



**TRƯỜNG ĐẠI HỌC FPT**

**Bachelor of Business Administration Thesis**

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**Determinants of the gold price in Vietnam**

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## ABSTRACT

**Purpose** – This study aims to evaluate the determinants of gold price in Vietnam from 2009 till now. In addition, basing on analyzing these determinants, the appropriate solutions would be given to help investors reduce the risk and gain return when investing in Vietnamese gold market.

**Methodology** – The econometric model and co-integration regression technique would be used in this thesis. Variables which are ‘consumer price index in Vietnam’, ‘inflation rate in Vietnam’, ‘the USD/VND exchange rate’ and ‘the nominal interest rate in Vietnam’ are used to build the model of gold price in Vietnam. The data used in the model are monthly observations from the last day of the month covering the period from January 2009 to June 2013.

**Findings** – As the results, by using 5 steps which are: test for the statistical significance, test for heteroscedasticity, test for multicollinearity test the assumption of normality and test for autocorrelation, a positive relationship is found between Vietnam gold price and USD/VND exchange rate. In detail, the inflation in Vietnam and the nominal interest rate in Vietnam have no statistically significant with the gold price. In statistical significance test, the coefficient for CPI and USD/VND exchange rate are statistical significant but there exists the multicollinearity between CPI and USD/VND exchange rate. To ensure the result, CPI is chosen to remove when comparing R-squared between two regression equations.

**Recommendations** – According to the empirical results of this study, the investors could forecast the gold price in Vietnamese market when recognizing the movements of USD/VND exchange rate. Moreover, the Vietnamese government also takes advantage of this research results to manage the domestic gold price more effective.

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## CHAPTER ONE: INTRODUCTION

This chapter provides the very first introduction to the subject of this study. The rationale, research objectives, research questions and structure of the thesis will also be clarified in below contents.

### 1.1. Rationale

#### 1.1.1. Background

Gold has been used widely throughout the world. It has a variety of applicants such as mean of exchange, jewelry, medicine, food and drink, electronics and, especially, investment. Government, institutional and private investors invest in gold for a number of reasons, of which the main reason is to hedge against inflation (Kolluri, 1981). Gold appears to act as safe-haven in times of political or financial turmoil (Baur and McDermott, 2010). Gold is often seen as an alternative to the stock market. Buying shares can give investors higher return because they receive dividends and possible growth in share capital. In times of economic turmoil or recession, the value of shares tends to go down. Then, investors may sell shares and buy gold. Thus, fear over a recession tends to increase the value of gold as people move from more risky stock market to the safer one.

Sharma and Mahendru (2010) showed that the movement of gold price is highly sensitive to the changes in fundamentals of any economy and future prospects' expectation. Expectations are influenced by the micro and macro fundamentals which may be formed either rationally or adaptively on economic fundamentals, as well as by subjective factors which are sometimes unpredictable and also non-quantifiable. The price of gold is determined by several factors. The common macroeconomic factors which may influence the gold prices are: oil price, USA exchange rate, interest rate, inflation rate (Toraman, 2011).

### **1.1.2. Problems**

In Vietnam, gold is used not only as a mean of reserve but also as a mean of payment in transactions. Recently, the economy in Vietnam has been in downturn where the real estate is frozen and stock market is still sensitive and has high risk, the gold market is one of the alternative channels for investors to concern. The gold market in Vietnam has been young and complicated (Dang, 2008 and Phan, 2012) and the government has attempted to stabilize and develop it by improving the policy system. Thus, thorough understanding the gold market as well as factors affecting the gold prices is necessary for not only investors but also the government.

According to Central institute for economic management (CIEM) (2011), from 2001, gold's price increases continuously, especially, from April 2006, the price gold in Vietnam increased dramatically (from 0.98 million to 1.5 million VND per unit). Although its stability after that with 1.3 million, gold price all over the world and in Vietnam increased sharply that broke the record in 1980. Until now, especially in 2012, the price of gold still fluctuated. It sometimes went up to 47.4 million per tael. Comparing December 2011 and December 2001, the gold's price rose about 8.6 times. This period of time can be called "the century of gold". After rising dramatically and continuously in a long time, the price had the trend of reducing (from October 2011 to July 2012). However, this trend could not remain any longer as from the end of August 2012, gold price started to rise sharply. The enormous rise in gold price causes an unhealthy psychological effect on people: when the price goes up, they try to buy as much as they can, but when it falls, people tend to sell gold as quickly as possible. This is one of the reasons for the expectation of increasing price level of gold, beside the main factors brought by the fluctuations in the international gold prices.

Decree No. 24/ND-CP on gold market was issued officially and was valid from 25th, May, 2012. According to the decree, the State Bank is responsible for supplement gold bars to the State foreign exchange reserve, importing and exporting gold, establishing quotas, making purchase and sales of gold bars in domestic market and mobilizing gold (the State Bank). In another word, the State Bank plays as a monopoly of bullion gold in Vietnam. When difference between the domestic gold price and the international gold is large and the international gold price fluctuates sharply, the State Bank's interventions in the form of auctions has kept domestic prices and domestic gold market more stable. This prevents from

motivation of speculation and price manipulation of speculators to make profit. However, in order to make the bullion gold as an effective channel in Vietnam, the investors had better to have deep understanding about the gold market as well as the factors affecting gold price.

### 1.1.3. Gaps

According to analysis, Vietnamese gold market has a correlation with the international gold market. Moreover, the process of international economic integration in recent years is gradually narrowing the price gap between internal and external economies (Pham and Vuong, 2009).

In recent years, basing on the large fluctuations in the gold price in the world and Vietnam as well as in the context of the global economy, there have been many articles and research on Vietnam gold price from many different aspects that include:

- The scientific seminar on effect of gold and foreign currencies in Vietnam's monetary policy was held on 10/11/2006 by Science Council in Banking - Service Strategy Development Bank in collaboration with the Development Bank of the Mekong Delta and the Handicraft Vietnam gemstone jewelry in Hanoi. In this seminar, the researchers analyzed gold price in many different aspects, however, they did not provide the appropriate reviews about Vietnam gold market as well as the specific factors affecting the gold price in Vietnam.
- The studies of Dang, T.T.V. (2008) and Pham, T.H.T. (2012) mentioned about the factors affecting the gold market and the solutions for development of gold market in Vietnam economy. However, the authors of these thesis did not do research about the relationship of the variables with Vietnam gold price in the quantitative method.

As a result, through these analyses, the authors have a general clear view about Vietnam gold market and the factors affecting gold prices such as: oil prices, USD dollar, sources of supply and demand, economic factors, and inflation; however, there exists a limitation about the financial modeling to show the relationship of the variables with gold price. Therefore, it is defined to be the gap in this thesis: “Determinants of gold price in Vietnam”. Through this research, in addition to analysis of factors affecting the gold price, this thesis also shows the relationship between variables through model. Thus, it can be used to show how variables affect

the price of gold. Moreover, the model can be used to define which are the variables dominating gold price and the investors can use it for more accurate investment.

This research is narrowed to examine the determinants of gold price from January, 2009 to June, 2013. The first reason is to keep up-to-date to Vietnamese gold market. The second one is to evade the gold price movements in the world crisis in 2008. At this point of time, the gold price went up and down dramatically and did not follow any rules (Financial Times). Thus, to limit the inconsistency of price movements of gold, the period from January, 2009 to June, 2013 is appropriate to choose as the time series.

## **1.2. Research objectives**

This thesis studies the determinants of the gold price comprised from different macroeconomic factors coming from not only inside but also outside of Vietnam. The results will support the findings of previous studies on the price of gold.

The first objective is to study and quantify the impact of variables on gold price. We will identify and examine the main factors affecting gold price in Vietnamese market. Some studies on other markets in the past defined various determinants and movements of gold price. In this research, we want to give a clear view on the most important divers having effect on Vietnamese gold price from January, 2009 to June, 2013.

Based on the thorough understandings about the determinants of gold price in Vietnam, the second objective is to suggest appropriate solutions to help investors reduce the risk and gain return when investing in Vietnamese gold market and help the government manage better the price of gold.

## **1.3. Research questions**

This research is aimed at trying out and testing the impact of determinants affecting gold price in Vietnamese market. The study attempts to answer the research questions as follows:

- Question 1: What are the determinants of gold price and to what extend do they affect gold price in Vietnamese market in period of time from January, 2009 to June, 2013?

- Question 2: What are the solutions for investors to reduce the risk and gain return when investing in Vietnamese gold market and for the government to manage the gold price more effectively?

The first question will be addressed by researching the available literature and using co-integration regression techniques. From the results of the model, the solutions needed would be drawn.

## 1.4. Structure

This study is divided into five chapters:

- **Chapter one** gives an overall picture of the subject related topic background, topic relevance, relevance of research question, overview of dissertation structure.
- **Chapter two** reviews literature related to the research question. Clearly states the gap in literature with respect to research questions.
- **Chapter three** presents methods used to collect data, ethic consideration, limitations of the research project.
- **Chapter four** provides systematic presentation of the data before interpretation. Analysis and discussion of findings relative to the literature review also are provided.
- **Chapter five** gives the conclusion throughout the study.

## **CHAPTER TWO: LITERATURE REVIEW**

In this chapter, an overview of international and Vietnamese gold markets in history will be discussed, as well as the review on previous related literature and developed hypotheses.

### **2.1.Overview of International and Vietnamese gold markets**

#### **2.1.1.The International gold market**

##### **2.1.1.1.The roles of gold in the history**

Already appeared early in history, gold was used to trade, as a token of wealth. According to Goodman (1956) supported with Solt and Swanson (1981), gold has some similar characteristics to money in that it acts as a store of wealth, medium of exchange and a unit of value. Characteristics of gold are its indestructibility, beauty and rareness relatively to other metals (Mani and Vuyyuri, 2005). It was a malleable metal that could be hammered cold into a thin and its color was sheen naturally equated it with the sun, so using gold is a symbol of wealth and power.

World Gold Council (2007) indicated that the history of gold related to the history of civilization. The history of gold started around 5000 years ago in Egypt and Nubia (which is an area in the northern part of Sudan). In 1500 BC, merchants in the Middle-East recognized gold as the standard medium of exchange. In 1091 BC golden leaflets were legalized as money in China. Meanwhile, the Romans started to use gold in a frequent manner in the first century BC. At that time, they used the “Aureus” which was a golden coin with a weight of around 8 grams. During the period where Egypt and Rome were flourishing, annual gold production was around one ton annually (Heritage of World Gold Council, 2012).

In 1377, England made an important decision that developed a monetary system based on gold and silver. During these Dark and Middle-Ages gold production dropped to an amount of less than one ton annually. From the 15th century on, Africa started to excavate gold which increased annual gold production to around five to eight tons annually. Annual gold production arrived at a new height with the discovery of North and South-America (Sjaastad and Scacciallani, 1996).

For the next milestone, the Bank of England was the first central bank to adopt the Gold Standard since 1844. Based on the World Gold Council (2007), the Gold Standard is a monetary system where the issued amount of paper is tightly or loosely tied to the central bank gold reserve. It was a system under which nearly all countries fixed the value of their currencies to trade with each other. At a country level, the Gold Standard has been credited for a long period of price stability which was supportive of economic growth. On an international level, the Gold Standard contributed to global trade, growth and significant global economic development. By the year 1890, most of the world had adopted the Gold Standard.

In term of the benefits and drawbacks of Gold Standard, Eichengreen and Flandreau (1987) pointed out that the increasing popularity of the Gold Standard can be explained by its network effects. The countries that refused using Gold Standard were facing difficulties in attracting money while countries with the Gold Standard were able to do better investment planning because of lower inflation volatility. Besides, a main drawback of the system was the potential destabilization of countries with a trade deficit that led to destabilize countries that already suffered from lower economic activity. In 1914, with the outbreak of World War I, Bank of England decided to leave the Gold Standard to finance the war by printing more paper money. After the First World War, America and England did some serious attempts to get back to the Gold Standard, but none of the attempts was successful.

By the end of World War II, a new monetary system was established between 44 countries over the world: the Bretton Woods System. In the Bretton Woods System, all currencies are tied to the dollar and the dollar is tied to gold. The first established parity was 35 dollars per ounce (Heritage of World Gold Council, 2012). The Bretton Woods System came to an end in 1971 because the Bank of America kept on printing dollars to finance its war in Vietnam that caused other countries to lose their trust in the maintainability of this system.

Until the seventies of twentieth century, the price of gold is free to move, it increases or decreases as a result of changes in supply or demand. Nevertheless, central banks intervened once more. On 26/9/1999, the Central Bank Agreement on Gold (CBGA) they stressed the importance of gold as a reserve asset (World Gold Council, 2007). This agreement limited the sale of gold by central banks by 400 tons a year and 2000 tons in the next five years. It also

limited the amount of gold leased to the level of previous years. This agreement was renewed after five years: on 8/3/2004 the central banks decided to renew it, but changed the amounts to 500 tons annually and 2500 tons in the next five years.

#### **2.1.1.2. The role of central bank on gold market**

Meltzer (2003) indicated that Central Banks have generally had three main objectives and roles:

- To maintain price stability, subject to the monetary regime in current operation, for example the gold standard, a pegged exchange rate or inflation target.
- To maintain financial stability, and to foster financial development more broadly.
- To support the State's financing needs at times of crisis, but in normal times to constrain misuse of the State's financial powers.

In the history of gold market, Central Banks has played an important role and had a huge impact to the change of the gold price (World Gold Council, 2007).

In 1944, the establishment of the IMF (International Monetary Fund) puts gold at the center of the new international monetary system. The first international agreement on gold came with the signing of the IMF's articles of agreement in July 1944 (Central Bank gold agreements of World Gold Council, 2012). These laid down that all member countries should establish "par values" for their currencies in terms of gold, or in terms of the US dollar which was its defined in terms of gold.

In the next decade, early 1960s – Central Banks tried to stabilize the price of gold by issue many agreements. This agreement known as "The Gold Pool" - was established to hold the price of gold close to the then official price of \$35 an ounce (World Gold Council, 2012). However, in 1968, the Central Banks abolished The Gold Pool, agreeing that they would no longer supply gold to the market but transact only among themselves at the official price.

In 1999, the Euro was launched to replace the currencies of the European Union with a common currency, but the launch of the Euro was still not without its risks, leads to the trend to turn to gold to ameliorate the risks was great. The Central Banks has formulated the



"Washington Agreement" through which the members sold a limited amount of gold that they would sell no more than 400 tons of gold per year, for the next five years (Central Bank gold agreements of World Gold Council, 2012). The sales held to these ceilings and had limited effect on the gold market, which allowed the Gold Price to rise. It is also known as the first Central Bank Gold Agreement.

On March 8th 2004, the signatory banks announced the second Central Bank Gold Agreement that covered a five-year period, in this case from September 27th 2004 (immediately after the expiry of the first Agreement) to September 26th 2009. The second Agreement started by reaffirming the first clause in the 1999 Agreement: "Gold will remain an important element of global monetary reserves" (Central Bank gold agreements of World Gold Council, 2012). While the rest of the Agreement covered similar ground to the first, there were some important differences. Subsequently, it became clear that the signatories had sold significantly less than the ceiling they had set themselves.

In 2009, the Central Banks worldwide announced the third Agreement that covers a five-year period, in this case from 27 September 2009 (immediately after the second Agreement expired) to 26 September 2014. This Agreement also included two important departures from the prior Agreements: First, the collective ceiling was reduced so that "annual sales will not exceed 400 tons and total sales over this period will not exceed 2,000 tons", 500 tons lower than the 2,500 tons five-year ceiling provided for in the second Agreement. However, the new lower ceiling did not come as a surprise to market participants and had no impact on the gold price. The second significant difference in the Agreement recognized the fact that the IMF intended to sell 403 tons of gold, and stated that these sales "can be accommodated within the above ceiling". In the event that the IMF is unable to arrange an off-market sale with another official sector institution, the sales will be conducted through the third Agreement (World Gold Council, 2007).

### **2.1.1.3. London gold market fixing**

Since 12 September 1919, London is the center in the world for fixing the gold price. The London gold fixing is the procedure by which the price of gold is determined twice each business day on the London. It is used as a benchmark for pricing the majority of gold products and derivatives throughout the world's markets (World Gold Council, 2007).

Five market-making members of the London Bullion Market Association are also members of the London fixing: Deutsche Bank, SocieteGenerale, HSBC, Scotia Mocatta and Barclay Capital. Any other market participant wishing to trade on the fix is required to do so through one of these five dealers. The price of gold is fixed twice each business and fixed in United States dollars (USD), Pound sterling (GBP) and European Euros (EUR).

According to the Meltzer (2003) about the process of London gold fixing, the gold fix usually begins with the chairman declaring a gold price which is very near the ongoing spot market gold price. Then, the participants will decide to erect flag or not based on their customers' supply and demand. Until all of the members' flag is put down, the gold price is fixed. Otherwise, the chairman must change the proposed price. In case the amount of gold the banks proposed to buy is higher than the amount proposed for sale, the chairman must raise the price. That will decrease the number of proposed purchases, both because more buy limit orders will fail and because of proprietary traders. At the same time, it increases the number of proposed sales, both because more sell limit orders succeed and because of proprietary trading. Conversely, if the amount proposed for sale is higher, the chairman must lower the price. This will have the exact opposite effects from above, increasing the number of proposed purchases and decreasing the number of proposed sales. This process iterates until a fix is found. Buyers are charged 20 cents per troy ounce as a premium to fund the fix process; this results in an implicit bid-offer spread. As with other forms of market making, participants attempt to predict the direction of the market and increase profits through timing.

## **2.1.2. The Vietnamese gold market**

### **2.1.2.1. The role of State Bank**

In the last 3 years (2009-2011), Vietnam gold market was chaotic; the fluctuation of the gold price is extremely large. To stabilize the gold market, Decree No. 24/ND-CP on gold market was issued officially and valid from 25<sup>th</sup>, May, 2012.

According to Decree No. 24/2012/ND-CP of the Government on gold business activities, the role of State banks on the gold market as follows:

“The State Bank is responsible to draw up and submit the strategies, plans on gold market development to competent authorities for issuing legal documents on management of gold business in accordance with provisions of this Decree. The State Bank is entitled to supplement gold bars to the State foreign exchange reserve. The State Bank shall intervene in and stabilize the gold market by the following measures:

- Importing and exporting gold material in accordance with Clause 1 Article 14 of this Decree.
- Organizing and managing the production of gold bars by establishing quotas, time and methods of gold bar production in each period. The expenses on the organization of production of gold bars shall be accounted into the operating expenses of the State Bank.
- Making purchase and sales of gold bars in domestic market and mobilizing gold as regulated by the Prime Minister.

The State Bank shall issue or withdraw:

- The Qualification certificate of gold jewellery and fine arts production.
- The Licenses to trade gold bars.
- The Licenses to import and export gold material.
- The License for individuals who bring along gold exceeding the limit prescribed by law when entering, exiting the country exceeding the limit prescribed by law.

License for other gold business activities was approved by the Prime Minister. The State Bank shall examine and inspect the production of gold jewellery and fine arts; the purchase and sale of gold bars, gold jewellery and fine arts; the import and export of gold materials and other gold business activities. The State Bank shall perform other tasks and powers related to the management of gold business under the Prime Minister’s decisions”.

Through this Decree, the State Bank plays an important role in operating and managing the gold market. SBV is responsible for supplement gold bars to the State foreign exchange reserve, importing and exporting gold, establishing quotas, making purchase and sales of gold bars in domestic market and mobilizing gold, which are main factors that make a great impact of the State bank on the gold market. Hence, SBV is defined as the monopoly of gold supply in Vietnam which has a big influence on Vietnamese gold price.

### **2.1.2.2. The trade on gold bar in domestic market**

Vietnam financial market is underdeveloped, so the derivative products and investment face many difficulties compared to developed markets. Trading in international markets helps investors by the variety of goods (currency, precious metals, oil...) and all the relevant services. Besides, the Vietnam financial market is quite young, there are some difficulties for the business such as: No legal frame work to protect investors from the risks, lack of derivative products or the cost for using that kind of products is too high (Vuong, 2004).

On March, 12<sup>th</sup>, 2013, the State Bank of Vietnam issued Circular No.06 guiding the trade on gold bar in domestic market. This Circular takes instruction on gold bar trades among the State Bank of Vietnam with other credit institutions and enterprises which are granted with permits on trading gold bars. According to Circular No. 06/2013/TT-NHNN of the State Bank of Vietnam, regulations on gold trading of the State Bank of Vietnam as follows:

“Type of gold bar trading: the State Bank shall trade in gold bar with content of 99,99%, type of 01 (one) piece produced by the State Bank or permitted for production in the periods.  
Form of gold bar trading: direct trading of gold bar and trading of gold bar through bidding by price or by volume.

In term of transaction documents, gold bar trading each time between the State Bank with the credit institutions and enterprises shall be shown by documents as follows.

Direct trading:

- Announcement of gold bar trading, announcement of trading price from the State Bank.
- Registration application of gold bar trading of the credit institutions and enterprises;
- Announcement on volume of gold bar volume from the State Bank;
- Transaction confirmation

Trading by bidding:

- Bidding notice, notices of selling and purchasing prices (bidding by volume), floor price and ceiling price (for bidding by price) from the State Bank.

- Bidding offer of the credit institutions or enterprises;
- Announcement of bidding result from the State Bank;
- Transaction confirmation

Transaction account:

- The credit institutions or enterprises shall make deposits and payment to the State Bank by an account notified by the State Bank.
- The State Bank shall return the deposit and make payment to the credit institutions and enterprises by accounts registered by the credit institutions and enterprises upon establishing trading relationships of gold bar.

Deposit:

- Credit institutions and enterprises must make a deposit in order to secure confirmation and implementation's obligations for gold bar trading with the State Bank.
- Credit institution's and enterprise's credit values upon gold bar trading with the State Bank shall be calculated by the formula as follows:

$$\text{Deposit value} = \text{Deposit ratio} \times \text{Reference price} \times \text{Reference volume}$$

(In which: Deposit ratio: in percent (%); Reference price: in VND/piece; Reference volume: is the minimum volume of gold bar trading (direct trading), the minimum volume of gold bar bid of a credit institution and enterprise (bidding), or volume of gold bar which the credit institutions or enterprises have registered for trading (direct trading) or volume of gold bar bid of each credit institution and enterprise). Deposit ratio, reference price and reference volume shall be noticed by the State Bank before each time of trading.

Project on gold bar trading:

- Foreign Transaction Department Management Department shall coordinate with the Monetary Policy Department and the Transaction Department to submit to receive approval from the Head of Foreign Transaction Department Reserve's Executive Committee and submit to the Governor for approval of the gold bar trading project to interfere into gold market in each period.

- Project on gold bar trading includes contents as follows:
  - Time of interference.
  - Type of gold bars.
  - Total volume of interfered gold bar trading; Volume of gold bar lot. The maximum or minimum volume of gold bar in a transaction with a partner; price step, bidding volume step.
  - Trading form.
  - Expected subject of trading.
  - Principle to determine the trading price (direct trading); principle to define purchasing and selling prices (bidding by volume), Principle to determine the floor and ceiling price (bidding by price).
  - Deposit ratio, reference volume and principle to determine the reference price.
  - The principle and ground to determine the price and fluctuation of gold price to decide to stop the trading in case of direct trading or cancel the bidding.
  - The trading of gold on accounts in foreign countries or purchasing gold from foreign countries for gold import or making gold sale to foreign countries to correspond to the volume of interfered gold trading: After the plan for trading of gold bar has been approved, the Transaction Department shall coordinate with Department and Administration concerned of the State Bank for implementation.

Processing deposit from credit institutions and enterprises:

- The State Bank shall not refund deposit and notify in writing form to the credit institutions or enterprises in case that credit institutions and enterprises that are allowed for trading of gold bar with the State Bank (direct trading) or winning bidding (bidding) violate their obligations prescribed in Article 13, point a, clause 1 and point a, clause 2, Article 15 of this Circular.
- Except for the cases specified in clause 1 of this Article, the State Bank (Transaction Department) shall refund deposit to credit institutions and enterprises by accounts registered by credit institutions and enterprises with the State Bank in the period as follows:

- In the transaction day for the case that the State Bank stops the trade or cancels the bidding and credit institutions or enterprises are not permitted for trading or has not won bidding.
- In the working day after the transaction day for credit institutions or enterprises purchasing gold bar of the State Bank.
- In 02 (two) working day after the transaction day for the credit institutions or enterprises selling gold bar of the State Bank.”

## **2.2.Literature review**

### **2.2.1.Supply and demand of gold**

The gold supply and demand is a key factor determining the price of gold. In many years, the world gold price has increased or decreased as a result of changes in supply or demand (World gold council, 2007). Therefore, to understand the price movements in gold, the supply and demand of gold need to be clarified.

#### **2.2.1.1. In the international market**

##### **Supply:**

Gold is a rare metal. The major gold entering the market comes from three sources: mining, recycling and official sector sales. In term of mining source, The Forbes Global Top 2000 (2011) includes 12 gold companies. The biggest is the US Newmont Mining; six are from Canada, two from South Africa, and one from Australia, Peru and Russia.

**Table 1: Gold Companies in the Forbes Global Top 2000**

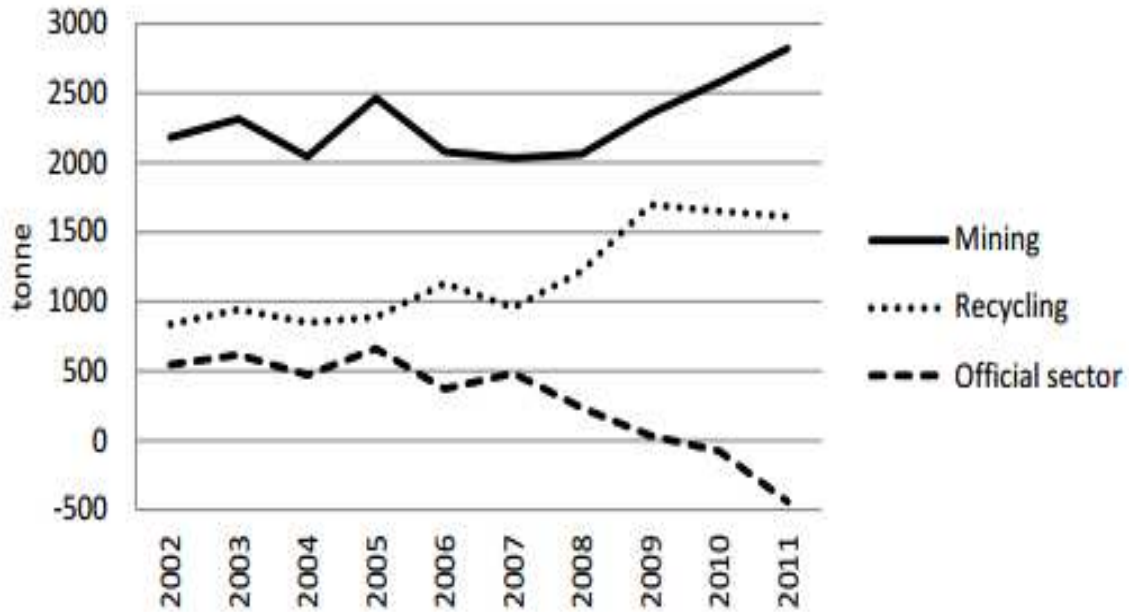
Name	Forbes Rank	Base	Revenue (Billion US\$)	Assets (Billion US\$)
Newmont Mining	398	US	7.71	22.3
Barrick Gold	704	Canada	8.14	27.08
Goldcorp	872	Canada	2.72	20.9
Kinross Gold	110	Canada	2.41	8.01
AngloGold Ashanti	1263	South Africa	4.15	9.82
Gold Fields	1329	South Africa	3.77	8.4
Yamana Gold	1416	Canada	1.18	9.71
Newcrest Mining	1473	Australia	2.04	4.21
Buenaventura	1886	Peru	0.74	1.99
Polyus Gold	1951	Russia	1.09	3.08
Eldorado Gold	1965	Canada	0.28	1.36
Agnico-Eagle Mines	1970	Canada	0.64	4.25

**Source: Forbes Magazine, 2011**

Mining was able to supply 2821.7 tons of gold in 2011 (Figure 1). The increase in gold coming from mines only started from 2008, which is two to three years after the start of the boom in the gold price. The reason for this slow reaction is the required time to open a new mine for gold digging.



**Figure 1: Evolution of the Gold supply in 2002 - 2011**



**Source: World Gold Council, 2011**

Since the financial crisis, governments and central banks (official sector) stopped liquidating their gold reserves and even started to increase their gold reserves. Central banks try to diversify their assets as much as possible and try to reduce their assets in Euros or Dollars, because they fear a fierce depreciation in the future.

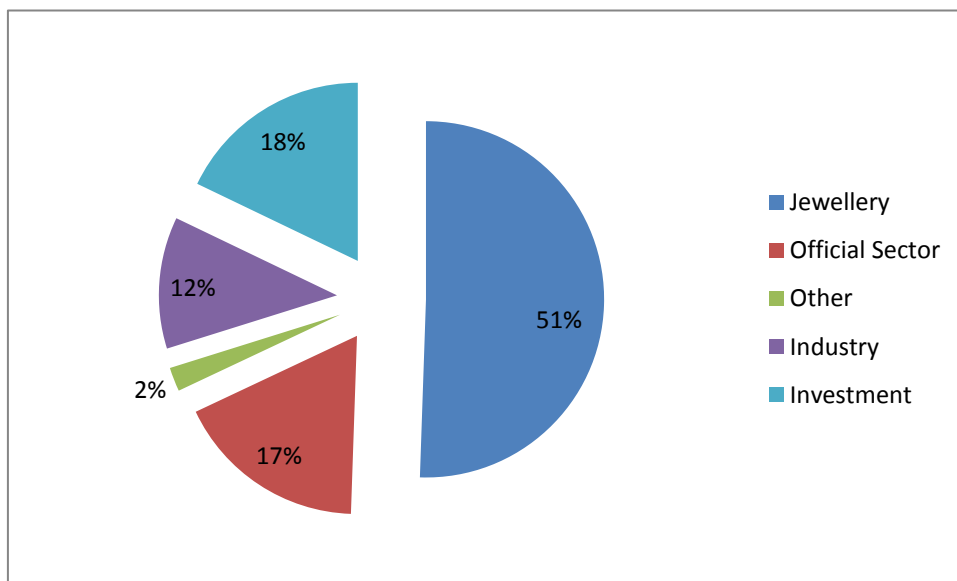
**Table 2: Gold production countries from mining in 2010**

Rank	1	2	3	4	5	6	7	8	9	10
Country	China	Australia	United States	Russia	South Africa	Peru	Indonesia	Ghana	Canada	Uzbekistan
Gold Production	345	255	230	190	190	170	120	100	90	90

**Source: United States Geological Survey, 2010**

According to USGS there is still 50000 tons of gold beneath the earth that can be excavated in an economical viable way. This amount will lead to the change of gold prices, production costs and techniques. If the price of gold stays the same and mankind keeps on excavating at a paste of 2500 tons per year, gold will be depleted in less than 20 years. However, the lack of gold mining will lead to the increase of gold price in the future.

**Figure 2: Gold in Circulation (Total 165600 tons)**



**Source: United States Geological Survey, 2010**

### **Demand:**

- Reserve demand for gold of Central Bank:

Central banks, international entities (e.g. International Monetary Fund) and governments are the single largest holder of gold in the world. These institutions controlled end of 2009 16.2 per cent (26,780 tons) of the worldwide available gold (World Gold Council). This corresponds to a market value of 7,950 billion US dollar, based on a gold value of 1427 dollar per ounce.

According to World Gold Council (2009), in the last years, several central banks, notably from Russia, India and China, have announced plans to increase their gold reserves. As a consequence, in 2009 central banks have become for the first time in 20 years net buyers of

gold. In this year, net buying resulted in 470 tons of gold. The invigorated interest in gold can be traced back to the financial crisis, as this precious metal can be used as a hedge.

– Investment demand for gold:

The role of gold amongst times of financial or political turmoil is significant. Investors tend to buy gold when there is financial or political instability, since the commodity is seen by investors as a safe haven, with a low credit risk which at times of turmoil is very liquid.

According to Ghosh (2004) supported with Mani and Vuyyuri (2005) and Tully and Lucey (2005), gold can be considered a tool for the reduction of risk, for their empirical analyses suggest that gold has a negative beta. As institutional investors have to diversify their portfolio to reduce risk, holdings of gold are attractive, as it tends to show a negative beta when compared to the market portfolio. Better diversification can be obtained by a more negative beta, which increases gold demand and thus the price of gold.

– Industry demand for gold:

Ghosh (2004) state that the industrial gold demand is negatively related to the price of gold, as it also becomes less attractive to purchase gold. Unfortunately, the literature and available data about industrial demand is not very extensive which constrains the possibility to research relations between movements in the demand of gold and movements in the price of gold.

In the electronic industry, gold is used for wiring and as electrical connectors. The advantages of this material are highly conductivity, resistant to corrosion and lack of toxicity. Other uses are in the commercial chemistry. In dentistry, gold alloys are used in tooth restorations. In medicine, gold can be applied as a conductive coating. As gold reflects infrared light 98%, this metal is used as a coating on glasses and mirrors. Besides the increasing number of appliances for industrial gold, demand also expands due to the strong economic performance of emerging countries. Moreover, gold is, or will be used for the following purposes: gold-based therapeutics, diagnostic technologies based on gold, as catalysts in industrial processes, for water purification and advanced consumer electronics.

- Jewelry demand for gold:

Gold has been used for jewelry for 6,000 years. The reasons are its rarity, ease of mechanical processing, resistance to corrosion and its exceptional color. In 2011, the demand of gold for jewelry is 1963 tons (World Gold Council, 2009).

Another decorative use of gold is as gold foil, also called gold leaf. Gold foil has been used since the ancient world. Gold foil is thinner than the wave length of the visible light and can be applied to non-metallic surfaces, such as frames, books, furniture and architectural elements. Besides producing gold jewelry, this precious metal can be also applied as a galvanized coating to plastic and metal.

#### 2.2.1.2. In Vietnam market

##### Supply:

Vietnam also produces and mines gold but the amount is not significant. The production of gold from 2006 to 2010 maintained below 3.5 tons (U.S. Geological survey minerals yearbook, 2010)

**Table 3: Vietnam Production of Mineral from 2006 to 2010**

<b>Gold</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
<b>(kilograms )</b>	2,500	3,000	3,000	3,000	3,500

**Source: U.S. Geological survey minerals yearbook 2010**

These figure compared with the statistic about Vietnam gold demand for investment and jewelry which are: 73.3 tons (World Gold Council, 2009), 81.4 tons (World Gold Council, 2010), 100.3 tons (World Gold Council, 2011), 77.0 tons (World Gold Council, 2012). Thus, it could be seen that, Vietnam gold mining and production are not enough to meet the demand for gold. The source of Vietnam's gold supply is mainly from import. Depending on targets of monetary policies and gold supply-demand in each period, the State Bank shall organize the import and export of gold material for gold bar production, issue the licenses to

import gold material to enterprises and issue the license to export gold material to enterprises that possess the License for gold exploitation (Article 14, Chapter 4, Decree No. 24/2012/ND-CP). Vietnam's gold supply is mainly from the decision of the State Bank. If the domestic price is too high or the gold demand of businesses, credit organizations and residents are too large, the State Bank will depend on the macroeconomic situation to make the decision to import gold.

### **Demand:**

As well as in the world, gold demand in Vietnam is mainly for reserve, investment, technology and jewelry.

- Reserve demand for gold:

Under Article 32, Law on the State Bank of Vietnam, foreign exchange reserves including Gold under the State Bank's management (Law on the State Bank of Vietnam, 2010). Therefore, the State Bank reserves gold aiming to increase foreign exchange reserves. Besides, Vietnamese people demand gold for gold reserve because of the economy instability and high inflation in recent years, so people tend to reserve gold in order to avoid risk.

- Investment demand for gold:

Investment demand for gold from both individuals and institutions is one of the fastest growing areas. It has increased in popularity because of its superior ability to insure against risk (The World Gold Council, 2012).

- Technological demand for gold:

Gold is a desirable metal for industry because it does not tarnish or corrode. It can be drawn into wire, hammered into thin sheets, and its alloys with other metals. It is used in a wide variety of applications because of its unique characteristics.

- Jewelry demand for gold:

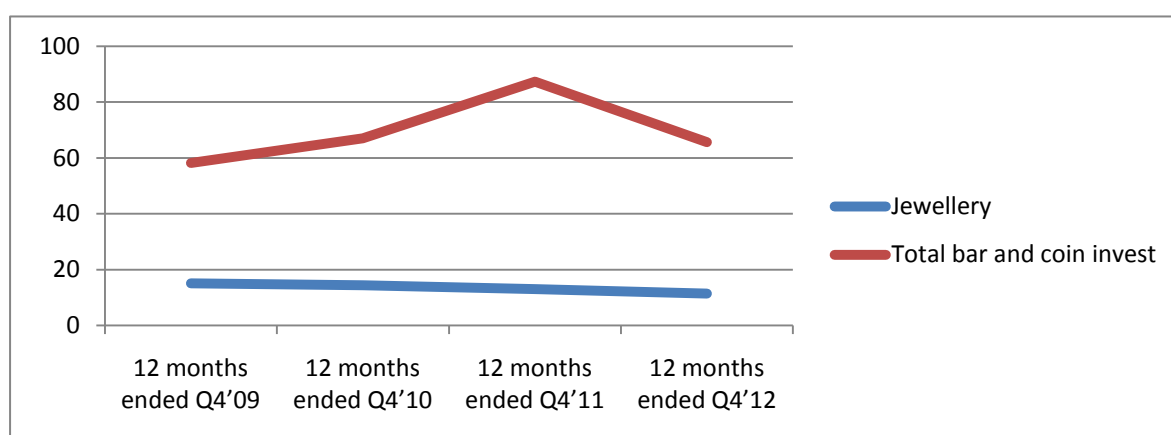
The jewelry industry accounts for the largest portion of demand. Gold is mostly used in rings, earrings, and necklaces. The demand for jewelry sales is driven by a combination between affordability and consumer sentiment (The World Gold Council, 2012).

**Table 4: Consumer demand in Viet Nam four quarter totals (tons) in 2008-2012**

Period of time	Jewelry	Total bar and coin invest	Total
12 months ended Q4'09	15.1	58.2	73.3
12 months ended Q4'10	14.4	67.0	81.4
12 months ended Q4'11	13.0	87.3	100.3
12 months ended Q4'12	11.4	65.6	77.0

Source: The World Gold Council, 2008-2012

**Figure 3: Consumer demand in Viet Nam four quarter totals (tons) in 2008-2012**



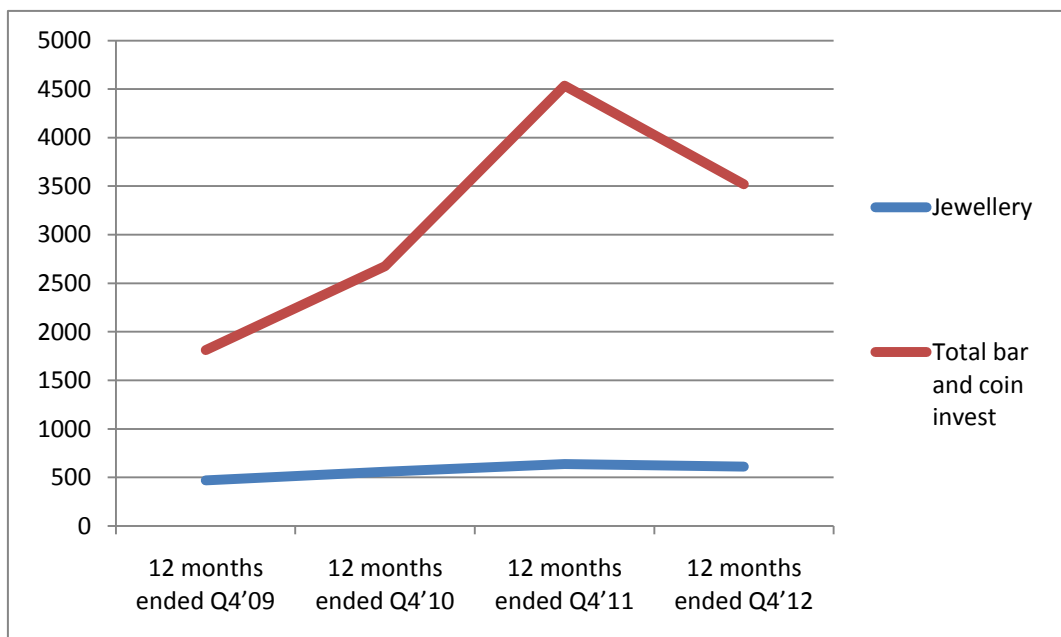
Source: The World Gold Council, 2008-2012

**Table 5: Consumer demand Viet Nam four quarter totals (value, US\$ mn) in 2008-2012**

Period of time	Jewelry	Total bar and coin invest	Total
12 months ended Q4'09	471	1,813	2,284
12 months ended Q4'10	558	2,674	3,232
12 months ended Q4'11	637	4,534	5,170
12 months ended Q4'12	610	3,521	4,131

Source: The World Gold Council, 2008-2012

**Figure 4: Consumer demand Viet Nam: four quarter totals (value, US\$mn) in 2008-2012**



Source: The World Gold Council, 2008-2012

Through the chart, we can see that the gold demand for jewelry in Vietnam have a tendency to decrease from 2009 to 2012 which contrast to investment demand. Vietnamese investors increased demand for gold bars and coins, Investment demand in Vietnam was fuelled by persistent high inflation, the poor performance of the domestic property and stock markets and the continued devaluation of the local currency against the US dollar. Despite local currency prices of gold surging to record highs, and the strength of demand generating considerable premiums on the domestic price of gold bars, investors continued to clamor for gold bars. It can be seen that the demand for gold reserves and investment has the big influence in the Vietnam gold market, as well as the gold price in Vietnam.

There are very few studies researching about factors influencing gold prices in Vietnam. It looks like there was no empirical test done to prove specific variables driving gold prices comprehensively. For instance, Dang (2008), Phan (2010) and Pham (2012) analyzed and assessed determinants of the price of gold in Vietnamese market. However, these studies used dialectical materialism, historical materialism combined with comparison, synthesis, economic statistics, and sociological investigation to show factors affect gold prices in Vietnam including supply of and demand for gold, government policies.

### **2.2.2. Approach to the model of the gold price**

In the world, the amount of studies that have attempted to empirically model the gold price is numerous. These studies can be categorized into three approaches (Lampinen, 2007). The first approach, studied by authors such as Ariovich (1983), Kaufmann and Winters (1989), Sherman (1982, 1983, 1986), Dooley, Isard and Taylor (1995), Sjaastad and Scacciallani (1996), and Godsell and Tran (2011), models variation in the gold price in terms of variation in main macroeconomic variables, for example, exchange rates, interest rates, world income and political shocks. The second approach conducted, for instance, by Koutsoyiannis (1983), Diba and Grossman (1984), Baker and Van Tassel (1985), and Pindyck (1993), with an aspect of speculation or the rationality of gold price movements. The third approach represented by Chappell and Moore (1990), Dowd (1997), Laurent (1994), Mahdavi and Zhou (1997), Ghosh et al. (2004), Gorton and Rouwenhorst (2006), Kolluri (1981), Levin and Wright (2006), Ranson and Wainwright (2005), Worthington and Pahlavani (2007), Tully and



Lucey (2007), and Blose (2010), examined about gold as an inflation hedge with particular focus on short-run and long-run relationships between gold price and the general price level.

### **2.2.2.1. Macroeconomic approach**

Dooley, Isard and Taylor (1995) conducted study to test the short and long term influences of gold prices on exchange rates conditional on the other monetary and real macroeconomic variables. The empirical tests, focusing on exchange rates between the U.S dollar and four other major currencies (the pound sterling, the Japanese yen, the Deutsche mark, and the French franc) and on the mark/yen also with data from 1976-1990, showed that gold price movements have explanatory power with respect to exchange rate movements, over and above the effects of monetary fundamentals and other variables that enter standard exchange rate models. In this research, they viewed gold as “an asset without a country”. Hence, Any type of shock that reduce the attractiveness of holding claims on one specific asset, other things equal, will raise the demands for other assets including gold, which leads to changes in market-clearing prices.

A study of Sjaastad and Scacciallani (1996) supported Dolley, Isard and Taylor (1995)‘s research. Sjaastad and Scacciallani investigated the relationship between the gold price and the foreign exchange market for from 1982 to 1990. The key finding of their study was the significant influence of an appreciation or depreciation of a European currency on the price of gold. They jumped in conclusion that the US dollar only had a minor impact on the gold price. According to the authors, fluctuations in the real exchange rates among the major currencies explained almost half of the variation in the gold price.

The paper of Tan (2011) attempted to reconcile an apparent contradiction between short-run and long-run movements in the world price of gold. A theoretical model using monthly gold price data from January, 1990 to April, 2009 and cointegration regression techniques was developed and demonstrated that four factors including US dollar exchange rate, U.S. inflation rates, oil prices and the Dow Jones industrial average all affect the gold price volatility in the short or long term, while the U.S. federal funds rate only impacts gold price in the long term and negligible in short term. In addition, the international political environment, significant political and war events will affect the price of gold.

Using regression techniques and seeking a simple predictive model using annual data, Kaufmann and Winters (1989) derived a formula for the annual price of gold based on changes in the rate of inflation in the USA, an index of the US dollar exchange rate and the annual world production of gold. Statistically, the model shows a high correlation between the formula price and the market price over the past 16 years (1974 – 1988) although many variables often considered important to the price of gold are ignored.

Under the background of open Chinese gold market where gold coexist with gold futures, the research of Ye and Zhou (2010) selected the main influence factors on gold price, using monthly data as study sample from 2006 to 2010, the multiple regression model through Ordinary Least Squares method and makes the empirical study on influence factors of gold price in Chinese market. The findings indicate that linkage between the Chinese gold and the foreign exchange rate is strong.

Moreover, the research of Godsell and Tran (2011) provided an insight into the factors driving price of gold in U.S from the past 41 years (1970-2010). Their study indicated that gold price was influenced significantly by variety of factors including national debt, gold production, interest rates and unemployment rate. They were able to use these variables to clarify a regression equation that met the classical normal linear regression model and justified this model from an economic perspective. They found out that there was a positive relationship between the nominal interest rate and the price of gold. In term of national debt, low national debt may temper gold prices, because domestic currency would be stronger and people would be less favor for using it as safe haven. On the other hand, low quantities of gold production supplied coincide with high price levels at which only those that value the product most are able to afford it. In addition, their results proved that lower unemployment rates would also increase gold demand, which leads to higher gold prices. Although their regression model had notable explanatory power, it was limited by only looking at short-term interest rates, and could be strengthened by including the effect that low interest rates could have over time. Nevertheless, the analysis provided great insight to the short term behavior of commodity prices and the effects of economic conditions and fiscal policy on gold prices.

#### **2.2.2.2. Speculation approach**

To confirm the empirical data analysis that short run movements are influenced by the gold lease rate, the convenience yield and the LIBOR (Ghosh et al., 2004), Bialkowski et al. (2011) investigated if the rapidly growing investment activities had triggered a new asset price bubble by using time sample from 1978 to 2010. They drew on the convenience yield model and used commodity dividends to derive gold's fundamental value. It proved that once the commodity dividend increases by one percent, the gold price goes up by 0.61 (0.76) percent. They approximated the commodity dividends with the help of future contracts, and used them to explain the gold price, establishing a stable long-run relationship. The empirical evidence was favorable for a fundamentally justified price level even during the current period of a drastically rising gold price.

Pindyck (1993) tried to develop a present value model for the gold price based on futures. For commodities which were copper, lumber and heating oil, the model performed well. However, the present value model did a poor job modeling the price of gold. According to Pindyck, this was due to the fact that gold had not the same level of convenience yield like the other commodities. Monthly net convenience yield had always been less than 1 percent of price, and usually less than 0.2 percent. Moreover, except for the brief spike in convenience yield in 1981, there is little co-movement with price. This suggested that sharp rise in price (such as those of 1980 and late 1982 - early 1983) were not expected to be temporary. The strongest rejections of the present value model were for gold; for this commodity, it was not even clear that futures and spot prices were co-integrated, and there was no evidence that the spot price and convenience yield were co-integrated. Throughout the 15 year sample, the convenience yield for gold was always very small relative to price, so the present value model can only explain price movements in terms of changes in market perceptions of either the mean arrival rate of an event, or the probability distribution for the size of the event. Since such changes in market perceptions are unobservable and do not affect current convenience yields, these test results are not surprising.

Diba and Grossman (1984) studied whether there were rational bubbles in the relative price of gold. The critical implication of the theoretical analysis is that: "if rational bubbles exist, the time series of the relative price of gold, as well as any time series obtained by

“differentiating a finite number of times, is non-stationary”. They found a close correspondence between the time series properties of real interest rates and the time series of the relative price of gold, which the theory related to the time series properties of the fundamental component of the relative price of gold. Their evidence was consistent with the conclusion that the relative price of gold corresponded to market fundamentals and the process generating first differences of market fundamentals was stationary, so actual price movements did not involve rational bubbles.

The main conclusions from the empirical study of Koutsoyiannis (1983), based on a time sample of 316 daily observations covering the period from January 1980 to March 1981 were: 1. Contrary to the findings of other studies, it seemed that speculative markets were inefficient in the very short run. Rational speculators dealing in assets (like gold) the prices of which were highly volatile, and which involved a large amount of funds, were unwilling to react immediately to all available market information, preferring to wait and see whether the changes in conditions are transient or more permanent in nature, 2. The price of gold, universally quoted in US dollars, had become firmly related to the state of the American economy: the strength of the American dollar, the US rate of inflation and the prevailing US interest rate were important determinants of the price of gold. 3. Stocks and silver provided speculative investment alternatives to gold holders, 4. Factors which were not easily quantified, such as political instability, can be meaningfully incorporated into a quantitative study. An index of political tension, constructed on the basis of major political developments, showed that geopolitical factors exerted a strong influence on the price of gold. 5. In variance to the findings of other studies, their results suggested that the gold market was not efficient in the very short run, in the sense that participants did not incorporate into current price behavior all new information available in any one period. 6. The structure of the model that was, the value of the parameters, was different in periods of high and low prices of gold. According to Koutsoyiannis, the theoretical hypotheses and the empirical results of the study should be considered only as the first step towards a more thorough exploration of the complex factors that affect speculative behavior.

### **2.2.2.3. Inflation hedge approach**

Kolluri (1981) did a study to investigate the role of gold for inflation hedging. To achieve the study's objectives, Kolluri followed two approaches. The first approach modeled the relationship between the return on gold investments and the anticipated inflation or variants of it estimated through the iterative procedure of Cochrane-Orcutt by using monthly gold prices from 1968 to 1980. In the second one, Kolluri modeled the return of shares and bonds between 1926-1978 to use it as minimum required return for gold investments. The study concluded that gold well hedged against inflation in the period 1968-1980.

Gorton and Rouwenhorst (2006) studied commodity derivatives and their hedging capabilities in the USA. They used historical data from 1959 to 2004 and found that indices made from spot prices and futures prices had beaten inflation. They also noticed that the positive correlation with commodities (including gold) and inflation was higher in the long-run than in the short-run. They also studied whether commodities could also act as a hedge against unexpected inflation and found a proof for that.

Levin and Wright (2006) proved that there was a long run relationship between the price of gold and the average price level in the US for the period 1975-2006. Their empirical results showed that an increase of 1% in the average US level made the gold price increased 1%. They used co-integration technique to model the long run relationship and error correction models for the short run dynamics. The main determinants of the gold price in the short run were changes in US inflation, inflation volatility, credit risk, the interest rate to lease gold and the US trade weighted exchange rate. They also proved that 66% of a deviation of the long run relationship will disappear within five years after the shock that caused the deviation.

Similarly, Worthington and Pahlavani (2007) did research to test for the presence of a stable long-run relationship between the price of gold and inflation in the United States in two periods of time: 1945 - 2006 and 1973 - 2006. After taking these breaks into account, strong evidence of a co-integrating relationship between gold and inflation in the post-war period and since the early 1970s was provided by using a modified co-integration approach. The results supported to the widely held view that both direct and indirect gold investment can serve as a useful inflation hedge.

By applying the same and co-integration regression techniques, Gosh et al. (2002) developed a theoretical model, using monthly gold price data from 1976 to 1999, suggested a set of the conditions that would have to be satisfied for the price of gold to rise over time at the general rate of inflation. If these conditions were met then gold would be an effective long-run hedge against inflation. The model also demonstrated that this equilibrium relationship was consistent with sizeable short-run movements in the gold price. The key finding was that movements in the nominal price of gold appeared to be dominated by these short run influences and consequently the long-run relationship (although significant) was of much less importance.

This research added value to the research of Ghosh et al. (2000) by including a variable “political risk in oil producing countries”. In his research, Lampinen (2007) tried to confirm the results from the study of Levin and Wright (2006) but he extends the research period with one year. Lampinen found similar results in his research. The biggest difference was the number of included time dummy variables (is one that takes the value 0 or 1 to indicate the absence or presence of some categorical effect that may be expected to shift the outcome). Levin and Wright (2006) only needed 10 time dummy variables while Lampinen needed 19 time dummy variables. These time dummy variables were added in order to prevent autocorrelation in the residuals.

The results of a study conducted by Moore (1990) indicated that an investor who followed the signals, buying gold when the up signal flashed and selling on the down signal of inflation index of Columbia University during 1970 - 1988 and investing in U.S. Treasury bonds or in common stocks at other times, would have earned an average annual rate of return of 18 to 20 percent. Following this strategy, investor can gain profit from gold prices during the signaled upswings and bond prices or stock prices during the signaled downswings. The demand for gold had been thought to grow when the prospects for inflation rose. Many individuals invested in gold as an inflation hedge, expecting that as the general price level rose, leading to higher gold prices. The leading index contains seven components, all selected on the basis of their relevance as measures of inflationary pressures and their historical record as leading indicators of inflation.

With the data of gold price and domestic inflation from 1996 to 2007 in China, Fu et al. (2009) analyzed the correlation between them with the Phillips expanding curve equation and the method of least squares estimation. The results indicated that the price of gold acted a role in forecasting the inflation. Therefore, the price of gold can be used as a reference to indicate the economic trends and the changes of the inflation fluctuations. At the same time, gold had the function of inflation hedge with the characteristics of commodity and currency.

However, Mahdavi and Zhou (1997) examined if gold and other commodity prices were leading indicators of the inflation rate by specifying an error- correction model. They found no evidence for a co-integrating relationship between the CPI and the London price of gold over the testing period (1979-1994). In an inflation forecasting exercise, the price of gold performed poorly as an indicator of inflation. The possible reasons given were: Short term movements in the price of gold are too volatile to properly explain small changes in the price level; and the role of gold as an inflation hedge may have diminished with the growth of the financial futures markets. According to the authors, the weak results were caused by the strong volatility of the gold price in the short run.

Similar with Mahdavi and Zhou, recent study by Tully and Lucey (2007) indicated that no significant relationship between the price of gold and inflation can be determined. Their result was confirmed by Blose (2010). Blose used unexpected changes in CPI announcement in the period 1900 -2008 as a proxy for future expectations. By applying the percentage change in the gold price as a dependent variable, the research rejected the hypothesis that an increase in expected inflation effects gold prices.

A simple but commonly applied Granger-Causality testing by Siregar and Nguyen (2013) further insinuated that the movement of gold price granger-caused inflation in Vietnam during the observation period (2001-2011). Concurrently, the test results also demonstrated that inflation did not granger-cause movement in the gold price.



### **2.2.3. Gaps in literature**

After thoroughly investigating, gathering and reviewing information about three approaches modeling the price of gold, there were many areas of deficits in literature review. The data that the previous studies used was not quite up-to-date at the moment and they just focused on gold market in developed countries such as America (for example, Sjaastad and Scacciallani, 1996, Dolley, Isard and Taylor, 1995, Chappell and Moore (1990), Dowd (1997), Laurent (1994), Ghosh et al. (2004), Gorton and Rouwenhorst (2006), Kolluri (1981), Levin and Wright (2006), Ranson and Wainwright (2005), Worthington and Pahlavani (2007), Tully and Lucey (2007), and Blöse (2010), England (Mahdavi and Zhou, 1997) and some emerging countries such as China (Ye and Zhou, 2010) and Indonesia (Clarine and Dewi, 2012). Whereas an ample number of studies have attempted to explain gold price movements in the context of Vietnam, to the best of knowledge, surprisingly there have been a few studies carried out so far to understand the determinants of gold prices in Vietnamese market with quantitative method. This study aims to fulfill these gaps.

### **2.2.4. Hypotheses**

Three approaches above support each other to determine the factors affecting gold price. Despite the different approaches, many studies examined the gold price with the same variables such as inflation, exchange rate, interest rate. This study is performed in the area of macroeconomic approach to investigate a number of macroeconomic variables. This approach gives a big picture about the determinants of the gold price in Vietnam as the name of this study suggesting. As mentioned before, Vietnamese gold market is price taker because gold is mainly imported from foreign countries. Thus the domestic gold price is influenced by the international price. However, because of the monopoly of the State Bank in Vietnamese gold market after releasing the Decree No. 24 on 25<sup>th</sup>, May, 2012, the gold price movements of gold in Vietnam has been not significantly affected by the world gold price (State Bank's report about the effectiveness of Decree No. 24, 2013). Thus, the international gold price is not considered a significant factor that affects the Vietnamese gold price. Based on the previous empirical research of gold price, this thesis derives several hypotheses that will be tested.



**Hypothesis 1:**

Rising interest rate increases the opportunity cost of holding gold, because gold does not pay interest, and therefore there is no need to hold gold in a rising interest rate environment and demand for gold reduces. In this situation, the price of gold will go down.

H0: Increase in nominal interest rate has no negative effect on the price of gold.

H1: Increase in nominal interest rate has a negative effect on the price of gold.

**Hypothesis 2:**

Increase in USD/VND exchange rate means that domestic currency would be weaker and people would be more favor for using it as safe haven. Thus, the demand for gold is higher which leading to the higher domestic gold price. In addition, the Vietnamese price of gold will also higher because gold is mainly imported from other countries and quoted in US dollar.

H0: Increase in USD/VND exchange interest rate has no positive effect on the price of gold.

H1: Increase in USD/VND exchange rate has a positive effect on the price of gold.

**Hypothesis 3:**

When gold acts as a hedge against inflation, high inflation or high inflation volatility accelerates the demand for gold and leads to higher gold price:

H0: High inflation or high inflation volatility has no positive effect on the price of gold.

H1: High inflation or high inflation volatility has a positive effect on the price of gold.

**Hypothesis 4:**

A large unexpected increase in the consumer price index causes higher expected inflation in the future. Thus, investors are more favor in gold as mean of hedge against inflation. This increases demand for gold and price of gold will rise.

H0: High consumer price index has no positive effect on the price of gold.

H1: High consumer price index has a positive effect on the price of gold.

According to the literature review, the other variables such as unemployment rate and national debt are the explanatory variables of gold price. However, these variables' data are generated annually, while this study tends to study base on monthly samples. Thus, these factors are eliminated to achieve the consistent of other variable samples.

### **2.3. Conclusion**

On the whole, this chapter has thoroughly reviewed literature that is relevant to the gold which is views as financial asset as well as factors driving the price of gold. The conceptual framework identified determinants affecting gold price with three main approaches which are macroeconomic approach, speculation approach and inflation hedge approach. There are gaps in the literature for further research to be carried out on how to model the price of gold in such a young and complex gold market like Vietnam in recent years. This has given a solid platform that will support our research on what determinants of gold price in Vietnam are recommendation to stabilize Vietnamese gold market and prediction of Vietnamese gold price in the near future.

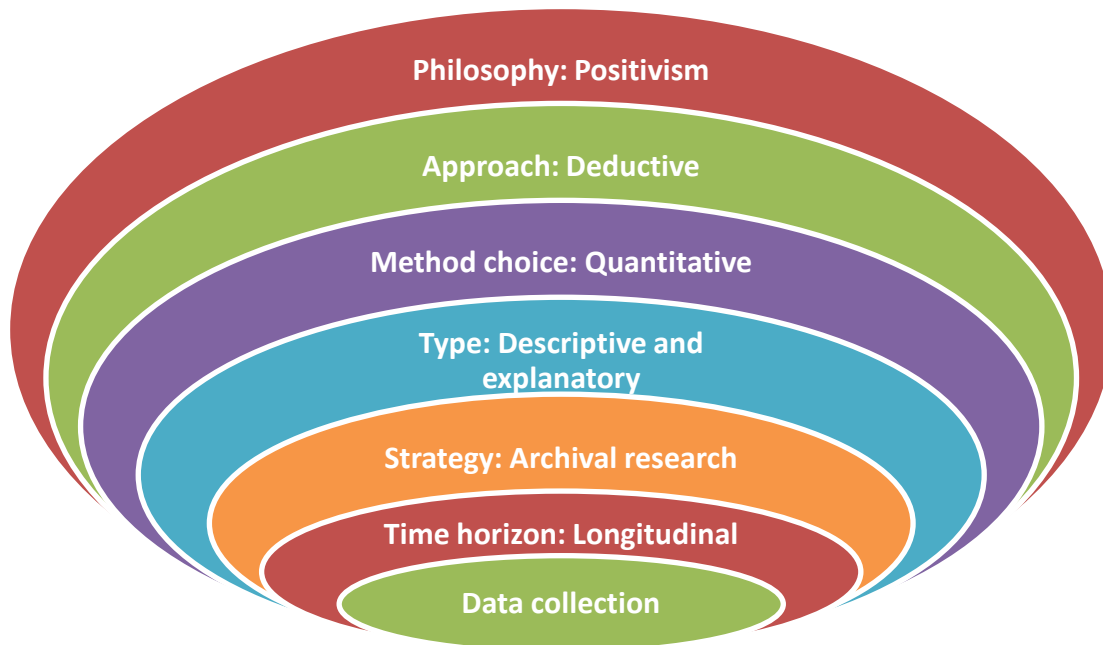
## CHAPTER THREE: DATA & METHODOLOGY

This chapter will describe how the empirical data has been gathered. It starts with research “onion” to demonstrate the structure of the research methodology, which consists of philosophy, approach, type of research, strategy, time horizon and data collection. Limitation and ethical considerations will also be discussed.

### 3.1. Research onion

Figure 5 exhibits the structure of the research methodology of this study. Firstly, the research philosophy is presented to define the development and the nature of the knowledge. Secondly, the research approach presents that the study involves the use of existing theory. The next part represents the choice of study which is quantitative method. The central part of “onion” is the types of study which outlines the purpose of the study. After specifying the research strategy, the time horizon is defined. The last one is data collection.

**Figure 5: The research onion**



### **3.2. Research philosophy**

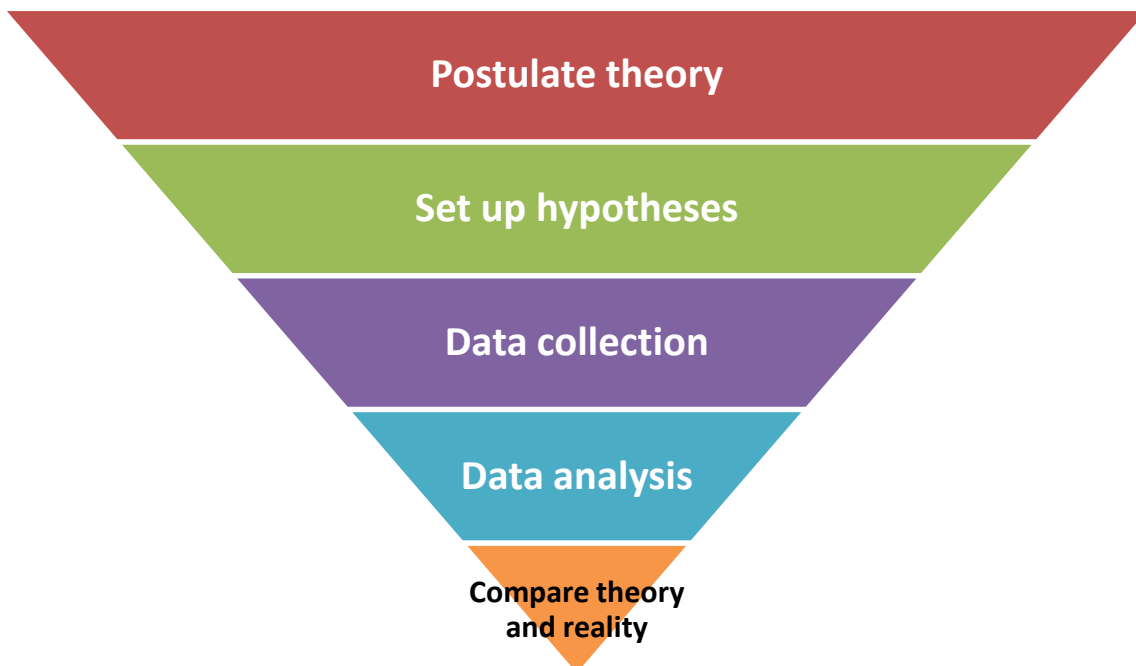
The choice of research philosophy not only helps to design a solid piece of study but also determines the direction of the study. The philosophical position of researchers shows how they see the world and how they are going to study the social reality. Moreover, the knowledge of research philosophy is very crucial for researcher since it plays an important role in the selection of approach and strategy for the study.

Positivism is selected philosophy for this study. Positivism is about adopting the philosophical stance of natural scientist. In this philosophical position, researcher will only work “with an observable social reality and that the end product of such research can be law like generalizations similar to those produced by the physical and natural scientist” (Saunders et al., 2009, p. 113). In order to generate a research strategy to collect the data, existing theory is likely used to develop hypotheses. These hypotheses will be tested and confirmed, in whole or part, or refuted, leading to the further development of theory which then may be tested by further research. Based on the above arguments, our study mainly stands on the positivism position for epistemological stance.

### **3.3. Research approach**

After the philosophical stance, the research approach determines the association between theory and research work. Deduction and induction are two research approaches that set the research design. In deductive approach, researchers use existing theory to develop hypothesis in the beginning, and design the research to test the hypothesis. The researchers either confirm or modify the theory on the basis of their hypothesis testing. Unlike deductive approach, research with inductive approach starts with data collection and ends with development of theory. The researcher uses his or her findings for the theory that prompted the whole exercise (Bryman and Bell, 2011). Deductive approach is more suitable for our study because, instead of creating a new theory, our thesis is based on existing theory. This method is also known as a “top-down” approach (see Figure 2) (Zikmund, 2000).

**Figure 6: Deductive approach**



Fifty-four months (period from 01/2009 to 06/2013) data are used to analyze the determinants of the gold price. Similarly, hypotheses have been generated from previous studies about factors affect the price of gold. The statistical results based on 54 months data have been used to either accept or reject the hypothesis which leads to the confirmation or modification of existing theory. Based on the above discussion, all the characteristics of our research approach follow the pattern of deductive logic.

### **3.4. Method choice**

In an academic research, there are two main method choices: qualitative or quantitative (Saunders et al., 2009). Quantitative research assumes that facts have an objective reality, variables can be identified, and their relationships measured. A quite understandable point as quantitative data is all about numbers. The purpose with this approach is to generalize facts and understandings, and not to think too much about the individual case, but instead what it means for the science in general, (Glesne and Peshkin, 1992). Quantitative data can be described as research in which the focus lies on numbers, statistics and facts. They can be obtained from surveys or data already collected and presented by others (referred to as secondary data). As the name refers to, the quantity or mass of data handled should be substantial and essential. In general, quantitative data gives a broad, general answer to the

problem, while qualitative data lets readers get deep into the question and understand why and how things are as they are (Jacobsen, 2002).

According to Creswell (2008), quantitative researches relies on empirical data, objectivism and in general tries to verify theories and use standards of validity and reliability. The quantitative method is therefore more appropriate for this research's purpose because this study bases on objective historical data. Surveys or questionnaires are conducted; instead this study used secondary data to reach to empirical findings. Because this study is looking for a general answer to its problem, this method was chosen as the most suitable.

### **3.5. Type of Study**

There are three types of study, which are exploratory, descriptive and explanatory type. An exploratory research is a mean to clarify the understanding of the problem, to search new ideas and solutions, to ask questions and to assess happening events in a new light. A descriptive study is a way to identify an accurate profile of situation, event or person, but not the relationship of the elements. In contrast to descriptive study, the objective of explanatory research is to ascertain relationship between variables (Saunders et al., 2009, pp. 139-140). This paper combines two types of study: descriptive and explanatory. The main purpose of the study is to find determinants of the gold price in Vietnam. However before detecting the drivers, the main features of the variables need to be presented.

### **3.6. Research strategy**

On the basis of the research questions and objectives, archival research strategy is chosen. The archival strategy signifies the utilization of “administrative records and documents as the principal source of data” (Saunders et al., 2009, p. 150). This research and conclusions are entirely based on the official data collected from administrative records and documents such as daily gold prices and economic sector indices available from the official database of reliable organization's websites. Besides, the data used in our archival study are part of the reality being studied (product of day-to-day activities), rather than being obtained originally as data for research purposes by the administration of the organizations (Saunders et al., 2009, p. 150). Thereby, such choice of strategy as archival strategy makes it feasible for to meet the objectives and to answer the research questions of the current thesis, which

concentrates on the factors affect gold price in Vietnam, in both descriptive and explanatory way.

### **3.7. Time horizon**

There are two types of time horizons to choose which are cross-sectional studies and longitudinal. The first horizon is often referred as a “snapshot” because the research is made at a particular point of time. This method is commonly used for research projects that have a time limit. The longitudinal time horizon is also known as the “diary” perspective which observes people or events over time (Saunders et al., 2009, p.156). The time horizon applied in this research will be longitudinal horizon, mainly because of the objective of this study which is to define the determinants of gold price in Vietnam from 01/2009 to 06/2013.

### **3.8. Data collection**

After specifying all the dimensions above, the next step is to select a type of data and its sources. There are three categories of literature sources available: primary, secondary and tertiary (Saunders et al., 2009, p. 69). The current research requires utilizing of secondary data, such as books, journals, newspapers and databases. The data used in the modeling are monthly observations from the last day of the month covering the period from January 2009 to June 2013. Monthly samples are chosen because many studies did the same with the short period of time, for example, studies of Pindyck (1993), Gosh et al. (2002), Kolluri (1981), etc. In addition, the data related to interest rate, consumer price index, exchange rate are not observed daily or weekly.

#### **3.8.1. The price of gold in Vietnam (VNGOLD)**

VNGOLD is the monthly average selling price of SJC gold per bar denominated in VND. The reason we choose SJC gold price as proxy for gold price in Vietnam is The Saigon Jewelry Company, the manufacturer, enjoys a monopoly on gold bars manufactured within Vietnam. The SJC gold is the purest gold available on the market, and is used for bank to bank transfers, real estate transactions and by private collectors. The variable is obtained from the Saigon Jewelry Company ([www.SJC.com.vn](http://www.SJC.com.vn)).

### **3.8.2. Interest rate of Vietnam (INTEREST)**

When interest rate rises, people tend to keep money on deposit better than gold which does not earn interest (non interest-bearing). This will cause pressure on the price of gold. Conversely, when interest rate falls down, the price of gold will likely rise. In theory, if the short-term interest rate rises, the gold price falls. In Vietnam, interest rates decisions are taken by The State Bank of Vietnam. The official interest rate is the Refinancing Rate. Interest rate data is collected from the official site of the State Bank of Vietnam (<http://www.sbv.gov.vn>).

### **3.8.3. USD/VND exchange rate (USD/VND)**

Increase in USD/VND exchange rate means that domestic currency would be weaker and people would be more favor for using gold as safe haven. In addition, the majority of gold in Vietnam is imported while the gold prices in world trade are quoted mainly by USD. Thus, when USD/VND exchange rate rises, the gold price in Vietnam rises. USD/VND exchange rate historical data can be found on Ministry of Finance website (<http://www.mof.gov.vn>).

### **3.8.4. CPI of Vietnam (CPI)**

The general price level in Vietnam (Vietnamese consumer price index) is included as an explanatory variable to test whether the gold price moves together with the general price level so that gold can be considered as a long run hedge against inflation. The authors of this thesis collect monthly CPI compared to the base year 2009. This variable is obtained from the Ministry of Finance's web-site ([www.mof.gov.vn](http://www.mof.gov.vn)).

### **3.8.5. Inflation rate of Vietnam (INFLAT)**

Gold is a hedge against inflation. In dollar terms gold has consistently proven to hold up to inflation. So as price inflation heats up expect more people to jump on the gold band wagon. This demand will create higher and higher highs in the price of gold. Inflation rate is calculated by the following equation:

$$\pi_t = \frac{CPI_t}{CPI_{t-12}} - 1$$



### 3.9. Analytical Method

The econometric model and cointegration regression technique will be used in this thesis. Econometric models are generally algebraic models that are stochastic in including random variables. The random variables that are included, typically as additive stochastic disturbance terms, account in part for the omission of relevant variables, incorrect specification of the model, errors in measuring variables, etc (Michael, 1983).

The concept of cointegration gains importance from the fact that the statistical properties of the composite variable are so dramatically different from the properties of the component series. Cointegration captures the notion of long-run relationships in economics and allows for possibly extensive divergences in the short-run. If a stationary linear combination does exist the regression is the cointegrating regression (Kevin, 1995)

So far, there were many researchers use different modeling methods for analyzing gold price. Widely used models used for modeling heteroscedasticity are Engle (1982)'s ARCH (Autoregressive conditional heteroskedasticity) model and Bollerslev (1986)'s GARCH (Generalized Autoregressive Conditional heteroskedasticity ) model. ARCH and GARCH model is used in some analysis, such as: Modelling and Forecasting Volatility of Gold Price with Other Precious Metals Prices by univariate GARCH Models (Yuchen,2012), Volatility Transmission between Gold and Oil Futures under Structural Breaks (Bradley and Farooq,2012). Tully and Lucey (2007) examine various macroeconomic influences on gold using models including the asymmetric power GARCH model for spot and future price over a 20 year period.

On the other hand, the co-integration regression method is also commonly used for modeling. The cointegration regression technique is developed by Granger, C. by the end of eighties. Granger (1987) proved that applying statistical methods that were developed for stationary series on non-stationary series resulted in spurious conclusion. And cointegration analysis allows non-stationary data to be used so that spurious results are avoided. This method also provides applied econometricians an effective formal framework for testing and estimating long-run models from actual time-series data. Therefore, in order to take advantage of the cointegration regression technique, many analyses use this method for more accurate results, such as Claire G., Ginette M., Rajneesh S. and Ahmet T. (2009), Dipak, G, Eric J, Peter, M.

and Roberte, W. (2000). Bernard, D. (2012) applied the cointegration regression technique to analyze the determinants of the gold price. Therefore, with the strengths of this approach, this essay will use the cointegration regression method to analyze the factors that affect the gold price in Vietnam.

The multiple regression models are used as follow:

$$Y = \beta_0 + \sum_{i=1}^4 \beta_i x_i + u_t$$

Where:

Y: Gold price \_ the dependent variable

$\beta$ : The coefficient estimates of the regression

x: The macro variables \_ the independent variables

$u_t$ : The error u is a random variable with mean or expected value of zero, that is,  $E(u) = 0$

Moreover the multiple regression models have to satisfy best linear unbiased estimators (BLUE). The full ideal conditions consist of a collection of assumptions about the true regression model and the data generating process and can be thought of as a description of an ideal data set. Ideal conditions have to be met in order for ordinary least squared (OLS) to be a good estimate BLUE. If all assumptions are met than the OLS estimators beta are BLUE.

Where:

Best: variance of the OLS estimators is minimal, smaller than the variance of any other estimator

Linear: if the relationship is not linear-OLS is not applicable

Unbiased: the expected values of the estimated beta equal the true values describing the relationship between x and y.

In order to build the model that is BLUE, there are assumptions relating to the classical linear regression model (CLRM) which are needed to satisfy (Gujarati, 1995):

- The regression model is linear in the parameters, which is specified in the form:

$$Y = \beta_0 + \sum_{i=1}^4 \beta_i x_i + u_t$$

Where:

Y is the dependent variable

$x_i$  is the independent variable

$\beta_0$  is the intercept

$\beta_i$  is the coefficient of independent variable  $x$

$u_t$  is the error term

- Zero mean value of disturbance  $u_t$
- Homoscedasticity or equal variance of  $u_t$
- No autocorrelation between the disturbances in the time series
- Zero covariance between  $u_t$  and  $x_t$
- The number of observations  $n$  must be greater than the number of parameters to be estimated
- The regression model is correctly specified, there is no specification bias
- There is no multicollinearity in the model, which means there are no perfect linear relationships among the explanatory variables.

In order to build the multiple regression models, it is necessary to check the accuracy of the model with the support of Eview tool, there are five steps to follow, which are: test for the statistical significance, test for heteroscedasticity, test for multicollinearity, test the assumption of normality and test for autocorrelation.

### 3.9.1. Test for the statistical significance

The statistical significance test of the parameters of the independent variables using test p-value that provides an interpretation to the test results.

#### Individual significant test:

For any parameter  $\beta_i$  :

$H_0 : \beta_i = 0$ . The variable is not relevant to explain Y (Gold price).

$H_1 : \beta_i \neq 0$ . The variable is relevant to explain Y (Gold price).

P-value of the test

$\alpha$ : Significant level = 0.05

If P-value of variable is higher than  $\alpha$ ,  $H_0$  is accepted.

If P-value of variable is lower than  $\alpha$ ,  $H_0$  is rejected.

### Joint significance test:

The p-value and the critical value of the F-distribution are used to test for the joint significance test of the model.

$H_0 : \beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \dots = \beta_i = 0$ . All variables are not jointly relevant to explain Y (Gold price)

$H_1 : H_0$  False

If P-value of F-statistic of variable is higher than  $\alpha$ ,  $H_0$  is accepted.

If P-value of F-statistic of variable is lower than  $\alpha$ ,  $H_0$  is rejected.

### 3.9.2. Test for heteroscedasticity

The White test is used for the heteroscedasticity test. This test is based on the difference between the variance of OLS estimates under homoskedasticity and that under heteroskedasticity.

The auxiliary regression:

$$\widehat{u}_i^2 = a_1 + a_2x_2 + a_3x_3 + a_4x_2^2 + a_5x_3^2 + a_6x_2x_3 + v_i$$

Where  $v_i$  is a normally distributed disturbance term independent of  $u_i$

$H_0 : a_2 = a_3 = a_4 = \dots = a_i = 0 \rightarrow \widehat{u}_i^2 = a_1$ . There is homoscedasticity in the model.

$H_1 : H_0$  false (any  $a_i \neq 0$ ). There is heteroscedasticity in the model.

If P-value of variable is higher than  $\alpha$ ,  $H_0$  is accepted.

If P-value of variable is lower than  $\alpha$ ,  $H_0$  is rejected.

If there is heteroscedasticity in the model, the standard errors of the OLS, t- test are not correct, we have to correct them. The meaning of the null hypothesis in this model is that it is

more general, include more functions, possibilities so do not need to assume that  $v_i$  is the normal distributed.

### 3.9.3. Test for multicollinearity

Eview is used to test the correlation between variables in order to find out the index  $\rho$ . If  $\rho$  is close to 1, the correlation between two variables is high.

- Test for multicollinearity:

The regression for two variables:  $x_1 = \beta_1 + \beta_2 x_2 + u_i$

$H_0: \beta_2 = 0 \rightarrow x_1$  and  $x_2$  are not correlated

$H_1: \beta_2 \neq 0 \rightarrow x_1$  and  $x_2$  are correlated

If P-value of variable is higher than  $\alpha$ ,  $H_0$  is accepted. Otherwise, if P-value of variable is lower than  $\alpha$ ,  $H_0$  is rejected.

- If there is multicollinearity between two variables, there are two options to solve this problem: increase the sample or remove one of them.

### 3.9.4. Test for the assumption of normality

The Jarque-Bera (JB) is used for testing the assumption of normality in the residual. Based on Eview, the regression is done:

$$Y = \beta_0 + \sum_{i=1}^4 \beta_i x_i + u_t$$

$$u_i \sim N(0, \sigma_u^2)$$

From the regression, the graph and Skewness (S) and Kurtosis (K) are obtained.

Skewness is the degree to which the distribution is “lopsided”. A positive skewness means a longer right tail; a negative skewness means a longer left tail; zero skewness means the distribution is symmetric about its mean. And Kurtosis is a measure of the peakedness of a distribution (David, 2008).

$H_0$ : the model is normally distributed

$H_1$ :  $H_0$  false

If P-value of variable is higher than  $\alpha$ ,  $H_0$  is accepted, and if P-value of variable is lower than  $\alpha$ ,  $H_0$  is rejected.

After five steps above, it is possible to find the appropriate variables and completed model.

### 3.9.5. Test for autocorrelation

Durbin-Watson test is used to test for autocorrelation in the residual

The auxiliary regression is:

$$u_i = \rho u_{i-1} + \varepsilon_i$$

$$d = \frac{\sum(\hat{u}_i - \hat{u}_{i-1})^2}{\sum \hat{u}_i^2}$$

Where  $\rho$  is a parameter with absolute value less than one and  $\varepsilon_i$  is a normally and independently distributed random variable with a mean of zero.

$$D \in [0, 4]$$

If successive values of residuals are close together (positive autocorrelation), the value of the Durbin-Watson test statistic will be small. If successive values of the residuals are far apart (negative autocorrelation), the value of the Durbin-Watson statistic will be large. The Durbin-Watson test statistic ranges in value from zero to four, with a value of two indicating no autocorrelation is present. The table below can be used to determine when their test statistic indicates the presence of autocorrelation, where  $d_L$  is lower bound and  $d_u$  is upper bound for hypothesis tests with  $\alpha = 0.05$ ;  $n$  denotes the number of observations. (David, Dennis and Thomas2008)

Have positive autocorrelation	Zone of indecision	No autocorrelation	Zone of indecision	Have negative autocorrelation		
0	$d_L$	$d_u$	2	$4 - d_L$	$4 - d_u$	4

No autocorrelation  $\hat{\rho} \approx 0$  then  $d \approx 2$ . Severe positive autocorrelation  $\hat{\rho} \approx 1$  then  $d \approx 0$ .

Severe negative autocorrelation  $\hat{\rho} \approx -1$  then  $d \approx 4$ .

### **3.10. Ethical Considerations**

Ethical considerations involve the application of fundamental ethical principles plays an important role in doing research (Bryman and Bell, 2007).

In this study, the determinants of Vietnamese gold price will be investigated mainly through the published data that gathered via the internet. Therefore, this information we ensure that is reliable, accurate and is collected from the official sources.

Other crucial issues such as the confidentiality and anonymity, individuals' expectations of privacy, data storage and research risks may be ethically problematic elements of social research (Bryman and Bell, 2007). Hence, efforts to respond to ethical concerns and resolve ethical conflicts should be taken into account in this study.

### **3.11. Limitation**

Vietnamese gold market is a complicated market that contains many uncontrollable characteristics affecting a lot to the gold price. As a result the market's inefficiency reduces the accuracy of the study result. Moreover, the research about gold price in Vietnam is few, that leads to no deep studies published to make result comparison.

Moreover, the information that one counts as public can freely be used for research purposes. However, it is difficult to clearly distinguish between what should be counted as private and what should be counted as public information in relation to information gathered from the internet.

Finally, this research presents a limited sample related to the determinants of gold price. It seems to be inevitable because the restricted access to a large number of information about gold in Vietnam, and finite duration of collecting data.

## CHAPTER FOUR: FINDINGS & ANALYSES

The following chapter is mainly divided into five parts to build the model of gold price in Vietnam. Firstly, test for the statistical significance is presented in order to examine whether the variables are relevant to explain the Vietnamese gold price. Secondly, test for heteroscedasticity are demonstrated to find out if there are sub-populations that have different variabilities from others. Thirdly, test for multicollinearity is discussed by defining correlation between variables. Finally, normality and autocorrelation test to complete Vietnamese gold price model are presented.

Before testing for the statistical significance, a multiple regression with four explanatory variables is run.

The data consists of a sample of 54. The description of the variables is given below:

Y: Viet Nam gold price (VNGOLD)

$x_1$ : Consumer price index in Viet Nam (CPI)

$x_2$ : Inflation in Vietnam (INFLAT)

$x_3$ : The USD/VND exchange rate (USD/VND)

$x_4$ : The nominal interest rate in Vietnam (INTEREST)

n is number of observation = 54

$\alpha$ : significant level = 0.05

The multiple regression model:

$$Y = \beta_0 + \beta_1 \text{CPI} + \beta_2 \text{INFLAT} + \beta_3 \text{USD/VND} + \beta_4 \text{INTEREST} + u$$



**Figure 7: Multiple regression with four variables (CPI, inflation rate, USD/VND exchange rate, nominal interest rate)**

Dependent Variable: VNGOLD

Method: Least Squares

Date: 07/24/13 Time: 14:07

Sample: 2009M01 2013M06

Included observations: 54

White heteroskedasticity-consistent standard errors & covariance

VNGOLD=C(1)+C(2)\*CPI+C(3)\*INFLAT+C(4)\*USD/VND+C(5)  
)\*INTEREST

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-47290.62	8701.898	-5.434518	0.0000
C(2)	270.5829	66.20516	4.087037	0.0002
C(3)	91285.14	52997.71	1.722435	0.0913
C(4)	2.284800	0.879990	2.596392	0.0124
C(5)	373.1629	196.4938	1.899107	0.0634
R-squared	0.937912	Mean dependent var	35087.41	
Adjusted R-squared	0.932844	S.D. dependent var	9404.797	
S.E. of regression	2437.208	Akaike info criterion	18.52312	
Sum squared resid	2.91E+08	Schwarz criterion	18.70728	
Log likelihood	-495.1241	Hannan-Quinn criter.	18.59414	
F-statistic	185.0511	Durbin-Watson stat	0.638190	
Prob(F-statistic)	0.000000			

Run the regression of Vietnamese gold price on CPI, inflation, the exchange rate, the interest rate and test for the significance of the coefficient. The individual significant test and the join significant test are used to test for the statistical significance.

## 4.1. Test for the statistical significance

### 4.1.1. Individual significant test:

#### Test for $x_1$ (CPI)

$H_0 : \beta_1 = 0$ . The variable CPI is not relevant to Vietnamese gold price

$H_1 : \beta_1 \neq 0$ . The variable CPI is relevant to explain Vietnamese gold price

After running the regression of Vietnam gold price on four variables and testing for the significance of the coefficient, it is observed that  $p\text{-value} = 0.0002 < 0.05$ . Hence,  $H_0$  is rejected and this thesis concludes that CPI is relevant in explaining Vietnamese gold price.

#### Test for $x_2$ (INFLAT)

$H_0 : \beta_2 = 0$ . The variable INFLAT is not relevant to explain Vietnamese gold price

$H_1 : \beta_2 \neq 0$ . The variable INFLAT is relevant to explain Vietnamese gold price

After running the regression of Vietnam gold price on four variables and testing for the significance of the coefficient, it is observed that  $p\text{-value} = 0.0913 > 0.05$ . Hence,  $H_0$  is accepted and this thesis concludes that INFLAT is not relevant in explaining Vietnamese gold price.

#### Test for $x_3$ (USD/VND)

$H_0 : \beta_3 = 0$ . The variable USD/VND is not relevant to Vietnamese gold price

$H_1 : \beta_3 \neq 0$ . The variable USD/VND is relevant to explain Vietnamese gold price

After running the regression of Vietnam gold price on four variables and testing for the significance of the coefficient, it is observed that  $p\text{-value} = 0.0124 < 0.05$ . Hence,  $H_0$  is rejected and this thesis concludes that USD/VND is relevant in explaining Vietnamese gold price.

### **Test for $x_4$ (INTEREST)**

$H_0 : \beta_4 = 0$ . The variable INTEREST is not relevant to Vietnamese gold price

$H_1 : \beta_4 \neq 0$ . The variable INTEREST is relevant to explain Vietnamese gold price

P-value of variable INTEREST = 0.0634

After running the regression of Vietnam gold price on four variables and testing for the significance of the coefficient, it is observed that p-value = 0.0634 > 0.05. Hence,  $H_0$  is accepted and this thesis concludes that INTEREST is not relevant in explaining Vietnamese gold price.

#### **4.1.2. Joint significance test:**

The p-value and the critical value of the F-distribution are used for a joint significance test.

$H_0 : \beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ . All variables are not jointly relevant to explain Vietnamese gold price

$H_1 : H_0$  False

Testing the joint significance of a subset of variables in a regression model is accomplished by generalizing the F-test of overall significance to:

$$F^* \sim F_{1-\alpha, k-1, n-1}$$

$$F^* = 185.0511$$

R: R-squared

k: number of parameters

n: number of observation

$$A.R = [0, F_{1-\alpha, k-1, n-1}] = [0, F_{1-0.05, 5-1, 54-1}] \text{ (F-distribution) table for } \alpha = 0.05$$

$$A.R = [0, 2.60]$$

After running the regression of Vietnam gold price on four variables and testing for the significance of the coefficient, it is observed that  $F^* = 185.0511$  that does not belong to A.R. Therefore  $H_0$  is rejected.

Besides, P-value of F-statistic of variable is smaller than  $\alpha$ , so  $H_0$  is rejected. Hence, the variables CPI, INFLAT, USD/VND and INTEREST are jointly relevant to explain Vietnamese gold price.

From the Figure 7, it can be seen that  $R^2$  (R-squared) = 0.937912, it means in the regression, CPI, INFLAT, USD/VND and INTEREST explain 93.79% of Vietnamese gold price. The goodness-of-fit of the model is rather good.

In the join significance test, the result given is four variables are jointly relevant to explain Vietnamese gold price, however, in the individual significant test, the two variables which are INFLAT and INTEREST have no statistically significant meaning with Vietnamese gold price. Hence, the multiple regression after removing two variables which are not significant (INFLAT and INTEREST) is as follows:

$$Y = \beta_0 + \beta_1 CPI + \beta_2 USDVND + u$$

**Figure 8: Multiple regression with two significant variables (CPI and USD/VND)**

Dependent Variable: VNGOLD

Method: Least Squares

Date: 07/23/13 Time: 15:09

Sample: 2009M01 2013M06

Included observations: 54

VNGOLD=C(1)+C(2)\*CPI+C(3)\*USD/VND

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-64515.86	7772.769	-8.300241	0.0000
C(2)	147.3778	63.54143	2.319398	0.0244
C(3)	4.189320	0.768912	5.448371	0.0000
R-squared	0.927914	Mean dependent var	35087.41	
Adjusted R-squared	0.925087	S.D. dependent var	9404.797	
S.E. of regression	2574.113	Akaike info criterion	18.59835	
Sum squared resid	3.38E+08	Schwarz criterion	18.70885	
Log likelihood	-499.1555	Hannan-Quinn criter.	18.64097	
F-statistic	328.2445	Durbin-Watson stat	0.615878	
Prob(F-statistic)	0.000000			

## 4.2. Test for heteroscedasticity

The auxiliary regression:

$$\hat{u}_i^2 = a_1 + a_2CPI + a_3USDVND + a_4CPI^2 + a_5USDVND^2 + a_6CPI * USDVND + v_i$$

Where  $v_i$  is a normally distributed disturbance term independent of  $u_i$

**Figure 9: The auxiliary regression for heteroskedasticity test**

Heteroskedasticity Test: White

F-statistic	2.308389	Prob. F(5,48)	0.0586
Obs*R-squared	10.46766	Prob. Chi-Square(5)	0.0630
Scaled explained SS	9.094720	Prob. Chi-Square(5)	0.1053

Test Equation:

Dependent Variable: RESID<sup>2</sup>

Method: Least Squares

Date: 07/23/13 Time: 15:14

Sample: 2009M01 2013M06

Included observations: 54

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	29557139	5.15E+08	0.057343	0.9545
CPI	20681793	9799682.	2.110456	0.0401
CPI <sup>2</sup>	47116.09	35582.48	1.324137	0.1917
CPI*USD/VND	-1618.228	902.9355	-1.792185	0.0794
USD/VND	-128050.1	105965.9	-1.208409	0.2328
USD/VND <sup>2</sup>	8.164778	5.483655	1.488930	0.1430

R-squared	0.193846	Mean dependent var	6257942.
Adjusted R-squared	0.109871	S.D. dependent var	8816554.
S.E. of regression	8318122.	Akaike info criterion	34.81021
Sum squared resid	3.32E+15	Schwarz criterion	35.03121
Log likelihood	-933.8757	Hannan-Quinn criter.	34.89544
F-statistic	2.308389	Durbin-Watson stat	1.233709
Prob(F-statistic)	0.058629		

$H_0 : a_2 = a_3 = 0 \rightarrow \hat{u}_i^2 = a_1$ . There is homoscedasticity in the model

$H_1 : H_0$  false (any  $a_i \neq 0$ ). There is heteroscedasticity in the model

After running the regression of Vietnam gold price on two variables, it is observed that p-value = 0.0586 > 0.05. Hence,  $H_0$  is accepted and this thesis concludes that there is homoscedasticity in the model.

### 4.3. Test for multicollinearity

Eview is used to test the correlation between CPI and USD/VND exchange rate.

**Table 6: The correlation between CPI and USD/VND exchange rate**

	CPI	USD/VND
CPI	1.000000	0.953869
USD/VND	0.953869	1.000000

As quite high correlations are detected between CPI and USD/VND ( $\rho = 1$  and = 0.953869), there are 2 options to solve this problem: increase the sample or remove one of them. The solution that raising the sample is not appropriate because of the global financial crisis in 2007 and 2008, so the data before 2009 would be inconsistent with the overall model. Thus, the second option is chosen that remove CPI or USD/VND due to fixed time horizon.

The two cases that remove one of the variables are considered as follows.

If CPI is removed:

**Figure 10: Regression with one variable - USD/VND exchange rate**

$$\text{The regression: } Y = \beta_0 + \beta_1 \text{USD/VND} + u$$

Dependent Variable: VNGOLD

Method: Least Squares

Date: 07/23/13 Time: 15:18

Sample: 2009M01 2013M06

Included observations: 54

VNGOLD=C(1)+C(2)\*USD/VND

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-79225.95	4678.999	-16.93224	0.0000
C(2)	5.890462	0.240371	24.50573	0.0000
R-squared	0.920310	Mean dependent var	35087.41	
Adjusted R-squared	0.918778	S.D. dependent var	9404.797	
S.E. of regression	2680.321	Akaike info criterion	18.66159	
Sum squared resid	3.74E+08	Schwarz criterion	18.73526	
Log likelihood	-501.8631	Hannan-Quinn criter.	18.69000	
F-statistic	600.5308	Durbin-Watson stat	0.676806	
Prob(F-statistic)	0.000000			

From the figure 10, R-squared = 0.920310



**If USD/VND exchange rate is removed**

The regression:  $Y = \beta_0 + \beta_1 CPI + u$

**Figure 11: Regression with one variable - CPI**

Dependent Variable: VNGOLD

Method: Least Squares

Date: 07/23/13 Time: 15:19

Included observations: 54

VNGOLD=C(1)+C(2)\*CPI

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-24227.27	2983.226	-8.121166	0.0000
C(2)	477.6046	23.76274	20.09888	0.0000
R-squared	0.885956	Mean dependent var	35087.41	
Adjusted R-squared	0.883763	S.D. dependent var	9404.797	
S.E. of regression	3206.429	Akaike info criterion	19.02004	
Sum squared resid	5.35E+08	Schwarz criterion	19.09370	
Log likelihood	-511.5410	Hannan-Quinn criter.	19.04845	
F-statistic	403.9651	Durbin-Watson stat	0.313841	
Prob(F-statistic)	0.000000			

From Figure 11, R-squared = 0.885956

After comparing R-squared in the figure 10 and figure 11, it can be observed that R-squared in the figure 10 higher than R-squared in table 6 so CPI will be removed.

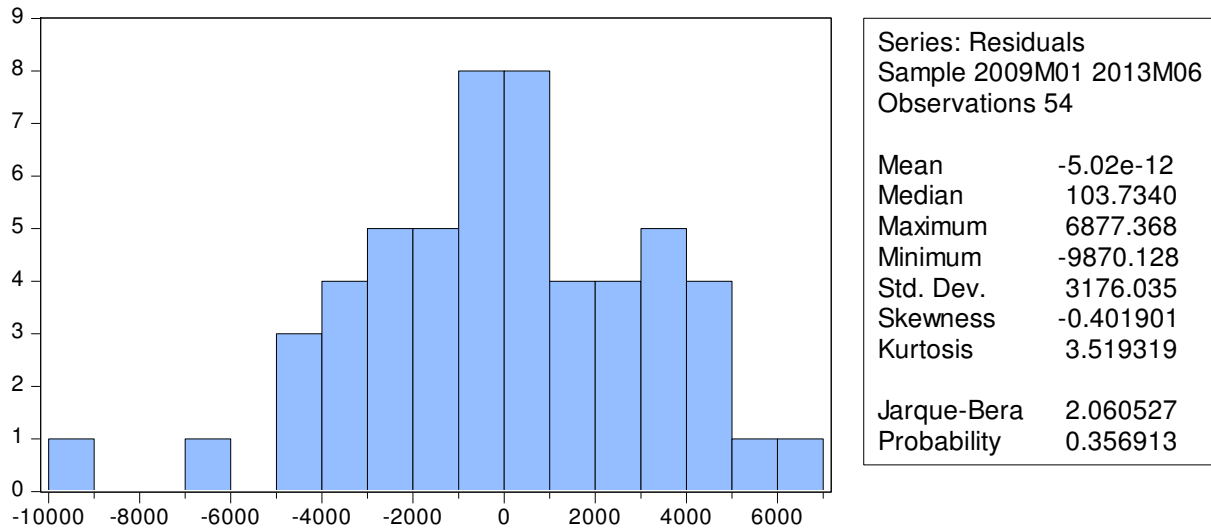
#### 4.4. Test the assumption of normality

The Jarque-Bera (JB) is used for testing the assumption of normality in the residual. Based on Eview, the regression is done:

$$\text{Log}(y_i) = \beta_0 + \beta_1 \log(x_1) + \beta_2 \log(x_2) + u_i$$

$$u_i \sim N(0, \sigma_u^2)$$

**Figure 12: Normality test in the residual**



$H_0$ : the model is normally distributed

$H_1$ :  $H_0$  false

Jarque-Bera (JB) = 2.06

A.R =  $[0, x_{\alpha,2}^2]$  where  $x_{\alpha,2}^2$  is Chi-squared and JB belongs to A.R.

P-value of variable = 0.3569

Jarque-Bera test is used to test for the normality of the residuals. The value of JB test of 2.06 and p-value of 0.3569 accept the hypothesis that the model is normal distributed.

### 4.5. Test for autocorrelation

According to the OLS Estimators in 4.4 (figure 10), Durbin-Watson (D-W) = 0.676806. For  $k=1$  (number of variables),  $n=54$  (number of observation),  $d_l = 1.528$ ,  $d_u = 1.601$  (Durbin-Watson table for  $\alpha = 0.05$ )

Have positive autocorrelation	Zone of indecision	No autocorrelation	Zone of indecision	Have negative autocorrelation
0	$d_L$	$d_u$	$4 - d_L$	$4 - d_u$

Hence, D-W does not belong to  $[d_u, 4 - d_u]$  which means that there is autocorrelation in this model. This is defined as a limitation of this study due to the lack of knowledge to resolve this problem.

In conclusion, the multiple regression model for Vietnamese gold price is as follow:

$$Y = -79225.95 + 5.89 * USD/VND$$

$\beta_0 = -79225.95$ . It means Vietnamese gold price is -79225.95VND when USD/VND exchange rate equals 0. This model does not have economic meaning.

$\beta_1 = 5.89$ . It means if the exchange rate USD/VND increases by 1 VND then the Vietnamese gold price increases by 5.89 VND.

#### 4.5. Interpretation of regression results

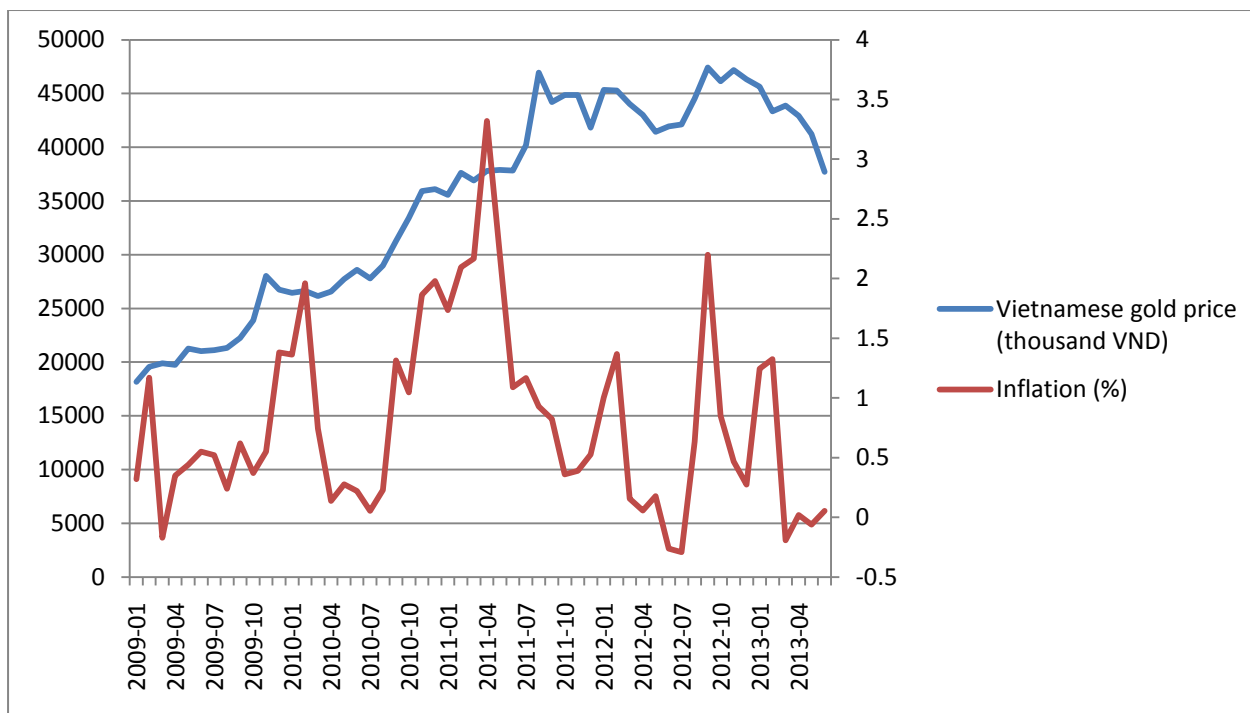
According to the statistical analyses, only USD/VND is significant in explaining Vietnamese gold price. USDVND exchange rate shows a positive relationship with Vietnamese gold price, as USD/VND exchange rate increases by 1 VND, the Vietnamese gold will increase by 5.89 VND. The two variables inflation and interest rate are not relevant to explain Vietnamese gold price. CPI is a significant variable, however, high correlations between two CPI and USDVND are found. Hence, the solution remove CPI was chosen because it has higher coefficient of determination.

For the autocorrelation test, Durbin-Watson = 0.313841 which presents that there is autocorrelation in this model. Therefore, this is one of the limitations in this model. However, this model could be considered a good model, the model on the whole could explains 92 percent ( $R^2 = 0.92$ ) of movements of Vietnamese gold price.

This thesis' results are consistent with the Central institute for economic management (CIEM) (2011) that in Vietnam, apart from the VND, there are two other means of payment that are gold and US dollar. Especially, in the stages of inflation, when confidence of the people in the domestic currency fell down, role of gold and US dollar has been confirmed. Therefore, there is a much close relationship among gold, US dollar and CPI in Vietnam. Any changes of one of the three types of prices also affect the other prices.

The studies of Mahdavi and Zhou (1997), Tulley and Lucey (2007), Jaffe (1989), Garner (1995), Larson and McQueen (1995), Cecchetti et al. (2000) concluded that the gold price does not affected by inflation. Some others also show that inflation in countries other than the US does not accurately predict the gold price (Chua and Woodward, 1982 and Tkacz, 2007) and proved that gold cannot hedge against inflation in many countries. Studies using data including the post-1999 period of gold price hikes also failed to prove the relationship between inflation and the gold price (Blöse, 2010). Similar with Siregar and Nguyen (2013), our study’s test results demonstrates that inflation does not significantly cause the movement of gold price in Vietnam.

**Figure 13: Movements of Vietnamese gold price and inflation from 01/2009 to 06/2013**

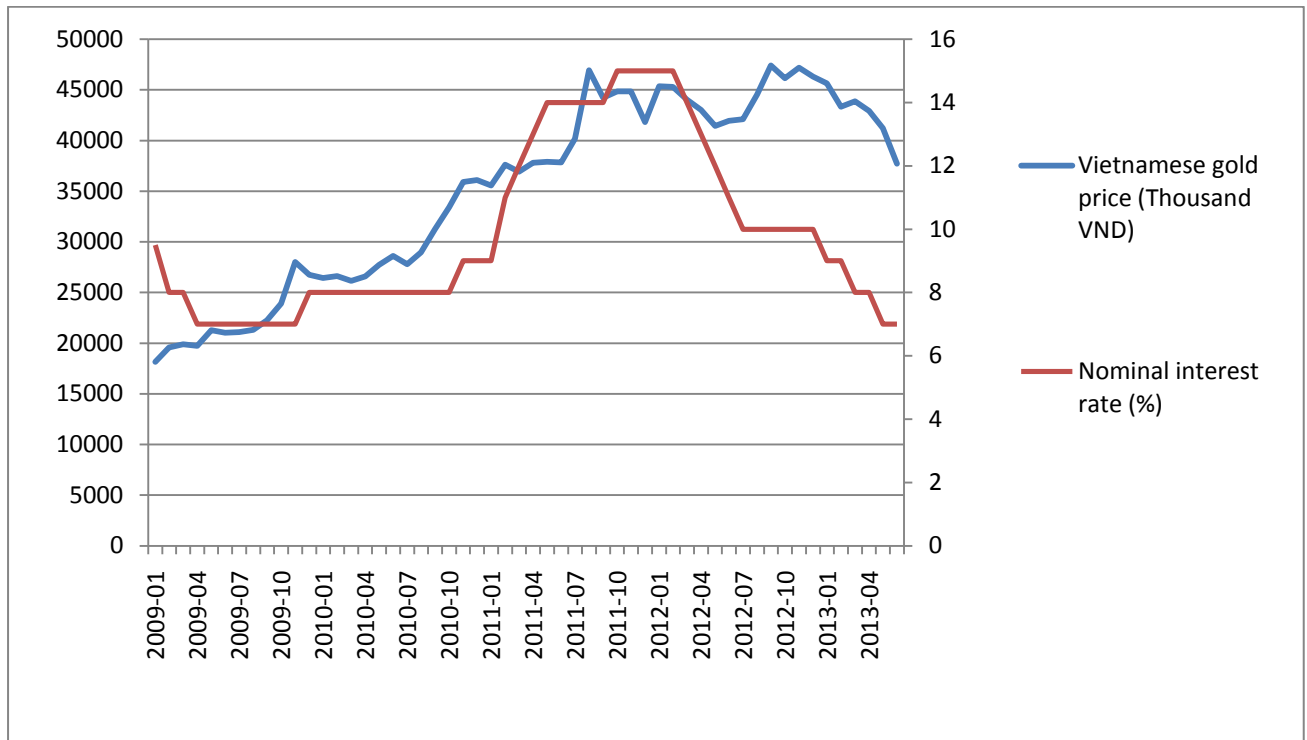


**Source: General Statistic Office of Vietnam, 2013**

According to Godsell and Tran (2011), Koutsoyiannis (1983), the gold price was influenced significantly by interest rate. They found out that there was a positive relationship between the nominal interest rate and the price of gold. However, this research does not have the same result. Figure 14 indicates that from May, 2012 the Vietnamese gold price and the nominal interest rate have the dramatically different movements. This point of time, the Decree

No.24 was released and valid on 25, May, 2012, so the gold price market has been strongly affected and did not move with the nominal interest rate.

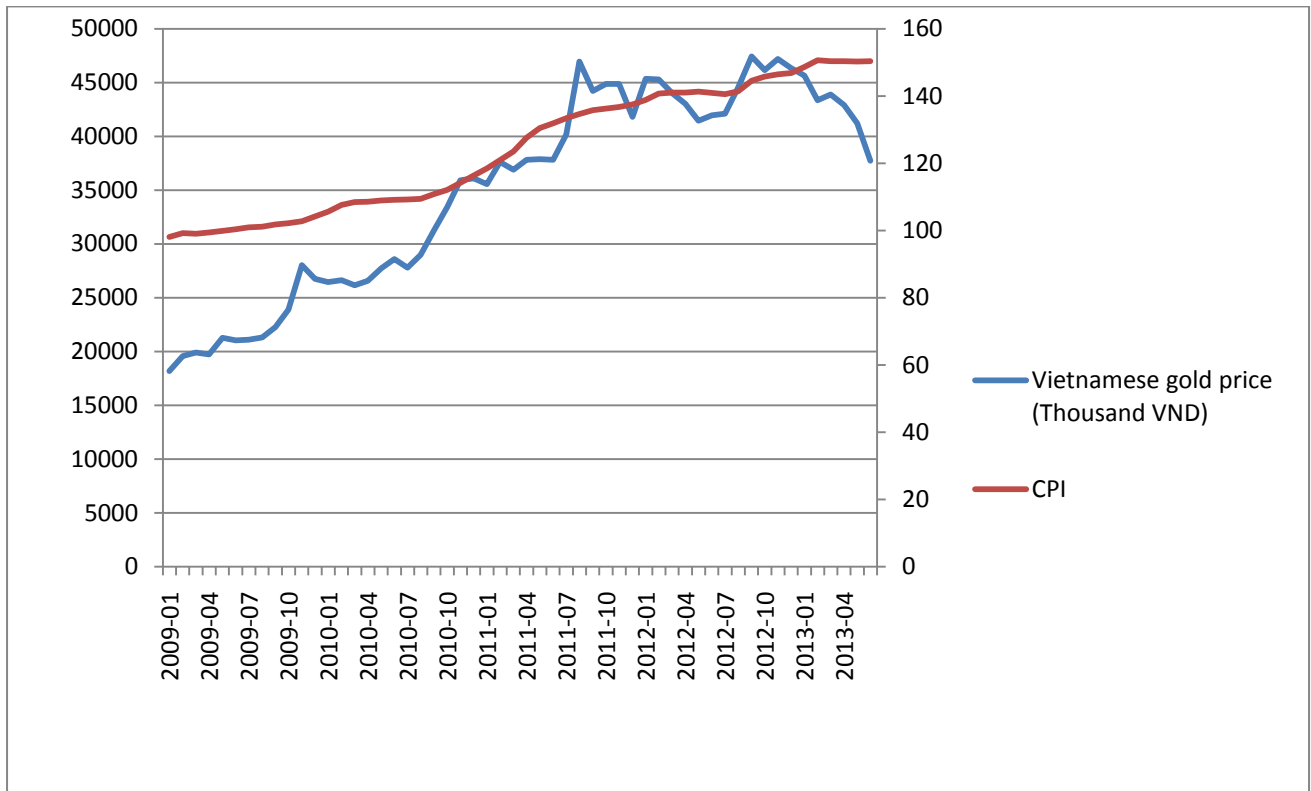
**Figure 14: Movements of Vietnamese gold price and nominal interest rate from 01/2009 to 06/2013**



**Source: General Statistic Office of Vietnam, 2013**

In contrast to the study Mahdavi and Zhou (1997) which found no evidence for a co-integrating relationship between the CPI and the London price of gold over the testing period (1979-1994), the empirical test of this research shows that the Vietnamese price index is one of factors significantly driving the domestic gold price (see figure 15). Higher CPI means higher expected inflation, which reduces the confidence of the people and enterprises in the domestic currency and increases hoard of gold and foreign currencies. In consequences, the demand for gold increases and the price of gold in the domestic market goes up.

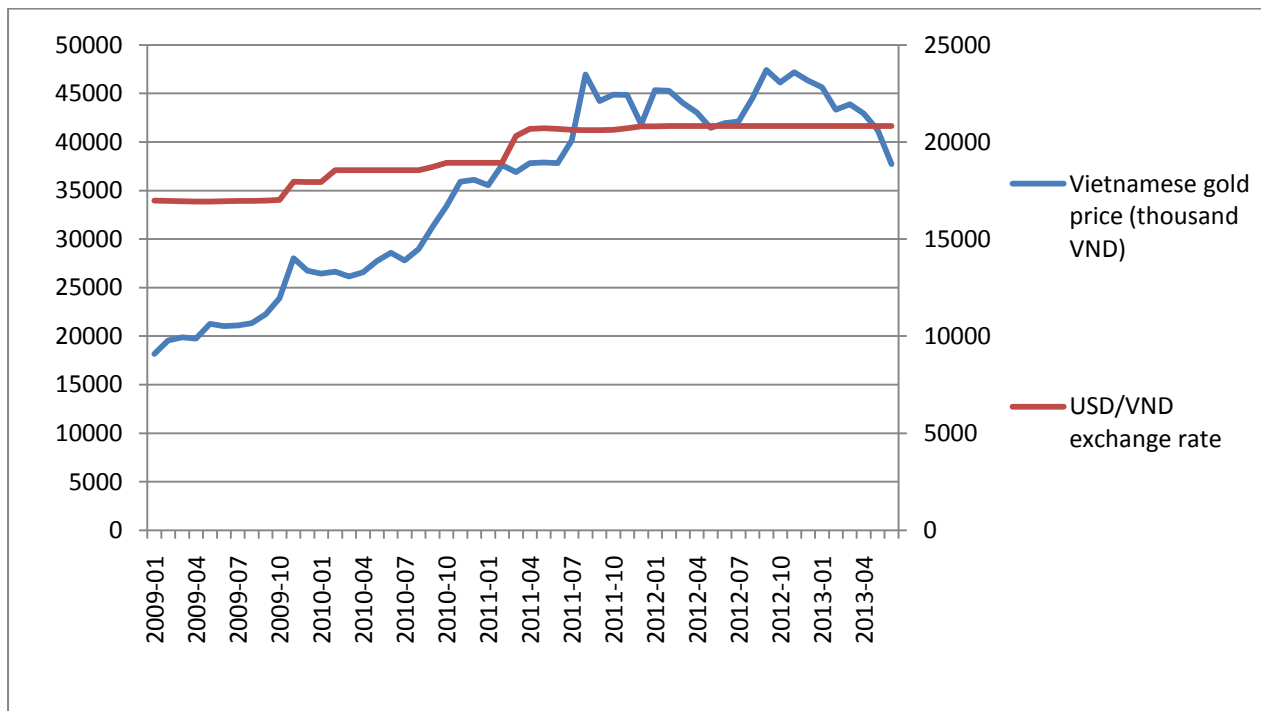
**Figure 15: Movements of Vietnamese CPI and the gold price from 01/2009 to 06/2013**



**Source: General Statistic Office of Vietnam, 2013**

This thesis confirms the empirical results of Sharma and Mahendru (2010), Toraman (2011) that the gold price is driven by USD exchange rate. As mentioned, the Vietnamese gold market is the price taker as gold is mainly imported from other countries and quoted in US dollars. Thus, the domestic gold price converting to VND has been subjected to a duplicate effect. On the one hand, it follows after the increase of the world gold price in terms of USD. On the other side, it is affected by the increase of USD/VND exchange rate. This duplicate effect is significant because the shortage of foreign currency reserve has been a hot issue in Vietnam since the beginning of 2010 that the USD/VND exchange rate keeps rising strongly.

**Figure 16: Movements of Vietnamese gold price and USD/VND exchange rate from 01/2009 to 06/2013**



**Source: General Statistic Office of Vietnam, 2013**

## 4.6. Conclusion

As a result of model by testing different macroeconomic variables that affects to gold price in Vietnam, a positive relationship is found between Vietnam gold price and the USD/VND exchange rate.

The findings of this study suggest that the USD/VND exchange rate and CPI are the two variables that have significantly positive effect on Vietnamese gold price. Although CPI is chosen to be removed because of the high correlation between them, it still has explanatory power. Hence, the highest correlation is found between the USD/VND exchange rate and Vietnamese gold price positively.

In summary, the results of this model reinforce the previous findings. Furthermore, the project also succeeds in testing the effect of four variables and building up a model to explain the determinants of gold price in Viet Nam. Therefore, it could be used as guidance for investment or reference for future study

## CHAPTER FIVE: CONCLUSIONS

This final chapter begins with the limitation of this study. Next is the recommendation part which including summary of key findings, recommendation for investors and the government. From limitation, this research makes a suggestion for the further study which also is the third part. Finally, conclusion will be jumped to.

### 5.1. Limitation of study

Although the findings has provided an important insight into the determinants of gold price in Vietnam and proposed a model to predict the gold price in the future, there exist a number of limitations in this research.

Firstly, the lack of same subject previous studies on Vietnamese market is also a limitation on literature review. So far, on our best knowledge we only found some articles discuss about the gold price analysis in Vietnam. There were no deep studies published for us to make result comparison.

Secondly, this research presents a limited data collection related to the determinants of gold price. It seems to be inevitable because the restricted access to a large number of information about gold in Vietnam and finite duration of collecting data. The study's result will be more significant if the data collection is bigger.

Thirdly, the collectable variables are smaller than expected due to the various uncontrollable characteristics in Vietnam gold market. Moreover, the empirical result of model could be more significant. To ensure the diversity of result, we keep the test for autocorrelation using statistical test though there is a limitation of the result that needs to explore this aspect in next studies.



## 5.2. Further research suggestion

The results and discussion have left some questions for further investigation of determinants of gold price in Vietnam.

Firstly, this study carries out macroeconomic approach that directly defines what macroeconomic factors affecting the gold price. This research recommends studying the same research questions by applying the other approaches that are speculation and inflation hedge approach.

Secondly, according to the limitation of literature review and the capability of accessing and gathering the related data, the hypotheses in this study are set based on several variables. Thus, a future study investigating more economic variables such as national debt, unemployment rate, etc, would be very interesting.

Thirdly, another suggestion for further research in order to extend the understanding the linkage of Vietnamese gold price and USD/VND exchange rate is to examine their relationship with USD/VND exchange rate in black market.

Finally, further research might explore the relationship between gold return and stock return in Vietnam because they are considered as financial assets and the alternative channels of each other. Such a study would provide more knowledge about the relationship of gold with the financial instrument and would suggest whether gold price is driven by stock price.

## 5.3. Recommendation

According to the empirical results of this study based on sample from 01/2009 to 06/2013, the consumer price index and USD/VND exchange rate have strong relationship with the price of gold in Vietnamese market. Increase in CPI or USD/VND exchange rate raises the domestic gold price. However, because CPI has strong correlation with USD/VND exchange rate and CPI has the lower coefficient of determination, USD/VND exchange rate movements explains more percentage of gold price movements. Thus, exchange rate is used in our final model to predict the gold price in Vietnam.

In the one hand, from this research model that Vietnamese gold price equals multiplication of USD/VND exchange rate and 5.89 minus 79,225.95, the investors can easily forecast the gold

price in Vietnamese market when recognizing the up and down of the exchange rate. This supports the investors making better decision for gold trading strategy. For instance, the investors buy gold immediately when noticing the increase in USD/VND exchange rate and upward trend. Thus, when the gold price already reaches the calculated one, they can sell for gains.

In the other hand, the Vietnamese government also takes advantage of this research results to manage the domestic gold price more effective. When the government wants to control the gold price, they can consider influencing the consumer price index or USD/VND exchange rate. The government can lower the gold price by adjusting factors affecting CPI or USD/VND exchange rate. Drivers of CPI should be considered are petrol price, rice price, USD/VND exchange rate (Nguyen, T.H.G. et al., 2012). However, both the exchange rate and CPI have impact on inflation (Nguyen, T.T.V. and Fujita, S., 2007), which affects the whole economy. Because of the linkages among the macroeconomics variables, the government should thoroughly consider all the alternatives and choose the best solution that not only potentially generates high effectiveness but also matches the government's economic strategy and policy.

## **5.4. Conclusion**

Throughout the history of mankind, gold has always been a valuable asset. The Greeks, the Romans, the Egyptians all used gold as a trade currency, a token of wealth or a safe-haven in times of political or financial turmoil.

In recent years, the world economic situation has been volatile, particularly the crisis in 2008 had a huge negative impact on the global economy. Vietnam is also affected by the economic crisis that had a big influence on Vietnam gold price during the period from 2009 to present. Due to the recent economic problems, gold is prominently back of investing, leading to new heights in the nominal gold price.

This thesis applied the econometric model and co-integration regression technique to model Vietnam gold price. In this study, data collection is analyzed from 2009 to June 2013. Consumer price index in Vietnam, inflation in Vietnam, the USD/VND exchange rate and the nominal interest rate in Vietnam data are included in the model as variables.

According to the findings, the inflation in Vietnam and the nominal interest rate in Vietnam have no statistically significant with the gold price. In statistical significance test, the coefficient for CPI and USD/VND exchange rate are statistical significant because their p-value is less than 0.05, however, there exists the multicollinearity between CPI and USD/VND exchange rate. In order to eliminate the multicollinearity, CPI is chosen to remove when comparing R-squared between two regression equations. Therefore, a positive relationship is found between Vietnam gold price and USD/VND exchange rate.

Although there are some limitations of this study, the model provides a quite good result with coefficient of determination equaling 0.92. Moreover, this model has answered all the research questions about the main factors affecting gold price in Vietnamese market. Based on the results, it can be used to forecast the gold price in the near future. Furthermore, there are many issues in Vietnam gold market and international market that can help investors reduce the risk and gain return when investing in Vietnamese gold market. Otherwise, it can be used by the authorities to further improve the policies for increasing more relevant in gold market in Vietnam.

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## APPENDICES

### APPENDIX 1: Detailed data collection used in the modeling

The data used in the modeling are monthly observations from the last day of the month covering the period from January 2009 to June 2013.

<b>Time period</b>	<b>Price of gold (Thousand VND/Tael)</b>	<b>CPI (%)</b>	<b>Inflation rate (%)</b>	<b>US/VND Exchange rate (VND/One Dollar)</b>	<b>Nominal Interest rates (%)</b>
2009-01	18170	98.09	0.32	16975	0.10
2009-02	19570	99.24	1.17	16971	0.08
2009-03	19900	99.07	-0.17	16954	0.08
2009-04	19740	99.41	0.35	16937	0.07
2009-05	21270	99.85	0.44	16938	0.07
2009-06	21030	100.40	0.55	16953	0.07
2009-07	21110	100.92	0.52	16967	0.07
2009-08	21320	101.16	0.24	16974	0.07
2009-09	22260	101.79	0.62	16991	0.07
2009-10	23900	102.17	0.37	17011	0.07
2009-11	28020	102.73	0.55	17956	0.07
2009-12	26760	104.15	1.38	17941	0.08

2010-01	26440	105.57	1.36	17941	0.08
2010-02	26630	107.64	1.96	18544	0.08
2010-03	26150	108.44	0.74	18544	0.08
2010-04	26580	108.59	0.14	18544	0.08
2010-05	27740	108.89	0.28	18544	0.08
2010-06	28600	109.13	0.22	18544	0.08
2010-07	27790	109.19	0.05	18544	0.08
2010-08	28970	109.44	0.23	18544	0.08
2010-09	31270	110.88	1.32	18715	0.08
2010-10	33420	112.04	1.05	18932	0.08
2010-11	35920	114.13	1.87	18932	0.09
2010-12	36100	116.39	1.98	18932	0.09
2011-01	35560	118.41	1.74	18932	0.09
2011-02	37610	120.89	2.09	18932	0.11
2011-03	36910	123.51	2.17	20318	0.12
2011-04	37810	127.61	3.32	20673	0.13
2011-05	37890	130.43	2.21	20713	0.14
2011-06	37830	131.85	1.09	20678	0.14
2011-07	40180	133.39	1.17	20622	0.14

2011-08	46950	134.63	0.93	20610	0.14
2011-09	44220	135.74	0.82	20618	0.14
2011-10	44870	136.23	0.36	20628	0.15
2011-11	44860	136.76	0.39	20708	0.15
2011-12	41820	137.48	0.53	20803	0.15
2012-01	45350	138.86	1.00	20813	0.15
2012-02	45290	140.76	1.37	20828	0.15
2012-03	44020	140.98	0.16	20828	0.14
2012-04	43020	141.06	0.06	20828	0.13
2012-05	41450	141.31	0.18	20828	0.12
2012-06	41950	140.94	-0.26	20828	0.11
2012-07	42110	140.53	-0.29	20828	0.10
2012-08	44540	141.42	0.63	20828	0.10
2012-09	47420	144.53	2.20	20828	0.10
2012-10	46150	145.76	0.85	20828	0.10
2012-11	47200	146.44	0.47	20828	0.10
2012-12	46320	146.84	0.27	20828	0.10
2013-01	45640	148.67	1.25	20828	0.09
2013-02	43340	150.64	1.33	20828	0.09

2013-03	43890	150.35	-0.19	20828	0.08
2013-04	42920	150.38	0.02	20828	0.08
2013-05	41220	150.29	-0.06	20828	0.07
2013-06	37720	150.37	0.05	20828	0.07

## APPENDIX 2: The F-distribution

The F distribution is an asymmetric distribution that has a minimum value of 0, but no maximum value. The F distribution can be used where there are several measurements (as chi-squared) but the number of samples is small (as t). Therefore, there is a different F distribution for each combination of the degrees of freedom of the numerator and denominator. In this study, F-value for  $\alpha = 0.05$  (level of significance) was used to clarify the result of modeling.

### F-value for $\alpha = 0.05$

df2/df1	1	2	3	4	5	10	20	40	60	120	INF
1	161,45	199,50	215,71	224,58	230,16	241,88	248,01	251,14	252,20	253,25	254,31
2	18,51	19,00	19,16	19,25	19,30	19,40	19,45	19,47	19,48	19,49	19,50
3	10,13	9,55	9,28	9,12	9,01	8,79	8,66	8,59	8,57	8,55	8,53
4	7,71	6,94	6,59	6,39	6,26	5,96	5,80	5,72	5,69	5,66	5,63
5	6,61	5,79	5,41	5,19	5,05	4,74	4,56	4,46	4,43	4,40	4,37
6	5,99	5,14	4,76	4,53	4,39	4,06	3,87	3,77	3,74	3,70	3,67
7	5,59	4,74	4,35	4,12	3,97	3,64	3,44	3,34	3,30	3,27	3,23
8	5,32	4,46	4,07	3,84	3,69	3,35	3,15	3,04	3,01	2,97	2,93
9	5,12	4,26	3,86	3,63	3,48	3,14	2,94	2,83	2,79	2,75	2,71
10	4,96	4,10	3,71	3,48	3,33	2,98	2,77	2,66	2,62	2,58	2,54



<b>11</b>	4,84	3,98	3,59	3,36	3,20	2,85	2,65	2,53	2,49	2,45	2,40
<b>12</b>	4,75	3,89	3,49	3,26	3,11	2,75	2,54	2,43	2,38	2,34	2,30
<b>13</b>	4,67	3,81	3,41	3,18	3,03	2,67	2,46	2,34	2,30	2,25	2,21
<b>14</b>	4,60	3,74	3,34	3,11	2,96	2,60	2,39	2,27	2,22	2,18	2,13
<b>15</b>	4,54	3,68	3,29	3,06	2,90	2,54	2,33	2,20	2,16	2,11	2,07
<b>16</b>	4,49	3,63	3,24	3,01	2,85	2,49	2,28	2,15	2,11	2,06	2,01
<b>17</b>	4,45	3,59	3,20	2,96	2,81	2,45	2,23	2,10	2,06	2,01	1,96
<b>18</b>	4,41	3,55	3,16	2,93	2,77	2,41	2,19	2,06	2,02	1,97	1,92
<b>19</b>	4,38	3,52	3,13	2,90	2,74	2,38	2,16	2,03	1,98	1,93	1,88
<b>20</b>	4,35	3,49	3,10	2,87	2,71	2,35	2,12	1,99	1,95	1,90	1,84
<b>21</b>	4,32	3,47	3,07	2,84	2,68	2,32	2,10	1,96	1,92	1,87	1,81
<b>22</b>	4,30	3,44	3,05	2,82	2,66	2,30	2,07	1,94	1,89	1,84	1,78
<b>23</b>	4,28	3,42	3,03	2,80	2,64	2,27	2,05	1,91	1,86	1,81	1,76
<b>24</b>	4,26	3,40	3,01	2,78	2,62	2,25	2,03	1,89	1,84	1,79	1,73
<b>25</b>	4,24	3,39	2,99	2,76	2,60	2,24	2,01	1,87	1,82	1,77	1,71
<b>26</b>	4,23	3,37	2,98	2,74	2,59	2,22	1,99	1,85	1,80	1,75	1,69
<b>27</b>	4,21	3,35	2,96	2,73	2,57	2,20	1,97	1,84	1,79	1,73	1,67
<b>28</b>	4,20	3,34	2,95	2,71	2,56	2,19	1,96	1,82	1,77	1,71	1,65
<b>29</b>	4,18	3,33	2,93	2,70	2,55	2,18	1,94	1,81	1,75	1,70	1,64

<b>30</b>	4,17	3,32	2,92	2,69	2,53	2,16	1,93	1,79	1,74	1,68	1,62
<b>40</b>	4,08	3,23	2,84	2,61	2,45	2,08	1,84	1,69	1,64	1,58	1,51
<b>60</b>	4,00	3,15	2,76	2,53	2,37	1,99	1,75	1,59	1,53	1,47	1,39
<b>120</b>	3,92	3,07	2,80	2,45	2,29	1,91	1,66	1,50	1,43	1,35	1,25
<b>inf</b>	3,84	3,00	2,60	2,37	2,21	1,83	1,57	1,39	1,32	1,22	1,00

### APPENDIX 3: The Durbin-Watson statistic

Significance points of  $d_L$  and  $d_u$  at 5% level of significance

$k'$  = number of explanatory variables excluding the constant term

obs	k'=1		k'=2		k'=3		k'=4		k'=5	
N	$d_L$	$d_u$	$d_L$	$d_u$	$d_L$	$d_u$	$d_L$	$d_u$	$d_L$	$d_u$
6	0.610	1.400	-	-	-	-	-	-	-	-
7	0.700	1.356	0.467	1.896	-	-	-	-	-	-
8	0.763	1.332	0.559	1.777	0.368	2.287	-	-	-	-
9	0.724	1.320	0.629	1.699	0.455	2.128	0.296	2.588	-	-
10	0.879	1.320	0.697	1.641	0.525	2.016	0.376	1.414	0.243	2.822
11	0.927	1.324	0.658	1.604	0.595	1.928	0.444	2.283	0.316	2.645
12	0.971	1.331	0.812	1.579	0.658	1.864	0.512	2.177	0.379	2.506
13	1.010	1.340	0.861	1.562	0.715	1.816	0.574	1.094	0.445	2.390
14	1.045	1.350	0.905	1.551	0.767	1.779	0.632	2.030	0.505	2.296
15	1.077	1.361	0.946	1.543	0.814	1.750	0.685	1.977	0.562	2.220
16	1.106	1.371	0.982	1.539	0.857	1.728	0.734	1.935	0.615	2.157
17	1.133	1.381	1.015	1.536	0.897	1.710	0.779	1.900	0.664	2.104
18	1.158	1.391	1.046	1.535	0.933	1.696	0.820	1.872	0.710	2.060
19	1.180	1.401	1.074	1.536	0.967	1.685	0.859	1.848	0.752	2.023
20	1.201	1.411	1.100	1.537	0.998	1.676	0.894	1.828	0.792	1.991
obs	k'=1		k'=2		k'=3		k'=4		k'=5	
N	$d_L$	$d_u$	$d_L$	$d_u$	$d_L$	$d_u$	$d_L$	$d_u$	$d_L$	$d_u$
21	1.221	1.420	1.125	1.538	1.026	1.669	0.927	1.812	0.829	1.964
22	1.239	1.429	1.147	1.541	1.053	1.664	0.958	1.797	0.863	1.940
23	1.257	1.437	1.168	1.543	1.078	1.660	0.986	1.785	0.895	1.920
24	1.273	1.446	1.188	1.546	1.101	1.656	1.013	1.775	0.925	1.902
25	1.288	1.454	1.206	1.550	1.123	1.654	1.038	1.767	0.953	1.886
26	1.302	1.461	1.224	1.553	1.143	1.652	1.062	1.759	0.979	1.873
27	1.316	1.469	1.240	1.556	1.162	1.651	1.084	1.753	1.004	1.861

<b>28</b>	1.328	1.476	1.255	1.560	1.181	1.650	1.104	1.747	1.028	1.850
<b>29</b>	1.341	1.483	1.270	1.563	1.198	1.650	1.124	1.743	1.050	1.841
<b>30</b>	1.352	1.489	1.284	1.567	1.214	1.650	1.143	1.739	1.071	1.833
<b>31</b>	1.363	1.496	1.297	1.570	1.229	1.650	1.160	1.735	1.090	1.825
<b>32</b>	1.373	1.502	1.309	1.574	1.244	1.650	1.177	1.732	1.109	1.819
<b>33</b>	1.383	1.508	1.321	1.577	1.258	1.651	1.193	1.730	1.127	1.813
<b>34</b>	1.993	1.514	1.333	1.580	1.271	1.652	1.208	1.728	1.144	1.808
<b>35</b>	1.402	1.519	1.343	1.584	1.283	1.653	1.222	1.726	1.160	1.803
<b>36</b>	1.411	1.525	1.354	1.587	1.295	1.654	1.236	1.724	1.175	1.799
<b>obs</b>	<b>k'=1</b>		<b>k'=2</b>		<b>k'=3</b>		<b>k'=4</b>		<b>k'=5</b>	
<b>N</b>	<b>d<sub>L</sub></b>	<b>d<sub>u</sub></b>	<b>d<sub>L</sub></b>	<b>d<sub>u</sub></b>	<b>d<sub>L</sub></b>	<b>d<sub>u</sub></b>	<b>d<sub>L</sub></b>	<b>d<sub>u</sub></b>	<b>d<sub>L</sub></b>	<b>d<sub>u</sub></b>
<b>37</b>	1.419	1.530	1.364	1.590	1.307	1.655	1.249	1.723	1.190	1.795
<b>38</b>	1.427	1.535	1.373	1.594	1.318	1.656	1.261	1.722	1.204	1.792
<b>39</b>	1.435	1.540	1.382	1.597	1.328	1.658	1.273	1.722	1.218	1.789
<b>40</b>	1.442	1.544	1.391	1.600	1.338	1.659	1.285	1.721	1.230	1.786
<b>45</b>	1.475	1.566	1.430	1.615	1.383	1.666	1.336	1.720	1.287	1.776
<b>50</b>	1.503	1.585	1.462	1.628	1.421	1.674	1.378	1.721	1.335	1.771
<b>55</b>	1.528	1.601	1.490	1.641	1.452	1.681	1.414	1.724	1.374	1.768
<b>60</b>	1.549	1.616	1.514	1.652	1.480	1.689	1.444	1.727	1.408	1.767
<b>65</b>	1.567	1.629	1.536	1.662	1.503	1.696	1.471	1.731	1.438	1.767
<b>70</b>	1.583	1.641	1.554	1.672	1.525	1.703	1.494	1.735	1.464	1.768
<b>75</b>	1.598	1.652	1.571	1.680	1.543	1.709	1.515	1.739	1.487	1.770
<b>80</b>	1.611	1.662	1.586	1.688	1.560	1.715	1.534	1.743	1.507	1.772
<b>85</b>	1.624	1.671	1.600	1.696	1.575	1.721	1.550	1.747	1.525	1.774
<b>90</b>	1.635	1.679	1.612	1.703	1.589	1.726	1.566	1.751	1.542	1.776
<b>95</b>	1.645	1.687	1.623	1.709	1.602	1.732	1.579	1.755	1.557	1.778
<b>100</b>	1.654	1.694	1.634	1.715	1.613	1.736	1.592	1.758	1.571	1.780
<b>150</b>	1.720	1.746	1.706	1.760	1.693	1.774	1.679	1.788	1.665	1.802
<b>200</b>	1.758	1.778	1.748	1.789	1.738	1.799	1.728	1.810	1.718	1.820