand. Moreover, the forecasting also shows high tendency of increasing gold price in Thailand.
From the study of Teerasan (2010), this study selected world gold price, oil price, exchange rate, consumer price index, and gold tax that have significant impact on Thai gold price to include in the conceptual framework to predict the gold price in Thailand; they are relevant and useful factors.

Figure 3.3: The research model of “Factors Affecting Thai Gold Price”.


Raktin (2009) studied the factors that affected gold price in Thailand. Factors used in the model are world gold price, oil price, Dow Jones Industrial Average, USD index, consumer price index, SET index, interest rate, in this case means Federal Funds Rate, and exchange rate. The study used monthly data from January 1999 to June 2008. There were 2 types of analysis used in this study which were descriptive analysis and quantitative analysis. In quantitative analysis, the researcher applied Multiple Regression analysis to examine the impact of the variables mentioned earlier on Thai gold price. The researcher found that the exchange rate and the world gold price have significant and positive correlation with Thai gold price. However, the other variables don’t show significant impact on gold price in Thailand for both fluctuation period, January 2005 – December 2008, and stable period, January 1999 –
December 2004. Moreover, the researcher found that the effect on both factors are different during the fluctuated period and the stable period.

From Raktin’s model in 2009, the current study chooses world gold price, oil price, Dow Jones Industrial Average, USD Index, consumer price index, SET Index, and exchange rate that have the significant impact on Thai gold price included to be in the conceptual framework to predict gold price in Thailand. They are considered relevant and useful factors.

3.2 Conceptual Framework

The conceptual framework of this study is based on the theoretical framework of the previous studies. In this model, World Gold Price, Oil Price, Consumer Price Index, and Exchange Rate are the common variables appeared in the studies of Praphaphak (2012), Teerasan (2010), and Raktin (2009), Interest Rate and SET Index are taken from Praphaphak (2012) and Raktin (2009), and USD Index and Dow Jones Industrial Average are taken from Raktin (2009).

The macroeconomic factors that have the effect on the Gold Price in Thailand which are Consumer Price Index, Exchange Rate, and Interest Rate included. The model also includes relevant factors which are World Gold Price, Oil Price, Dow Jones Industrial Average, USD Index, and SET Index. Therefore, this model has nine predictive variables to explain the fluctuation of Gold Price in Thailand.

There is a relationship between World Gold Price and Gold Price in Thailand. World Gold Price, as an important factor that Gold Traders Association uses to determine Gold Price in Thailand; thus, it is expected to move the same direction as the gold price in Thailand.
There is a relationship between Oil Price and Gold Price in Thailand. Oil Price reflects the production cost of gold plus gold is often used as a tool to hedge against inflation, therefore, when Oil Price increases, the production cost also increases, as a result, the price of goods increase which causes inflation. The increase of inflation causes the demand of gold to increase in order to hedge against inflation, it results in the increase in gold price. Hence, it is expected that Oil Price and Gold Price in Thailand move in the same direction. However, when the Oil Price increases, it shrinks the economic growth rate as it increases the production cost, it may cause the reduction in spending as well as the gold demand especially in term of jewelry and will cause the price of gold to decrease.

There is a relationship between Dow Jones Industrial Average and Gold Price in Thailand. Dow Jones Industrial Average, the index that represents the US economy as the USA is a powerful country in term of economic and it has a large capital market which is related to the world economy. Therefore, Raktin (2009) stated that Dow Jones Industrial Average is used as a representative of the world economy. Dow Jones Industrial Average is expected to move in the opposite direction from Gold Price in Thailand because when the stock market falls, the investors switch to invest in other assets including gold. Consequently, the demand of gold increases and it causes the World Gold Price to increase as well as Gold Price in Thailand that has the positive relationship with the World Gold Price.

There is a relationship between USD Index and Gold Price in Thailand. USD Index is the index used to compare US dollar and another 6 currencies, Euro (57.6%), Japanese yen (13.6%), Pound sterling (11.9%), Canadian dollar (9.1%), Swedish krona (4.2%), and Swiss franc (3.6%), USD Index moves in the opposite direction from Gold Price in Thailand.
There is a relationship between Consumer Price Index and Gold Price in Thailand. Consumer Price Index is another factor affecting Gold Price in Thailand in the same direction as the return from gold depends on the inflation, therefore, if consumer price index increases, gold price in Thailand also increases.

There is a relationship between SET Index and Gold Price in Thailand. SET Index is used to be a representative of Thai stock market, if SET Index rises, it reflects the uptrend of Thai stock market which means the investors invest more in stock and less in gold which causes the demand for gold to decline. Therefore, SET Index has a negative relationship with Gold Price in Thailand.

There is a relationship between Interest Rate and Gold Price in Thailand. Interest Rate is a factor affecting Gold Price in Thailand in the opposite direction. To explain further, if the Interest Rate increases, people tend to switch to save money in the bank account instead of holding gold as saving provides lower risk. Consequently, the demand of gold decreases as well as the Price of Gold in Thailand. Even though, Gold Price in Thailand is referred from World Gold Price, Gold Traders Association makes the adjustment before announcing the price.

There is a relationship between Exchange Rate and Gold Price in Thailand. Exchange Rate is the factor that affect Gold Price in Thailand. If Thai Baht appreciates, the gold importer will require less Thai Baht to exchange for US dollar to import gold. As a result, the cost of importing gold decreases, thus, Gold Price in Thailand decreases.

There is a relationship between Time Lag and Gold Price in Thailand. Time Lag is the factor that affect Gold Price in Thailand. To explain further, the Gold Price
in Thailand should change in the same direction as the price of last month based on the speculation of the investors.

The illustration of the conceptual framework of this study provided in Figure 3.4 that shows the relationship between Gold Price in Thailand and the nine independent variables including World Gold Price, Oil Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, Interest Rate, and Exchange Rate.

Figure 3.4: The conceptual framework of this study.

![Conceptual Framework](image)

Source: Adapted from Praphaphak (2012); Teerasan (2010); Raktin (2009).

3.3 Research Hypotheses

H10: There is no significant impact of World Gold Price on Gold Price in Thailand during 2005-2015.

H1a: There is a significant impact of World Gold Price on Gold Price in Thailand during 2005–2015.

H2a: There is a significant impact of Oil Price on Gold Price in Thailand during 2005 – 2015.

H3o: There is no significant impact of Dow Jones Industrial Average on Gold Price in Thailand during 2005 – 2015.

H3a: There is a significant impact of Dow Jones Industrial Average on Gold Price in Thailand during 2005 – 2015.

H4o: There is no significant impact of USD Index on Gold Price in Thailand during 2005 – 2015.

H4a: There is a significant impact of USD Index on Gold Price in Thailand during 2005 – 2015.

H5o: There is no significant impact of Consumer Price Index on Gold Price in Thailand during 2005 – 2015.

H5a: There is a significant impact of Consumer Price Index on Gold Price in Thailand during 2005 – 2015.

H6o: There is no significant impact of SET Index on Gold Price in Thailand during 2005 – 2015.

H6a: There is a significant impact of SET Index on Gold Price in Thailand during 2005 – 2015.

H7o: There is no significant impact of Interest Rate on Gold Price in Thailand during 2005 – 2015.

H7a: There is a significant impact of Interest Rate on Gold Price in Thailand during 2005 – 2015.
H8o: There is no significant impact of Exchange Rate on Gold Price in Thailand during 2005 – 2015.

H8a: There is a significant impact of Exchange Rate on Gold Price in Thailand during 2005 – 2015.

H9o: There is no significant impact of Time Lag on Gold Price in Thailand during 2005 – 2015.

H9a: There is a significant impact of Time Lag on Gold Price in Thailand during 2005 – 2015.
Table 3.1 Operationalization of Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Conceptual Definition</th>
<th>Operational Components</th>
<th>Measurement Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Price in Thailand</td>
<td>Gold Price in Thailand is the bullion price in Bangkok market, announced by Gold Traders Association (Raktin, 2009).</td>
<td>Gold Price in Thailand = [(Spot Gold + Premium) × 32.148 × Exchange Rate × 0.965] ÷ 65.6</td>
<td>Ratio Scale</td>
</tr>
<tr>
<td>World Gold Price</td>
<td>World Gold Price is 99.99% gold traded in the world market (Teerasan, 2010).</td>
<td>World Gold Price has been determined by London Market Price which one troy ounce is equal a given market price in US dollar.</td>
<td>Ratio Scale</td>
</tr>
</tbody>
</table>
Table 3.1 Operationalization of Variables (Con’t)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Price</td>
<td>Oil Price, West Texas Intermediate (WTI) is used as a benchmark in oil pricing and it is quoted from NYMEX (New York Mercantile Exchange).</td>
<td>Oil Price has been determined by NYMEX which one barrel is equal to a given market price in US dollar.</td>
</tr>
</tbody>
</table>
Table 3.1 Operationalization of Variables (Con’t)

| Dow Jones Industrial Average | Dow Jones represents the world economy as the USA is a large capital market and related to the world economy (Raktin, 2009). | \[
DJIA = \frac{\sum p}{d}
\]

Where \( p \) is the prices of the component stock and \( d \) is the Dow Divisor (the divisor is updated sporadically and modified to counterbalance the effect of stock splits, bonus issues or any change in the component stocks included in DJIA). | Ration Scale |
Table 3.1 Operationalization of Variables (Con’t)

<table>
<thead>
<tr>
<th>USD Index</th>
<th>USD Index is the index used to compare US dollar and another 6 currencies (Raktin, 2009).</th>
<th>EUR 57.6% weight</th>
<th>Ratio Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>JPY 13.6% weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GBP 11.9% weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAD 9.1% weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SEK 4.2% weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHF 3.6% weight</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3.1 Operationalization of Variables (Con’t)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Formula</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Price Index</td>
<td>Consumer Price Index reflects the inflation of the country as it gauges the change of price level in of goods and services purchased by households.</td>
<td>( CPI = \sum_{i=1}^{n} CPI_i \times WEIGHT_i )</td>
<td>Ratio Scale</td>
</tr>
<tr>
<td>SET Index</td>
<td>SET Index is a measurement of Thai stock market calculated by the prices of all common stocks traded in Thai stock market and have not been suspended for more than one year.</td>
<td>( SET \text{ Index} = \frac{Current \text{ Market Value} \times 100}{Base \text{ Market Value}} )</td>
<td>Ratio Scale</td>
</tr>
</tbody>
</table>
### Table 3.1 Operationalization of Variables (Con’t)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest Rate</td>
<td>Interest Rate, 3-month fixed deposits rate, is one of the factors people use to consider the investment alternatives in order to compare the return from investment.</td>
<td>Interest Rate is a reference 3-month fixed deposits percentage rate that yield for the saving and it will be adjusted periodically.</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>Exchange Rate means the exchange rate of Thai baht to US dollar.</td>
<td>Exchange Rate is the amount of Thai baht to exchange to 1 US dollar at the market price.</td>
</tr>
<tr>
<td>Time Lag</td>
<td>Time Lag means the Gold Price in Thailand of last month.</td>
<td>Time Lag = Gold Price in Thailand $t-1$</td>
</tr>
</tbody>
</table>
Chapter 4

Research Methodology

This chapter discusses about an overview of methodology applied in this research. This chapter is divided into two parts which are the data collection and statistical treatment of data used in this research. Part one, data collection, includes types of data collected in this research and collection of time series data. Part two, statistical treatment of research includes unit root test, multiple regression, regression coefficients, the multiple coefficient of determination, F test, t test, multicollinearity, and autocorrelation.

4.1 Data Collection

Primary data are the original data collected for a specific research goal and secondary data are the material created by other researchers which are made available for reuse for another research question (Hox & Boeije, 2005). This research applied secondary data to analyze the impact of chosen factors to cause the fluctuation of the Gold Price in Thailand. The details of the types of data used and the sources of the data in the empirical analysis will be discussed in the following parts respectively.

4.1.1 Types of Data

The times series data is used in this research including Gold Price in Thailand, World Gold Price, Oil Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, Interest Rate, Exchange Rate, and Gold Tax observed at monthly frequency.
### 4.1.2 Collection of Time Series Data for this study

Monthly time series data of World Gold Price, Oil Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, Interest Rate, and Exchange Rate are collected from January 2005 to March 2015 in order to study the relationship between the independent variables and the dependent variable, Gold Price in Thailand. The major sources of secondary data for the research are the Gold Traders Association who sets the Gold Price in Thailand, Kitco website which is the website that provides all metal prices, Yahoo website which is the website that provides market data in finance, Investing.com which is the website that provides data in finance regarding the investment, Bureau of Trade and Economic Indices who conducts survey for economic indices, SCBAM which is the website that provides investment choices of Siam Commercial Bank, and Bank of Thailand who is the central bank of Thailand. Sources of data for every variable applied in this research are listed in Table 4.1 below.

### Table 4.1 Sources of data used in this research

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Time Period</th>
<th>Data Source</th>
</tr>
</thead>
</table>
Table 4.1 Sources of data used in this research (Con’t)

<table>
<thead>
<tr>
<th>Source of Data</th>
<th>Frequency</th>
<th>Time Period</th>
<th>Source</th>
</tr>
</thead>
</table>

4.2 Statistical Treatment of Data

This research will use EVIEWS 7.0 software to analyze data and test nine hypotheses listed in Chapter 3. There are two statistical methods applied in this research including Augmented Dickey Fuller Unit Root Test and Multiple Linear Regression.
4.2.1 Augmented Dickey Fuller (ADF) Unit Root Test

During the analysis of time series data, it is important to assure that all
data are stationary, otherwise the empirical results can show significant
relationship between variables that do not supposed to be related in realism. A
non-stationary process results in false regression between unrelated factors.
Many macroeconomic and financial variables are non-stationary time series; a
time series is said to be non-stationary if it has a unit root (Hill et al., 2001). In
a stationary time series, shocks are accounted temporary unless in a non-
stationary time series, the mean and variance of the series depend on time; as
time moves toward infinity, the variance also moves toward infinity (Asteriou
and Hall, 2006). In this research, Augmented Dickey Fuller (ADF) test is used
to check stationarity of data for use in Multiple Regression so as to prevent the
false results.

Unit root test is a test of stationarity that has been broadly used over
the past many years. Augmented Dickey Fuller test is used to find the unit root
under the null hypothesis that $\gamma = 0$ by applying $\tau$ (tau) statistic. If the
hypothesis that $\gamma = 0$ is fail to accept, the usual Student’s t test can be used.
Moreover, Dickey-Fuller test is one-sided as the alternative hypothesis is that
$\gamma < 0$.

For ADF test, the following model is estimated (Dickey and Fuller,
1981):

$$\Delta V_t = \alpha + \beta t + \gamma V_{t-1} + \delta_1 \Delta V_{t-1} + \cdots + \delta_{p-1} \Delta V_{t-p+1} + \varepsilon_t \quad \text{(eq. 4.1)}$$

Where,
α is the constant,

β is the coefficient on a time trend,

γ is the coefficient presenting process root,

δ₁ to δₚ₋₁ are coefficients,

εᵣ is the first difference operator,

Vᵣ, Vᵣ₋₁, and Vᵣ₋ₚ₊₁ are the time series at times t, t₋₁, and t₋ₚ₊₁ respectively,

p is the number of lags, and

ε is the pure white noise error term.

The ADF test uses lagged values of the dependent variable, ΔVᵣ, to find a unit root. The precise number of lagged difference terms to include are judged using empirical analysis in the way that the error term, ε, is serially uncorrelated. The Dickey-Fuller t-statistic is different from the standard t-distribution as its sampling distribution is skewed to the left, thus, the ADF test is left-tailed. The null and alternative hypotheses for existence of a unit root under ADF are (Gujarati and Porter, 2009):

H₀: γ = 0 (i.e., the data are non-stationary and have a unit root);

Hₐ: γ < 0 (i.e., the data are stationary with no unit root).

For ADF testing, if the computed test statistic is less than the critical value, H₀ can be rejected. The critical values are displayed in Table 4.2 below.
Table 4.2 Critical Tau Values for ADF testing

<table>
<thead>
<tr>
<th>Sample size</th>
<th>$t_{nc}$</th>
<th>$t_{c}$</th>
<th>$t_{dc}$</th>
<th>$F^*$</th>
<th>$F^+$$^*$</th>
<th>$F^+$</th>
<th>$F^+$ $^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>-2.66</td>
<td>-1.95</td>
<td>-3.75</td>
<td>-3.00</td>
<td>-4.48</td>
<td>-3.60</td>
<td>10.61</td>
</tr>
<tr>
<td>50</td>
<td>-2.62</td>
<td>-1.95</td>
<td>-3.58</td>
<td>-2.93</td>
<td>-4.15</td>
<td>-3.50</td>
<td>9.31</td>
</tr>
<tr>
<td>100</td>
<td>-2.80</td>
<td>-1.95</td>
<td>-3.51</td>
<td>-2.89</td>
<td>-4.04</td>
<td>-3.45</td>
<td>8.73</td>
</tr>
<tr>
<td>250</td>
<td>-2.58</td>
<td>-1.95</td>
<td>-3.46</td>
<td>-2.88</td>
<td>-3.99</td>
<td>-3.43</td>
<td>8.43</td>
</tr>
<tr>
<td>500</td>
<td>-2.58</td>
<td>-1.95</td>
<td>-3.44</td>
<td>-2.87</td>
<td>-3.98</td>
<td>-3.42</td>
<td>8.34</td>
</tr>
<tr>
<td>$\infty$</td>
<td>-2.58</td>
<td>-1.95</td>
<td>-3.43</td>
<td>-2.86</td>
<td>-3.96</td>
<td>-3.41</td>
<td>8.27</td>
</tr>
</tbody>
</table>

$^*$Subscripts $nc$, $c$, and $d$ denote, respectively, that there is no constant, a constant, and a constant and trend term in the regression.

$^*$The critical $F$ values are for the joint hypothesis that the constant and $\delta$ terms in (21.9.6) are simultaneously equal to zero.

$^*$The critical $F$ values are for the joint hypothesis that the constant, trend, and $\delta$ terms in (21.9.5) are simultaneously equal to zero.


The ADF test is used to test stationarity where time series data are found to be non-stationary at level, it will be transformed into stationary data via differencing. The first or log differences are not able to change the time series data to be stationary, the first (or log) differences of first (or log) differences have to be used (Stock & Watson, 2007). Once the data is stationary, the model can be used to in the next step.

4.2.2 Multiple Linear Regression Model

Multiple linear regression is applied when it is required to test the predictive impact of two or more independent variables to justify the changes in the dependent variable (Gujarati & Porter, 2009). Multiple regression analysis has been used in various prior research to test the relationship between the Gold Price in Thailand and macroeconomic variables (Aunyankovit, 2010; Raktin, 2009; Innoi, 2009). In this research, multiple regression analysis will be used to test the dependence of Gold Price in Thailand on the chosen independent variables. The key benefit of using
multiple regression analysis is that it allows greater use of available information (Champi, 1999). Multiple regression analysis shows the proportion of fluctuation in the dependent variable caused by the independent illustrative variables, the fluctuation is gauged through the goodness of fit or $R^2$ of the model. The major limitation of $R^2$ is that it is sensitive to the number of regressors in the model, it increases as the number of illustrative variables increase. Thus, statistical analysis makes use of the adjusted $R^2$ to solve for this problem (Gujarati & Porter, 2009). The following equation is used to conduct regression analysis in this study:

$$
GPT = \beta_0 + \beta_1 WGP + \beta_2 OP + \beta_3 DJI + \beta_4 USDX + \beta_5 CPI + \beta_6 SET + \beta_7 IR + \beta_8 FX + \beta_9 LAG + \varepsilon
$$

(eq. 4.2)

Where,

- $\beta_0$ = constant,
- $\beta_1$ to $\beta_9$ = coefficients of variables,
- WGP = World Gold Price,
- OP = Oil Price,
- DJI = Dow Jones Industrial Average,
- USDX = USD Index,
- CPI = Consumer Price Index,
- SET = SET Index,
IR = Interest Rate,  
FX = Exchange Rate  
LAG = Time Lag  
ε = error term  

The values $\beta_j$ represent parameters to be estimated. To test all significance of the previous multiple regression model, the Analysis of Variance (ANOVA) F test will be applied to search if the independent primary analysis indicators have significant relationship with Gold Price in Thailand. The hypotheses for the F test are (Gujarati & Porter, 2009):

$H_0$: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$

$H_a$: At least one $\beta_j$ does not equal zero.

If the $p$ value of the F test is lower than the 5% significance level, $H_0$ can be rejected. In this case, it can be said that one or more of the coefficients is not equal to zero which means that all relationship between the Gold Price in Thailand and independent variable is statistically significant. In contrast, if the F test fails to reject $H_0$, it can conclude that there is insufficient evidence to support a significant relationship between the chosen primary factors and Gold Price in Thailand.

To test the individual variables significance of the previous multiple regression model, the $t$ test will be applied to search if the single independent variable has significant relationship with Gold Price in Thailand. The hypotheses for $t$ test are:


\[ H_0: \beta_j = 0 \]

\[ H_a: \beta_j \neq 0 \quad \text{for all } j \]

If the \( p \) value is less than alpha (5\% significant level), \( H_0 \) can be rejected. In this case, it can be concluded that the independent variable is statistically significant in the model.

The results of the multiple regression analysis will be checked for multicollinearity problem. The problem happens when pairs of highly correlated variables are used together in a model. The multicollinearity problem lowers the individual impact of the highly correlated independent variables (Pindyck and Rubinfeld, 1998). The Variance Inflation Factor (VIF) will be used to find multicollinearity in this research, basically, if the VIF of a variable exceeds 10, there is a multicollinearity problem. Gujarati and Porter (2009) proclaimed that multicollinearity is importantly a sample problem; thus, there is no solution but to exclude variables known to be correlated through prior research or that are found to be highly correlated using the VIF value. Multicollinearity can be adjusted by transforming the data into first difference or by adding data with a lesser degree of correlation (Gujarati & Porter, 2009).

For the tests in this study, the results can be interpreted using the presence or absence of an asterisk; no asterisk or one asterisk (*) means sig. at .10 or set the confidence interval = 90\%, two asterisks (**) mean sig. at .05 or set the confidence interval = 95\%, and three asterisks (***) mean sig. at .01 or set the confidence interval = 99\%.
4.2.3 Regression Coefficients $\beta$

The regression coefficients denoted by $\beta$, are known as partial regression or partial slope coefficients. The meaning of partial regression coefficient is it measures the change in the mean value of $Y$ variable per unit change in $X$ variable, holding the value of other $X$ variables constant (Gujarati & Porter, 2009). If $\beta$ is positive, it means $X$ variable and $Y$ variable change in the same direction. On the other hand, if $\beta$ is negative, it means $X$ variable and $Y$ variable change in the opposite direction. Moreover, regression coefficient value is infinite.

4.2.4 The Multiple Coefficient of Determination $R^2$

The multiple coefficient of determination or $R^2$ is the measure of percentage of the total variation in the dependent variable $Y$ explained by the independent variables $X_1$, $X_2$...$X_n$. A key property of $R^2$ is that it is a nondecreasing function of the amount of independent variables or regressors in the model except that the added variable is perfectly collinear with other regressors. To explain further, if the regressors increase, $R^2$ almost invariably increases and never decreases. In other word, an additional independent variable will not decrease $R^2$. To compute $R^2$, the following formula is applied (Gujarati & Porter, 2009, p.201):

$$R^2 = \frac{ESS}{TSS} \quad (eq. \ 4.3)$$

$$= 1 - \frac{RSS}{TSS}$$

$$= 1 - \frac{\sum \hat{u}_i^2}{\sum y_i^2}$$
The value of $R^2$ is between 0 and 1. If it is 1, 100 percent of the variation in $Y$ is explained on the regression line. However, if it is 0, the model does not explain any of variation in $Y$. Moreover, if $R^2$ is closer to 1 is better (Gujarati & Porter, 2009).

In order to compare two $R^2$ terms, the following computation can be done by considering an alternative coefficient of determination (Gujarati & Porter, 2009):

$$\bar{R}^2 = 1 - \frac{\sum \hat{u}_i^2/(n-k)}{\sum y_i^2/(n-1)} \quad \text{(eq. 4.4)}$$

Where $k =$ the number of parameters in the model including the intercept term. Therefore, the defined $R^2$ is known as adjusted $R^2$, denoted by $\bar{R}^2$. The term adjusted means adjusted for the degree of freedom (df), the number of independent values or quantities which can be assigned to a statistical distribution (www.oxforddictionaries.com, 2015), associated with the sum of squares entering into (eq. 4.3): $\sum \hat{u}_i^2$ has $n-k$ df in a model involving $k$ parameters that include the intercept term, and $\sum y_i^2$ has $n-1$ df.

To explain how $\bar{R}^2$ and $R^2$ are related, the following equation illustrates the relationship:

$$\bar{R}^2 = 1 - (1 - R^2) \frac{n-1}{n-k} \quad \text{(eq. 4.5)}$$

It is obvious from (eq. 4.5) that (1) for $k > 1$, $\bar{R}^2 < R^2$ which means that adjusted $R^2$ increases less than unadjusted $R^2$ when the number of $X$ variables increase, and (2) $\bar{R}^2$ can be negative, even though, $R^2$ is necessarily nonnegative (can be 0 or positive). In case $\bar{R}^2$ is negative, its value is taken as
zero (Gujarati & Porter, 2009). Moreover, the range of coefficient of determination ranges from 0 to 1 and the larger value indicates stronger relationship where 0.25 or higher indicates strong relationship, 0.16 indicates moderate to strong relationship, 0.06 to 0.12 indicates moderate relationship, 0.04 indicates weak to moderate relationship, and 0.01 or lower indicates weak relationship (Rubin, 2012).

4.2.5 Testing the Overall Significance of Multiple Regression: The F Test

The null hypothesis that $\beta_2$ and $\beta_3$ are simultaneously equal to zero is written as follows:

$$H_0 = \beta_2 = \beta_3 = 0$$

A test of this hypothesis is called a test of the overall significance of the observed or estimated regression line. In other words, it tests whether $Y$ is linearly related to both $X_2$ and $X_3$. In order to test the joint hypothesis, the analysis of variance (ANOVA) technique is applied and can be demonstrated as follows (Gujarati and Porter, 2009, p.238-240):

$$\sum y_i^2 = \hat{\beta}_2 \sum y_i x_{2i} + \hat{\beta}_3 \sum y_i x_{3i} + \sum \hat{u}_i^2$$

$$TSS = ESS + RSS \quad (eq. 4.6)$$

Given the k-variable regression model:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_k X_{ki} + u_i$$
To test the hypothesis

\[ H_0: \beta_2 = \beta_3 = \ldots = \beta_k = 0 \]

(all slope coefficients are simultaneously zero) versus

\[ H_a: \text{Not all slope coefficients are simultaneously zero} \]

Compute

\[ F = \frac{ESS/df}{RSS/df} = \frac{ESS/(k-1)}{RSS/(n-k)} \]  
(eq. 4.7)

If \( F > F_{\alpha}(k-1, n-k) \), reject \( H_0 \); if not, do not reject \( H_0 \), where \( F_{\alpha}(k-1, n-k) \) is the critical F value at the 95% level of significance and \((k-1)\) numerator df and \((n-k)\) denominator df. Moreover, another way to make the decision is to look at the \( p \) value, if the \( p \) value of \( F \) is sufficiently low (lower than the 5% level of significance), \( H_0 \) can be rejected.

4.2.6 Testing the Individual Significance of Multiple Regression: The \( t \) Test

The \( t \) test is used to determine the significance of each of the individual parameters in multiple regression model. The \( t \) test for individual significance is written as follows (Anderson et al., 2002):

To test the hypothesis for any parameter \( \beta_j \)

\[ H_0: \beta_j = 0 \]

\[ H_a: \beta_j \neq 0 \]
Compute

\[ t = \frac{b_j}{s_{bj}} \quad \text{(eq. 4.8)} \]

If \( t < -t_{a/2} \) or if \( t > t_{a/2} \), reject \( H_0 \); if not, do not reject \( H_0 \), where \( t_{a/2} \) is based on a \( t \) distribution with \( n - p - 1 \) degrees of freedom. Moreover, another way to make the decision is to look at the \( p \) value, if the \( p \) value of \( t \) is sufficiently low (lower than the 5% level of significance), \( H_0 \) can be rejected.

4.2.7 Multicollinearity

Multicollinearity originally means the existence of a “perfect” linear relationship among some or all independent variables of a regression model. For the \( k \)-variable regression associating independent variables \( X_1, X_2, \ldots, X_k \) (where \( X_1 = 1 \) for all observations to allow for the intercept term), and perfect linear relationship is said to exist if the following condition is met:

\[ \lambda_1 X_1 + \lambda_2 X_2 + \ldots + \lambda_k X_k = 0 \quad \text{(eq. 4.9)} \]

where \( \lambda_1, \lambda_2, \ldots, \lambda_k \) are constants such that not all of them are zero simultaneously.

Nowadays the term multicollinearity is used in a more extensive sense to include the case of perfect multicollinearity and the case where the \( X \) variables are intercorrelated but not exactly so, as follows:

\[ \lambda_1 X_1 + \lambda_2 X_2 + \ldots + \lambda_k X_k + v_i = 0 \quad \text{(eq. 4.10)} \]

where \( v_i \) is a stochastic error term.
If multicollinearity is perfect in the sense of eq. 4.8, the regression coefficients of the X variables are indeterminate and their standard errors are infinite. If multicollinearity is less than perfect, as in eq. 4.9, the regression coefficients are determinate and have many standard errors (in relation to the coefficients themselves), as a result, it is unable to accurately estimate the coefficients (Gujarati & Porter, 2009).

Montgomery and Peck noted that multicollinearity may be due to the following factors:

1. The data collection method employed.
2. Constraints on the model or in the population being sampled.
4. An overdetermined model.

In addition, multicollinearity can be caused by a common trend shared by the regressors in the model especially in time series data, that is, they all move together in the same direction over time.

Multicollinearity can be detected by variance inflation factor (VIF) which is the widely used technique and it is an inverse version of tolerance (TOL) (Gujarati and Porter, 2009), the speed with which variances and covariances increase, the following formula is used to calculate VIF:

\[
VIF_j = \frac{1}{(1-R_j^2)} \quad \text{(eq. 4.11)}
\]

As \(R_j^2\) increases toward unity, that is, as the collinearity of \(X_j\) with other regressors increases, VIF increases as well and it can be infinite in the limit. Multicollinearity can be measured by the value of VIF, that is, the more
value of VIF, the more collinearity, which Gujarati and Porter (2009) gave the standard of highly collinear to be when the value of VIF exceed 10 which will occur if $R_j^2$ exceeds 0.90.

Gujarati and Porter (2009) stated that when multicollinearity occurs, nothing can be done but to exclude the variables, however, the variables can be adjusted by transforming data into the first difference which the model of transformed data is written as follows:

$$Y_t - Y_{t-1} = \beta_2(X_{2t} - X_{2,t-1}) + \beta_3(X_{3t} - X_{3,t-1}) + v_t \quad (eq. 4.12)$$

Another solution for multicollinearity is to add more data in order to increase the size of the sample and it might reduce the collinearity problem.

### 4.2.8 Autocorrelation

Autocorrelation is the correlation between members of series of observations ordered in time (as in time series data) or space (as in cross-sectional data) (Kendall & Buckland, 1971) which can be written as the following model:

$$E(u_iu_j) \neq 0 \quad i \neq j$$

When autocorrelation occurs, the error terms are not independent is one of the assumptions of the regression model. In the case of first-order autocorrelation, the error at time $t$, denoted by $\epsilon_t$, will be related to the error at time period $t - 1$, denoted by $\epsilon_{t-1}$. Autocorrelation can be both positive and negative. Once autocorrelation occurs, serious errors can be made in the testing for statistical significance process. Therefore, in order to detect
autocorrelation, Durbin-Watson test will be applied in the autocorrelation testing process, the formula is written as follows (Gujarati & Porter, 2009):

\[
d = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2}
\]

(eq. 4.13)

If positive autocorrelation is found, the value of Durbin-Watson test will be small, on the other hand, if negative autocorrelation is found, the value of Durbin-Watson test will be large. The Durbin-Watson test value is between zero to four, with a value of two indicating no autocorrelation and the value far from two indicates a serious problem (Anderson et al., 2002, p.702-703).

The null hypotheses for testing autocorrelation are written as follows:

\[
H_0: \rho = 0
\]

\[
H_a: \rho \neq 0
\]

If autocorrelation is found to be significant then Newey-West method will be applied to get standard errors of OLS estimators that are corrected for autocorrelation (Gujarati & Porter, 2009, p.441). Newey-West method is suitable for reasonably large samples in order to correct OLS standard errors for autocorrelation (Gujarati & Porter, 2009).
Chapter 5

Data Presentation and Critical Discussion of Results

This chapter analyzes the secondary data on factors affecting Gold Price in Thailand including World Gold Price, Oil Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, Interest Rate, Exchange Rate, and Time Lag to identify their impact on Gold Price in Thailand. The data are analyzed using EVIEWS software. There are three parts in this chapter including descriptive analysis, unit root testing, and hypothesis testing using multiple regression analysis.

5.1 Descriptive Analysis

The following descriptive statistics provide the mean, standard deviation, minimum and maximum values, skewness, and kurtosis for each variable in order to check if the data need to be corrected. There are 123 monthly observations (N) for each variable. In terms of skewness, values between +1 and -1 indicate that the data are symmetrical (Rafay et al., 2014); where this is not the case, the variables will log transformed.

Table 5.1 Descriptive Statistics of Gold Price in Thailand (GPT)

<table>
<thead>
<tr>
<th>Analysis Variable: GPT</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16670.82</td>
<td>5187.142</td>
<td>7835.42</td>
<td>25738.46</td>
<td>0.006079</td>
<td>1.872155</td>
<td>123</td>
</tr>
</tbody>
</table>

Table 5.1 shows the descriptive statistics for the Gold Price in Thailand (GPT); the average price from 2005 to 2015 was 16670.82. The standard deviation in the Gold Price in Thailand was 5187.142; the coefficient of variation is 31.12%; this is calculated from (standard deviation ÷ mean) × 100 (Anderson et al., 2002). Thus, it can be said that Gold Price in Thailand was not highly volatile during the period of
study. The minimum price was 7835.42 while the maximum price was 25738.46 from 2005 to 2015. The skewness of 0.006079 lies between the values of -1 and +1; hence, the data for Gold Price in Thailand are symmetrical.

Table 5.2 Descriptive Statistics of World Gold Price (WGP)

<table>
<thead>
<tr>
<th>Analysis Variable: WGP</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1079.967</td>
<td>401.4978</td>
<td>416.3</td>
<td>1828.5</td>
<td>0.017429</td>
<td>1.859206</td>
<td>123</td>
</tr>
</tbody>
</table>

Table 5.2 shows the descriptive statistics for the World Gold Price (WGP); the average price from 2005 to 2015 was 1079.967. The standard deviation in the World Gold Price was 401.4978. The coefficient of variation is 37.18%. Thus, it can be said that World Gold Price was not highly volatile during the period of study. The minimum price was 416.3 while the maximum price was 1828.5 from 2005 to 2015. The skewness of 0.017429 lies between the values of -1 and +1; hence, the data for World Gold Price are symmetrical.

Table 5.3 Descriptive Statistics of Oil Price (OP)

<table>
<thead>
<tr>
<th>Analysis Variable: OP</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>81.33691</td>
<td>20.01539</td>
<td>41.68</td>
<td>140</td>
<td>0.082239</td>
<td>2.495734</td>
<td>123</td>
</tr>
</tbody>
</table>

Table 5.3 shows the descriptive statistics for the Oil Price (OP); the average price from 2005 to 2015 was 81.33691. The standard deviation in the Oil Price was 20.01539. The coefficient of variation is 24.61%. Thus, it can be said that Oil Price was not highly volatile during the period of study. The minimum price was 41.68 while the maximum price was 140 from 2005 to 2015. The skewness of 0.082239 lies between the values of -1 and +1; hence, the data for Oil Price are symmetrical.
Table 5.4 Descriptive Statistics of Dow Jones Industrial Average (DJI)

<table>
<thead>
<tr>
<th>Analysis Variable: DJI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>12426.6</td>
</tr>
</tbody>
</table>

Table 5.4 shows the descriptive statistics for the Dow Jones Industrial Average (DJI); the average index value from 2005 to 2015 was 12426.6. The standard deviation in the Dow Jones Industrial Average was 2463.508. The coefficient of variation is 19.82%. Thus, it can be said that Dow Jones Industrial Average was not highly volatile during the period of study. The minimum index value was 7062.93 while the maximum index value was 18132.7 from 2005 to 2015. The skewness of 0.464623 lies between the values of -1 and +1; hence, the data for Dow Jones Industrial Average are symmetrical.

Table 5.5 Descriptive Statistics of USD Index (USDX)

<table>
<thead>
<tr>
<th>Analysis Variable: USDX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>81.80659</td>
</tr>
</tbody>
</table>

Table 5.5 shows the descriptive statistics for the USD Index (USDX); the average index value from 2005 to 2015 was 81.80659. The standard deviation in the USD Index was 5.027779. The coefficient of variation is 6.15%. Thus, it can be said that USD Index was not highly volatile during the period of study. The minimum index value was 72.17 while the maximum index value was 98.66 from 2005 to 2015. The skewness of 0.525401 lies between the values of -1 and +1; hence, the data for USD Index are symmetrical.
Table 5.6 Descriptive Statistics of Consumer Price Index (CPI)

<table>
<thead>
<tr>
<th>Analysis Variable: CPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>96.15992</td>
</tr>
</tbody>
</table>

Table 5.6 shows the descriptive statistics for the Consumer Price Index (CPI); the average index value from 2005 to 2015 was 96.15992. The standard deviation in the Consumer Price Index was 7.749804. The coefficient of variation is 8.06%. Thus, it can be said that Consumer Price Index was not highly volatile during the period of study. The minimum index value was 80.4 while the maximum index value was 107.9 from 2005 to 2015. The skewness of -0.119769 lies between the values of -1 and +1; hence, the data for Consumer Price Index are symmetrical.

Table 5.7 Descriptive Statistics of SET Index (SET)

<table>
<thead>
<tr>
<th>Analysis Variable: SET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>962.8301</td>
</tr>
</tbody>
</table>

Table 5.7 shows the descriptive statistics for the SET Index (SET); the average index value from 2005 to 2015 was 962.8301. The standard deviation in the SET Index was 336.2077. The coefficient of variation is 34.92%. Thus, it can be said that SET Index was not highly volatile during the period of study. The minimum index value was 401.84 while the maximum index value was 1597.86 from 2005 to 2015. The skewness of 0.481027 lies between the values of -1 and +1; hence, the data for SET Index are symmetrical.
Table 5.8 Descriptive Statistics of Interest Rate (IR)

<table>
<thead>
<tr>
<th>Analysis Variable: IR</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR</td>
<td>2.269</td>
<td>1.074</td>
<td>0.75</td>
<td>4.75</td>
<td>0.508908</td>
<td>2.864353</td>
<td>123</td>
</tr>
</tbody>
</table>

Table 5.8 shows the descriptive statistics for the Interest Rate (IR); the average rate from 2005 to 2015 was 2.26935. The standard deviation in the Interest Rate was 1.074722. The coefficient of variation is 47.36%. Thus, it can be said that Interest Rate was not highly volatile during the period of study. The minimum rate was 0.75 while the maximum rate was 4.75 from 2005 to 2015. The skewness of 0.508908 lies between the values of -1 and +1; hence, the data for Interest Rate are symmetrical.

Table 5.9 Descriptive Statistics of Exchange Rate (FX)

<table>
<thead>
<tr>
<th>Analysis Variable: FX</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>FX</td>
<td>33.406</td>
<td>3.195</td>
<td>29.275</td>
<td>41.655</td>
<td>1.108007</td>
<td>3.263817</td>
<td>123</td>
</tr>
</tbody>
</table>

Table 5.9 shows the descriptive statistics for the Exchange Rate (IR); the average rate from 2005 to 2015 was 33.40622. The standard deviation in the Exchange Rate was 3.19536. The coefficient of variation is 9.57%. Thus, it can be said that Interest Rate was not highly volatile during the period of study. The minimum rate was 29.275 while the maximum rate was 41.655 from 2005 to 2015. The skewness of 1.108007 does not lie between the values of -1 and +1; hence, the data for Exchange Rate are asymmetrical and need to be log transformed. The descriptive statistics of the transformed data are shown in Table 5.10 below.
Table 5.10 Descriptive Statistics of Log of Exchange Rate (LFX)

<table>
<thead>
<tr>
<th>Analysis Variable: LFX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>3.504465</td>
</tr>
</tbody>
</table>

Table 5.10 shows the descriptive statistics for the log transformed data of Exchange Rate (LFX). The skewness of the data is 0.96585 which lies between the values of -1 and +1; hence, the data for Exchange Rate has been made symmetrical through log transformation.

Table 5.11 Descriptive Statistics of Time Lag (LAG)

<table>
<thead>
<tr>
<th>Analysis Variable: LAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>16657.70</td>
</tr>
</tbody>
</table>

Table 5.11 shows the descriptive statistics for the Time Lag (Lag); the average price from 2005 to 2015 was 16657.70. The standard deviation in the Time Lag was 5206.481. The coefficient of variation is 31.26%. Thus, it can be said that Time Lag was not highly volatile during the period of study. The minimum price was 7835.42 while the maximum price was 25738.46 from 2005 to 2015. The skewness of 0.013413 lies between the values of -1 and +1; hence, the data for Time Lag are symmetrical.

5.2 Unit Root Testing

As noted in Chapter 4, section 4.2.1, time series data used for empirical analysis needs to be stationary. In this study, the Augmented Dickey Fuller (ADF) test is used to check for stationarity of data; the absence of a unit root indicates stationarity. The hypotheses of the ADF test are:
$H_0$: $\gamma = 0$ (non-stationary and presence of a unit root),

$H_a$: $\gamma < 0$ (stationary and no unit root).

**Table 5.12 Augmented Dickey Fuller test at Level**

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>P-Value</th>
<th>Reject/Failed to Reject</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPT has a unit root</td>
<td>0.9015</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>WGP has a unit root</td>
<td>0.8017</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>OP has a unit root</td>
<td>0.4179</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>DJI has a unit root</td>
<td>0.9622</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>USDX has a unit root</td>
<td>0.8474</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>CPI has a unit root</td>
<td>0.9965</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>SET has a unit root</td>
<td>0.9412</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>IR has a unit root</td>
<td>0.3477</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>LFX has a unit root</td>
<td>0.368</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
<tr>
<td>LAG has a unit root</td>
<td>0.9192</td>
<td>Failed to reject null hypothesis</td>
<td>Not stationary</td>
</tr>
</tbody>
</table>

Notes: Refer to Appendix for the full outputs of ADF test.

Table 5.12 shows the results of the Augmented Dickey Fuller test at level. All variables were found to be non-stationary at the 5% level. Therefore, the variables were first differenced in order to make the data stationary. Results from the ADF test on the modified data are shown in Table 5.13 below.

**Table 5.13 ADF test at 1st Difference**

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>P-Value</th>
<th>Reject/Failed to Reject</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPT has a unit root</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
<tr>
<td>WGP has a unit root</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
<tr>
<td>OP has a unit root</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
<tr>
<td>DJI has a unit root</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
<tr>
<td>USDX has a unit root</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
<tr>
<td>CPI has a unit root</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
</tbody>
</table>
Table 5.13 ADF test at 1st Difference (Con’t)

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value</th>
<th>Decision</th>
<th>Stationary</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
<tr>
<td>IR</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
<tr>
<td>LFX</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
<tr>
<td>LAG</td>
<td>0.0000</td>
<td>Reject null hypothesis</td>
<td>Stationary</td>
</tr>
</tbody>
</table>

Notes: Refer to Appendix for the full outputs of ADF test.

Table 5.13 shows the results of the Augmented Dickey Fuller test on first differenced data; all variables were found to be stationary at first difference since the p-values were less than 0.05.

5.3 Hypotheses Testing

This section contains the results from hypotheses testing using multiple regression analyses. In the following section, the link between the independent variables and the Gold Price in Thailand will be tested as well as the multicollinearity and autocorrelation.

$H_{1a}$: There is a significant impact of World Gold Price on Gold Price in Thailand during 2005-2015.

$H_{1a}$: There is a significant impact of World Gold Price on Gold Price in Thailand during 2005 – 2015.

$H_{2a}$: There is no significant impact of Oil Price on Gold Price in Thailand during 2005 – 2015.

$H_{2a}$: There is a significant impact of Oil Price on Gold Price in Thailand during 2005 – 2015.
$H_3$: There is no significant impact of Dow Jones Industrial Average on Gold Price in Thailand during 2005 – 2015.

$H_3^a$: There is a significant impact of Dow Jones Industrial Average on Gold Price in Thailand during 2005 – 2015.

$H_4$: There is no significant impact of USD Index on Gold Price in Thailand during 2005 – 2015.

$H_4^a$: There is a significant impact of USD Index on Gold Price in Thailand during 2005 – 2015.

$H_5$: There is no significant impact of Consumer Price Index on Gold Price in Thailand during 2005 – 2015.

$H_5^a$: There is a significant impact of Consumer Price Index on Gold Price in Thailand during 2005 – 2015.

$H_6$: There is no significant impact of SET Index on Gold Price in Thailand during 2005 – 2015.

$H_6^a$: There is a significant impact of SET Index on Gold Price in Thailand during 2005 – 2015.

$H_7$: There is no significant impact of Interest Rate on Gold Price in Thailand during 2005 – 2015.

$H_7^a$: There is a significant impact of Interest Rate on Gold Price in Thailand during 2005 – 2015.

$H_8$: There is no significant impact of Exchange Rate on Gold Price in Thailand during 2005 – 2015.
H8a: There is a significant impact of Exchange Rate on Gold Price in Thailand during 2005 – 2015.

H9o: There is no significant impact of Time Lag on Gold Price in Thailand during 2005 – 2015.

H9a: There is a significant impact of Time Lag on Gold Price in Thailand during 2005 – 2015.

Multiple Regression Analysis

Using the results from the ADF unit root test, this study uses the following modified model for regression analysis.

\[ GPT = \beta_0 + \beta_1DWGP + \beta_2DOP + \beta_3DDJI + \beta_4DUSDX + \beta_5DCPI + \beta_6DSET + \beta_7DIR \\
+ \beta_8DLFX + \beta_9DLag + \varepsilon \]

Where, D represents first differences

After the multiple regression analysis, the results of the regression model (see in Appendix B) shows that the regression of the Gold Price in Thailand on nine factors used in the analysis – World Gold Price (WGP), Oil Price (OP), Dow Jones Industrial Average (DJI), USD Index (USDX), Consumer Price Index (CPI), SET Index (SET), Interest Rate (IR), Exchange Rate (FX), and Time Lag (LAG), there are four variables found to be significantly impact on Gold Price in Thailand including World Gold Price, Dow Jones Industrial Average, Consumer Price Index, and Time Lag. However, before this study can really make deductions about the impact of the independent variables on the Gold Price in Thailand, it is important to check whether the above regression model has multicollinearity and autocorrelation problems. The results of these tests are discussed below.
**Multicollinearity Test**

**Table 5.14 Multicollinearity**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient Variance</th>
<th>Uncentered VIF</th>
<th>Centered VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCPI</td>
<td>8429.490</td>
<td>1.466000</td>
<td>1.281781</td>
</tr>
<tr>
<td>DDJI</td>
<td>0.016683</td>
<td>1.690620</td>
<td>1.663132</td>
</tr>
<tr>
<td>DIR</td>
<td>27731.67</td>
<td>1.041543</td>
<td>1.041522</td>
</tr>
<tr>
<td>DLAG</td>
<td>0.005416</td>
<td>1.072441</td>
<td>1.050132</td>
</tr>
<tr>
<td>DLFX</td>
<td>8718582.</td>
<td>1.780628</td>
<td>1.773012</td>
</tr>
<tr>
<td>DOP</td>
<td>70.53159</td>
<td>1.871265</td>
<td>1.871224</td>
</tr>
<tr>
<td>DSET</td>
<td>1.465136</td>
<td>2.033722</td>
<td>2.005018</td>
</tr>
<tr>
<td>DUSDX</td>
<td>1022.606</td>
<td>2.057148</td>
<td>2.048205</td>
</tr>
<tr>
<td>DWGP</td>
<td>0.664866</td>
<td>1.415088</td>
<td>1.402662</td>
</tr>
<tr>
<td>C</td>
<td>2692.308</td>
<td>1.321682</td>
<td>NA</td>
</tr>
</tbody>
</table>

Multicollinearity is indicated if the VIF of any variable in the model exceeds 10 (Champi, 1999). From Table 5.14, the VIF values for all variables in the regression model are less than 10 with a maximum of 2.05. Therefore, there is no multicollinearity problem in this study.

**Autocorrelation**

In this study, the Durbin-Watson test is used to detect autocorrelation. The Durbin-Watson statistic for the regression model used in this study is 2.638264 from the multiple regression analysis output (see in Appendix B). Using 9 regressors and 121 observations, the $d_L$ and $d_U$ values from the Durbin-Watson test table (see in Appendix C) are found to be 1.608 and 1.862 respectively. Since $4 - 1.608 < 2.638264 < 4$, there is negative autocorrelation problem. Moreover, the Durbin-Watson test result of 2.638264 is not equal to 2, therefore, it has autocorrelation (Anderson *et al.*, 2002).
Table 5.15 Autocorrelation

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Decision rules</th>
<th>If</th>
</tr>
</thead>
<tbody>
<tr>
<td>No positive auto-correlation</td>
<td>Reject</td>
<td>$0 \leq d &lt; d_L$</td>
</tr>
<tr>
<td>No negative auto-correlation</td>
<td>No decision</td>
<td>$d_L \leq d \leq d_U$</td>
</tr>
<tr>
<td>No negative auto-correlation</td>
<td>Reject</td>
<td>$4 - d_L &lt; d &lt; 4$</td>
</tr>
<tr>
<td>No negative auto-correlation</td>
<td>No decision</td>
<td>$4 - d_U \leq d \leq 4 - d_L$</td>
</tr>
<tr>
<td>No negative or positive auto-correlation</td>
<td>Do not reject</td>
<td>$d_U &lt; d &lt; 4 - d_U$</td>
</tr>
</tbody>
</table>

In order to make the correction for autocorrelation problem, Newey-West method is applied to get the standard error of OLS estimators. The modified regression out is shown in the following table.

Table 5.16 Modified Regression Output (OLS)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCPI</td>
<td>161.2093</td>
<td>89.38820</td>
<td>1.803474</td>
<td>0.0740</td>
</tr>
<tr>
<td>DDII</td>
<td>-0.438130</td>
<td>0.132762</td>
<td>-3.300115</td>
<td>0.0013</td>
</tr>
<tr>
<td>DIR</td>
<td>39.60591</td>
<td>146.3810</td>
<td>0.270567</td>
<td>0.7872</td>
</tr>
<tr>
<td>DLAG</td>
<td>0.211797</td>
<td>0.081578</td>
<td>2.596250</td>
<td>0.0107</td>
</tr>
<tr>
<td>DLFX</td>
<td>1325.711</td>
<td>1918.944</td>
<td>0.690854</td>
<td>0.4911</td>
</tr>
<tr>
<td>DOP</td>
<td>-7.401779</td>
<td>9.702244</td>
<td>-0.762893</td>
<td>0.4471</td>
</tr>
<tr>
<td>DSET</td>
<td>-1.841631</td>
<td>0.947696</td>
<td>-1.943273</td>
<td>0.0545</td>
</tr>
<tr>
<td>DUSDX</td>
<td>-45.59525</td>
<td>23.67192</td>
<td>-1.926133</td>
<td>0.0566</td>
</tr>
<tr>
<td>DWGP</td>
<td>5.073020</td>
<td>0.841821</td>
<td>6.026248</td>
<td>0.0000</td>
</tr>
<tr>
<td>C</td>
<td>46.10311</td>
<td>45.17049</td>
<td>1.020647</td>
<td>0.3096</td>
</tr>
</tbody>
</table>

According to the F test in Table 5.16, the $p$ value is less than 0.01, therefore, it can be said that at least one coefficient is not equal to zero. In other word, at least one
relationship between the Gold Price in Thailand and independent variable is statistically significant.

$R^2$ and adjusted $R^2$ indicate the overall model fit, that is, how much of the variation in the dependent variable is caused by the independent variables in the model. From Table 5.17, the $R^2$ is 0.435128 which means that the model explains 43.51 percent of the changes in the Gold Price in Thailand. However, since the value of $R^2$ is susceptible to errors, adjusted $R^2$ is usually considered a better indicator. From Table 5.17, the adjusted $R^2$ is 0.389328 which indicated that the variables affecting Gold Price in Thailand included in this model explain 38.93 percent of the variation in the Gold Price in Thailand.

Moreover, the results show that World Gold Price has a significant impact on Gold Price in Thailand during 2005 – 2015 since the $p$ value is 0.0000 which is less than 0.01. The coefficient is 5.07302 which means that an increase in World Gold Price by one dollar would cause Gold Price in Thailand during 2005 – 2015 to increase by 5.07302 baht.

However, Oil Price is not found to have significant impact on Gold Price in Thailand during 2005 – 2015 as the $p$ value is 0.4471 which is greater than 0.10. The coefficient is -7.401779 which means that an increase in Oil Price by one dollar would cause Gold Price in Thailand during 2005 – 2015 to decrease by 7.401779 baht.

Nevertheless, Dow Jones Industrial Average is found to have significant on impact Gold Price in Thailand during 2005 – 2015 as the $p$ value is 0.0013 which is less than 0.01. The coefficient is -0.43813 which means that an increase in Dow Jones
Industrial Average by one point would cause Gold Price in Thailand during 2005 – 2015 to decrease 0.43813 baht.

The result also shows that USD Index is found to have significant impact on Gold Price in Thailand during 2005 – 2015 as the $p$ value is 0.0566 which is less than 0.10. The coefficient is -45.59525 which means that an increase in USD Index by one point would cause Gold Price in Thailand during 2005 – 2015 to decrease 45.59525 baht.

Further, Consumer Price Index is found to have significant impact on Gold Price in Thailand during 2005 – 2015 as the $p$ value is 0.074 which is less than 0.10. The coefficient is 161.2093 which means that an increase in Consumer Price Index by one percent would cause Gold Price in Thailand during 2005 – 2015 to increase 161.2093 baht.

SET Index is also found to have significant impact on Gold Price in Thailand during 2005 – 2015 as the $p$ value is 0.0545 which is less than 0.10 with the coefficient of -1.841631 which means that an increase in SET Index by one point would cause Gold Price in Thailand during 2005 – 2015 to decrease 1.841631 baht.

Though, Interest Rate is not found to have significant impact on Gold Price in Thailand during 2005 – 2015 as the $p$ value is 0.7872 which is greater than 0.10. The coefficient is 39.60591 which means that an increase in Interest Rate by 1 percent would cause the Gold Price in Thailand during 2005 – 2015 to increase by 39.60591 baht.

In addition, Exchange Rate is not found to have significant impact on Gold Price in Thailand during 2005 – 2015 as the $p$ value is 0.4911 which is greater than
0.10. The coefficient is 1325.711 which means that an increase in Exchange Rate by 1 baht would cause Gold Price in Thailand to increase by 1325.711 baht.

Lastly, Time Lag is found to have significant impact on Gold Price in Thailand during 2005 – 2015 as the p value is 0.0107 which is less than 0.05. The coefficient is 0.211797 which means that an increase in last month Gold Price in Thailand by 1 baht would cause Gold Price in Thailand to increase by 0.211797 baht.

From the results of the multiple regression analysis, the derived equation can be written as follows:

\[ GPT = 46.10311 + 5.073020DWGP - 7.401779DOP - 0.43813DDJI - 45.59525USDX + 161.2093DCPI - 1.841631DSET + 39.60591DIR + 1325.711DLFX + 0.211797LAG + \varepsilon \quad (eq. 5.1) \]

To illustrate the results from Multiple Regression Analysis in terms of coefficient values, figure 5.1 provided as follows:

Notes: * means significant at 10%
** means significant at 5%
*** means significant at 1%

**Figure 5.1** Results from Regression Analysis
To explain further, 1% significance level is the strongest among these three levels as it means that only 1% error occurs while 5% significance level and 10% significance level provide 5% and 10% errors respectively (Manderscheid, 1965).

The results of this chapter and the relevant conclusions are summarized in Chapter 6 along with the implications and recommendations for future research.
Chapter 6

Conclusion and Recommendations

This chapter summarizes the findings from Chapter 5 and presents the implications and recommendations based on the results of this study. It consists of six sections – introduction, summary of hypotheses, discussion and implications, conclusion, recommendations, and further study.

6.1 Introduction

The main objectives of this research were to define the determinants of Gold Price in Thailand including – World Gold Price, Oil Price, Dow Jones Index, USD Index, Consumer Price Index, SET Index, Interest Rate, Exchange Rate, and Time Lag, and to find the impact of these determinants on the Gold Price in Thailand. Further, this study aimed to test whether the model could be used to predict the Gold Price in Thailand in the long run. This study used Multiple Regression analysis to analyze monthly data from January 2005 to March 2015.

6.2 Summary of Hypotheses Testing

Multiple Regression analysis was used to test the hypotheses of this study. After analyzing the hypotheses, six of the null hypotheses were rejected and three failed to reject. The results are summarized in Table 6.1 below.
Table 6.1 Results of Hypotheses Testing

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of World Gold Price on</td>
<td>Rejected</td>
</tr>
<tr>
<td>H2&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of Oil Price on Gold Price</td>
<td>Failed to</td>
</tr>
<tr>
<td>H3&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of Dow Jones Industrial</td>
<td>Rejected</td>
</tr>
<tr>
<td>H4&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of USD Index on Gold Price</td>
<td>Rejected</td>
</tr>
<tr>
<td>H5&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of Consumer Price Index on</td>
<td>Rejected</td>
</tr>
<tr>
<td>H6&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of SET Index on Gold Price</td>
<td>Rejected</td>
</tr>
<tr>
<td>H7&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of Interest Rate on Gold</td>
<td>Failed to</td>
</tr>
<tr>
<td>H8&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of Exchange Rate on Gold</td>
<td>Failed to</td>
</tr>
<tr>
<td>H9&lt;sub&gt;0&lt;/sub&gt;: There is no significant impact of Time Lag on Gold Price</td>
<td>Rejected</td>
</tr>
</tbody>
</table>

Table 6.1 shows that the null hypotheses of H1, H3, H4, H5, H6, and H9 were rejected; this means that World Gold Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, and Time Lag have statistically significant impact on the Gold Price in Thailand in terms of Multiple Regression analysis.
However, since H2, H7, and H8 were failed to reject, Oil Price, Interest Rate, and Exchange Rate have no statistically significant impact on the Gold Price in Thailand.

6.3 Discussion and Implications

The study of gold price is relevant not only for maximizing return but also to predict trends in the fundamental and statistical indicators. Since Thailand’s gold market is fluctuated, thus, it is important to identify the relationship between the Gold Price in Thailand and the fundamental and statistical indicators.

Based on the result of hypothesis one from the multiple regression analysis, World Gold Price has a significant impact on the Gold Price in Thailand at the 1% significance level. Also, the multiple regression model showed the p-value for World Gold Price to be 0.0000 (<0.01) which means that it is significant for predicting the Gold Price in Thailand. Moreover, the coefficient was positive as expected. The results are consistent with the findings of Boonsri. (2012), Praphaphak. (2012), Teerasan (2010), Raktin (2009), Innoi (2009) and Sanphechudayan (2008) who found a relationship between World Gold Price and Gold Price in Thailand.

Based on the result of hypothesis two from the multiple regression analysis, Oil Price has no significant impact on the Gold Price in Thailand at either the 5% or the 10% significance level. Also, the multiple regression model showed the p-value for Oil Price to be 0.4471 (>0.10) which means that it is insignificant for predicting the Gold Price in Thailand. However, the coefficient was negative unlike expected. The results are consistent with the findings of Praphaphak. (2012) and Raktin (2009) who found no relationship between Oil Price and Gold Price in Thailand.

Based on the result of hypothesis three from the multiple regression analysis, Dow Jones Industrial Average has a significant impact on the Gold Price in Thailand at the 1% significance level. Also, the multiple regression model showed the p-value
for Dow Jones Industrial Average to be 0.0013 (<0.01) which means that it is significant for predicting the Gold Price in Thailand. Moreover, the coefficient was negative as expected. The results are found to be different from the findings of Raktin (2009) who found no relationship between Dow Jones Industrial Average and Gold Price in Thailand.

Based on the result of hypothesis four from the multiple regression analysis, USD Index has a significant impact on the Gold Price in Thailand at the 10% significance level. Also, the multiple regression model showed the p-value for World Gold Price to be 0.0566 (<0.10) which means that it is significant for predicting the Gold Price in Thailand. Moreover, the coefficient was negative as expected. The results are found to be different from the findings of Raktin (2009) who found no relationship between USD Index and Gold Price in Thailand.

Based on the result of hypothesis five from the multiple regression analysis, Consumer Price Index has a significant impact on the Gold Price in Thailand at the 10% significance level. Also, the multiple regression model showed the p-value for Consumer Price Index to be 0.074 (<0.10) which means that it is significant for predicting the Gold Price in Thailand. Moreover, the coefficient was positive as expected. The results are consistent with the findings of Boonsri (2012), Teerasan (2010), Innoi (2009) and Sanphechudayan (2008) who found a relationship between Consumer Price Index and Gold Price in Thailand.

Based on the result of hypothesis six from the multiple regression analysis, SET Index has a significant impact on the Gold Price in Thailand at the 10% significance level. Also, the multiple regression model showed the p-value for Consumer Price Index to be 0.0545 (<0.10) which means that it is significant for predicting the Gold Price in Thailand. Moreover, the coefficient was negative as
expected. The results are consistent with the findings of Aunyakovit (2010) who found a relationship between SET Index and Gold Price in Thailand.

Based on the result of hypothesis seven from the multiple regression analysis, Interest Rate has no significant impact on the Gold Price in Thailand at either the 5% or the 10% significance level. Also, the multiple regression model showed the p-value for Interest Rate to be 0.7872 (>0.10) which means that it is insignificant for predicting the Gold Price in Thailand. Moreover, the coefficient was positive unlike expected. The results are consistent with the findings of Praphaphak (2012) and Raktin (2009) who found no relationship between SET Index and Gold Price in Thailand.

Based on the result of hypothesis eight from the multiple regression analysis, Exchange Rate has no significant impact on the Gold Price in Thailand at either the 5% or the 10% significance level. Also, the multiple regression model showed the p-value for Exchange Rate to be 0.4911 (>0.10) which means that it is insignificant for predicting the Gold Price in Thailand. Moreover, the coefficient was positive as expected. The results are consistent with the findings of Innoi (2009) who found no relationship between SET Index and Gold Price in Thailand.

Based on the result of hypothesis nine from the multiple regression analysis, Time Lag has a significant impact on the Gold Price in Thailand at the 5% significance level. Also, the multiple regression model showed the p-value for Interest Rate to be 0.0107 (<0.05) which means that it is significant for predicting the Gold Price in Thailand. Moreover, the coefficient was positive unlike expected. The results are as expected regarding to the study of Wei et al. (2014) that the last month price can predict the price of the following month, that is, the relationship between Time Lag and Gold Price in Thailand.
Overall, multiple regression analysis indicates a positive relationship between fundamental and statistical variables and the Gold Price in Thailand based on the intercept value.

6.4 Conclusions

This study aimed to explore whether fundamental and statistical variables – World Gold Price, Oil Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, Interest Rate, Exchange Rate, and Time Lag – have the impact on the Gold Price in Thailand. Secondary data from January 2005 to March 2015 were used in this study at monthly frequency for a total of 123 observations. Raw data were converted into logs where skewness was indicated, and differenced variables were used where non-stationarity, i.e. the presence of unit roots, was found. Using multiple regression analysis, it was affirmed that the fundamental and statistical variables included in this study's model have a significant impact on the Gold Price in Thailand. Moreover, this study found that World Gold Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, and Time Lag have a significant impact on the Gold Price in Thailand. The impacts of Oil Price, Interest Rate, and Exchange Rate were found to be statistically insignificant. Further, World Gold Price is found to be significantly impact on the Gold Price in Thailand at 1% significance level, thus, it is affirmed as a reference price for quoting the Gold Price in Thailand according to the Gold Traders Association. Therefore, it is important for the investors or the individual buyers and sellers to pay more attention on the six factors that impact Gold Price in Thailand especially World Gold Price and they can apply the model to predict the trend of Gold Price in Thailand.
6.5 Recommendations

The results of this study can be used by the investors and individual buyers and sellers to predict the Gold Price in Thailand. Investment includes risk, thus, the fundamental and statistical variables can be used as a tool for risk management by studying patterns in the fundamental and statistical indicators which could explain fluctuations in the Gold Price in Thailand. Accurate forecasting of Gold Price in Thailand can allow investors and individual buyers and sellers to maximize the returns while minimizing the risk. Hence, this study recommends the investors and individual buyers and sellers to trade gold with caution regarding the impact of all the possible factors included in the model studied which are World Gold Price, Dow Jones Industrial Average, USD Index, Consumer Price Index, SET Index, and Time Lag since they have significant impact on the Gold Price in Thailand.

To explain further, World Gold Price was found to have positive impact on the Gold Price in Thailand. This means that an increase in the World Gold Price would increase the Gold Price in Thailand. Therefore, investors and individual buyers and sellers should make use of the correlation. If the World Gold Price increases, the investors and individual sellers may sell gold because the Gold Price in Thailand would likely increase. They can gain more profit. On the other hand, the investors and individual buyers may not buy gold when the World Gold Price increases because they will buy gold at the high price.

If World Gold Price decreases, the investors and individual buyers may buy gold because the Gold Price in Thailand would likely decrease. They can buy gold at low price. In contrast, the investors and individual sellers may not sell gold when the World Gold Price decreases because they will sell gold at low price.
Dow Jones Industrial Average was found to have negative impact on the Gold Price in Thailand. This means that an increase in the Dow Jones Industrial Average would likely decrease the Gold Price in Thailand. Therefore, investors and individual buyers and sellers should make use of the correlation. If the Dow Jones Industrial Average increases, the investors and individual buyers may buy gold because the Gold Price in Thailand would likely decrease. They can buy gold at the low price. On the other hand, the investors and individual sellers may not sell gold when the Dow Jones Industrial Average increases because they will sell gold at the low price.

If the Dow Jones Industrial Average decreases, the investors and individual sellers may sell gold because the Gold Price in Thailand would likely increase. They can sell gold at high price. In contrast, the investors and individual buyers may not buy gold when the Dow Jones Industrial Average decreases because they will buy gold at high price.

USD Index was found to have negative impact on the Gold Price in Thailand. This means that an increase in the USD Index would decrease the Gold Price in Thailand. Therefore, investors and individual buyers and sellers should make use of the correlation. If the USD Index increases, the investors and individual buyers may buy gold because the Gold Price in Thailand would likely decrease. They can buy gold at the low price. On the other hand, the investors and individual sellers may not sell gold when the USD Index increases because they will sell gold at the low price.

If the USD Index decreases, the investors and individual sellers may sell gold because the Gold Price in Thailand would likely increase. They can sell gold at high price. In contrast, the investors and individual buyers may not buy gold when the USD Index decreases because they will buy gold at high price.
Consumer Price Index was found to have positive impact on the Gold Price in Thailand. This means that an increase in the Consumer Price Index would increase the Gold Price in Thailand. Therefore, investors and individual buyers and sellers should make use of the correlation. If the Consumer Price Index increases, the investors and individual sellers may sell gold because the Gold Price in Thailand would likely increase. They can gain more profit. On the other hand, the investors and individual buyers may not buy gold when the Consumer Price Index increases because they will buy gold at the high price.

If Consumer Price Index decreases, the investors and individual buyers may buy gold because the Gold Price in Thailand would likely decrease. They can buy gold at low price. In contrast, the investors and individual sellers may not sell gold when the Consumer Price Index decreases because they will sell gold at low price.

SET Index was found to have negative impact on the Gold Price in Thailand. This means that an increase in the SET Index would decrease the Gold Price in Thailand. Therefore, investors and individual buyers and sellers should make use of the correlation. If the SET Index increases, the investors and individual buyers may buy gold because the Gold Price in Thailand would likely decrease. They can buy gold at the low price. On the other hand, the investors and individual sellers may not sell gold when the SET Index increases because they will sell gold at the low price.

If the SET Index decreases, the investors and individual sellers may sell gold because the Gold Price in Thailand would likely increase. They can sell gold at high price. In contrast, the investors and individual buyers may not buy gold when the SET Index decreases because they will buy gold at high price.

Time Lag was found to have positive impact on the Gold Price in Thailand. This means that an increase in the Gold Price in Thailand of last month (Time Lag)
would increase the Gold Price in Thailand in the current month based on the price speculation. Therefore, investors and individual buyers and sellers should make use of the correlation. If the Gold Price in Thailand of last month (Time Lag) increases, the investors and individual sellers may sell gold because the Gold Price in Thailand would likely increase. They can gain more profit. On the other hand, the investors and individual buyers may not buy gold when the Gold Price in Thailand of last month (Time Lag) increases because they will buy gold at the high price.

If the Gold Price in Thailand of last month (Time Lag) decreases, the investors and individual buyers may buy gold because the Gold Price in Thailand would likely decrease. They can buy gold at low price. In contrast, the investors and individual sellers may not sell gold when the Gold Price in Thailand of last month (Time Lag) decreases because they will sell gold at the low price.

However, Gold Price in Thailand may fluctuate along with other factors that cannot be measured such as economic crisis, political situation, war, and other rumors which can lead to the different direction from using the possible factors included in this study to predict the Gold Price in Thailand.

6.6 Future Studies

This research could prove to be a useful guide for students and other researchers interested in studying the Gold Price in Thailand. It is recommended that future researches focus on other independent variables such as unemployment rate, GDP, and loan rate not included in this study and may apply the daily data instead of the monthly data for more accuracy. In addition, more related literatures such as literatures in the other countries in the same region especially the neighboring countries may provide wider range of the assumption and give more ideas about the variables. Moreover, only multiple regression analysis is used to test the model in this
study, thus, any other methodologies such as autoregression may be applied for the test in the future studies. Further, it will be more useful if the model is applicable for predicting the gold price in other countries than only in Thailand as well as the right time to trade gold.
Bibliography


Manderscheid, L.V. (1965). Significance Levels. 0.05, 0.01, or?. Journal of Farm Economics. 47(5), 1381-1385.


Appendix A

Unit Root Testing

Table A.1 ADF test at Level for GPT (No Trend, No Intercept)

Null Hypothesis: GPT has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.904402</td>
<td>0.9015</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -2.584055
- 5% level: -1.943471
- 10% level: -1.614984


Table A.2 ADF test at 1st difference for GPT (with Trend and Intercept)

Null Hypothesis: D(GPT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-9.710187</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -4.035648
- 5% level: -3.447383
- 10% level: -3.148761


Table A.3 ADF test at Level for WGP (No Trend, No Intercept)

Null Hypothesis: WGP has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.416394</td>
<td>0.8017</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -2.584055
- 5% level: -1.943471
- 10% level: -1.614984

### Table A.4 ADF test at 1st difference for WGP (with Trend and Intercept)

Null Hypothesis: D(WGP) has a unit root  
Exogenous: Constant, Linear Trend  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-13.44139</td>
</tr>
</tbody>
</table>

Test critical values:  
1% level: -4.055648  
5% level: -3.447383  
10% level: -3.148761


### Table A.5 ADF test at Level for OP (No Trend, No Intercept)

Null Hypothesis: OP has a unit root  
Exogenous: None  
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-0.686085</td>
</tr>
</tbody>
</table>

Test critical values:  
1% level: -2.584214  
5% level: -1.943494  
10% level: -1.614970


### Table A.6 ADF test at 1st difference for OP (with Trend and Intercept)

Null Hypothesis: D(OP) has a unit root  
Exogenous: Constant, Linear Trend  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-8.073474</td>
</tr>
</tbody>
</table>

Test critical values:  
1% level: -4.055648  
5% level: -3.447383  
10% level: -3.148761


### Table A.7 ADF test at Level for DJI (No Trend, No Intercept)

Null Hypothesis: DJI has a unit root  
Exogenous: None  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>1.438592</td>
</tr>
</tbody>
</table>

Test critical values:  
1% level: -2.584055  
5% level: -1.943471  
10% level: -1.614984

Table A.8 ADF test at 1st difference for DJI (with Trend and Intercept)

Null Hypothesis: D(DJI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-10.46888</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-4.035648</td>
</tr>
<tr>
<td>5% level</td>
<td>-3.447383</td>
</tr>
<tr>
<td>10% level</td>
<td>-3.148761</td>
</tr>
</tbody>
</table>


Table A.9 ADF test at Level for USDX (No Trend, No Intercept)

Null Hypothesis: USDX has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>0.612738</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-2.584055</td>
</tr>
<tr>
<td>5% level</td>
<td>-1.943471</td>
</tr>
<tr>
<td>10% level</td>
<td>-1.614984</td>
</tr>
</tbody>
</table>


Table A.10 ADF test at 1st difference for USDX (with Trend and Intercept)

Null Hypothesis: D(USDX) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-10.94453</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
</tr>
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<td>1% level</td>
<td>-4.035648</td>
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<tr>
<td>5% level</td>
<td>-3.447383</td>
</tr>
<tr>
<td>10% level</td>
<td>-3.148761</td>
</tr>
</tbody>
</table>


Table A.11 ADF test at Level for CPI (No Trend, No Intercept)

Null Hypothesis: CPI has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>2.441847</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-2.584214</td>
</tr>
<tr>
<td>5% level</td>
<td>-1.943494</td>
</tr>
<tr>
<td>10% level</td>
<td>-1.614970</td>
</tr>
</tbody>
</table>

Table A.12 ADF test at 1st difference for CPI (with Trend and Intercept)

Null Hypothesis: D(CPI) has a unit root  
Exogenous: Constant, Linear Trend  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-7.431318</td>
</tr>
</tbody>
</table>

Test critical values:  
1% level: -4.035648  
5% level: -3.447383  
10% level: -3.148761


Table A.13 ADF test at Level for SET (No Trend, No Intercept)

Null Hypothesis: SET has a unit root  
Exogenous: None  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>1.205700</td>
</tr>
</tbody>
</table>

Test critical values:  
1% level: -2.584055  
5% level: -1.943471  
10% level: -1.614984


Table A.14 ADF test at 1st difference for SET (with Trend and Intercept)

Null Hypothesis: D(SET) has a unit root  
Exogenous: Constant, Linear Trend  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-9.489015</td>
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</tbody>
</table>

Test critical values:  
1% level: -4.035648  
5% level: -3.447383  
10% level: -3.148761


Table A.15 ADF test at Level for IR (No Trend, No Intercept)

Null Hypothesis: IR has a unit root  
Exogenous: None  
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-0.845641</td>
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</tbody>
</table>

Test critical values:  
1% level: -2.584214  
5% level: -1.943494  
10% level: -1.614970

Table A.16 ADF test at 1st difference for IR (with Trend and Intercept)

Null Hypothesis: D(IR) has a unit root  
Exogenous: Constant, Linear Trend  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-7.727135</td>
<td>0.0000</td>
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<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-4.035648</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-3.447383</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-3.148761</td>
<td></td>
</tr>
</tbody>
</table>


Table A.17 ADF test at Level for LFX (No Trend, No Intercept)

Null Hypothesis: LFX has a unit root  
Exogenous: None  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-0.798962</td>
<td>0.3680</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-2.584055</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-1.943471</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-1.614984</td>
<td></td>
</tr>
</tbody>
</table>


Table A.18 ADF test at 1st difference for LFX (with Trend and Intercept)

Null Hypothesis: D(LFX) has a unit root  
Exogenous: Constant, Linear Trend  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-11.15627</td>
<td>0.0000</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-4.035648</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-3.447383</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-3.148761</td>
<td></td>
</tr>
</tbody>
</table>


Table A.19 ADF test at Level for Lag (No Trend, No Intercept)

Null Hypothesis: LAG has a unit root  
Exogenous: None  
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>1.024830</td>
<td>0.9192</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-2.584214</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-1.943494</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-1.614970</td>
<td></td>
</tr>
</tbody>
</table>

null hypothesis: D(DLAG) has a unit root
exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=12)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-9.334607</td>
<td>0.0000</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-4.039075</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-3.449020</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-3.149720</td>
<td></td>
</tr>
</tbody>
</table>

## Appendix B

### Multiple Regression Analysis

Dependent Variable: DGPT  
Method: Least Squares  
Date: 11/14/15   Time: 01:13  
Sample (adjusted): 2005M03 2015M03  
Included observations: 121 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCPI</td>
<td>161.2093</td>
<td>91.81225</td>
<td>1.755858</td>
<td>0.0819</td>
</tr>
<tr>
<td>DDJI</td>
<td>-0.438130</td>
<td>0.129164</td>
<td>-3.392055</td>
<td>0.0010</td>
</tr>
<tr>
<td>DIR</td>
<td>39.60591</td>
<td>166.5283</td>
<td>0.237833</td>
<td>0.8124</td>
</tr>
<tr>
<td>DLAG</td>
<td>0.211797</td>
<td>0.073592</td>
<td>2.877990</td>
<td>0.0048</td>
</tr>
<tr>
<td>DLFX</td>
<td>1325.711</td>
<td>2952.724</td>
<td>0.448979</td>
<td>0.6543</td>
</tr>
<tr>
<td>DOP</td>
<td>-7.401779</td>
<td>8.398309</td>
<td>-0.881342</td>
<td>0.3800</td>
</tr>
<tr>
<td>DSET</td>
<td>-1.841631</td>
<td>1.210428</td>
<td>-1.521471</td>
<td>0.1310</td>
</tr>
<tr>
<td>DUSDX</td>
<td>-45.59525</td>
<td>31.97822</td>
<td>-1.425822</td>
<td>0.1567</td>
</tr>
<tr>
<td>DWGP</td>
<td>5.073020</td>
<td>0.815393</td>
<td>6.221564</td>
<td>0.0000</td>
</tr>
<tr>
<td>C</td>
<td>46.10311</td>
<td>51.88746</td>
<td>0.888521</td>
<td>0.3762</td>
</tr>
</tbody>
</table>

R-squared: 0.435128  
Adjusted R-squared: 0.389328  
S.E. of regression: 496.4684  
Sum squared resid: 27359376  
Log likelihood: -917.5827  
F-statistic: 9.500525  
Prob(F-statistic): 0.000000

Mean dependent var: 86.25273  
S.D. dependent var: 635.3126  
Akaike info criterion: 15.33195  
Schwarz criterion: 15.56300  
Hannan-Quinn criter.: 15.42579  
Durbin-Watson stat: 2.638264
## Appendix C

**Durbin-Watson Significance Table**

<table>
<thead>
<tr>
<th>$k^* - 1$</th>
<th>$d_L$</th>
<th>$d_U$</th>
<th>$d_L$</th>
<th>$d_U$</th>
<th>$d_L$</th>
<th>$d_U$</th>
<th>$d_L$</th>
<th>$d_U$</th>
<th>$d_L$</th>
<th>$d_U$</th>
<th>$d_L$</th>
<th>$d_U$</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.709</td>
<td>1.409</td>
<td>0.783</td>
<td>1.536</td>
<td>0.877</td>
<td>1.677</td>
<td>0.970</td>
<td>1.861</td>
<td>1.062</td>
<td>2.042</td>
<td>1.154</td>
<td>2.215</td>
</tr>
<tr>
<td>7</td>
<td>0.730</td>
<td>1.409</td>
<td>0.783</td>
<td>1.536</td>
<td>0.877</td>
<td>1.677</td>
<td>0.970</td>
<td>1.861</td>
<td>1.062</td>
<td>2.042</td>
<td>1.154</td>
<td>2.215</td>
</tr>
<tr>
<td>8</td>
<td>0.750</td>
<td>1.422</td>
<td>0.783</td>
<td>1.536</td>
<td>0.877</td>
<td>1.677</td>
<td>0.970</td>
<td>1.861</td>
<td>1.062</td>
<td>2.042</td>
<td>1.154</td>
<td>2.215</td>
</tr>
<tr>
<td>9</td>
<td>0.770</td>
<td>1.422</td>
<td>0.783</td>
<td>1.536</td>
<td>0.877</td>
<td>1.677</td>
<td>0.970</td>
<td>1.861</td>
<td>1.062</td>
<td>2.042</td>
<td>1.154</td>
<td>2.215</td>
</tr>
<tr>
<td>10</td>
<td>0.790</td>
<td>1.422</td>
<td>0.783</td>
<td>1.536</td>
<td>0.877</td>
<td>1.677</td>
<td>0.970</td>
<td>1.861</td>
<td>1.062</td>
<td>2.042</td>
<td>1.154</td>
<td>2.215</td>
</tr>
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<td>0.800</td>
<td>1.550</td>
<td>0.880</td>
<td>1.730</td>
<td>1.000</td>
<td>1.910</td>
<td>1.070</td>
<td>2.130</td>
<td>1.150</td>
<td>2.350</td>
</tr>
<tr>
<td>12</td>
<td>0.830</td>
<td>1.445</td>
<td>0.800</td>
<td>1.550</td>
<td>0.880</td>
<td>1.730</td>
<td>1.000</td>
<td>1.910</td>
<td>1.070</td>
<td>2.130</td>
<td>1.150</td>
<td>2.350</td>
</tr>
<tr>
<td>13</td>
<td>0.850</td>
<td>1.468</td>
<td>0.820</td>
<td>1.570</td>
<td>0.900</td>
<td>1.750</td>
<td>1.020</td>
<td>1.930</td>
<td>1.090</td>
<td>2.170</td>
<td>1.170</td>
<td>2.430</td>
</tr>
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<td>14</td>
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<td>0.820</td>
<td>1.570</td>
<td>0.900</td>
<td>1.750</td>
<td>1.020</td>
<td>1.930</td>
<td>1.090</td>
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<td>2.430</td>
</tr>
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<td>15</td>
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<td>1.468</td>
<td>0.820</td>
<td>1.570</td>
<td>0.900</td>
<td>1.750</td>
<td>1.020</td>
<td>1.930</td>
<td>1.090</td>
<td>2.170</td>
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<td>2.430</td>
</tr>
<tr>
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<td>0.840</td>
<td>1.590</td>
<td>0.920</td>
<td>1.770</td>
<td>1.040</td>
<td>1.950</td>
<td>1.110</td>
<td>2.210</td>
<td>1.190</td>
<td>2.530</td>
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<tr>
<td>17</td>
<td>0.930</td>
<td>1.481</td>
<td>0.840</td>
<td>1.590</td>
<td>0.920</td>
<td>1.770</td>
<td>1.040</td>
<td>1.950</td>
<td>1.110</td>
<td>2.210</td>
<td>1.190</td>
<td>2.530</td>
</tr>
<tr>
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$k^*$ is the number of regressors excluding the intercept