

**UNIVERSITY OF GHANA**

**COLLEGE OF HUMANITIES**

**EFFECTS OF MACROECONOMIC VARIABLES ON GOLD PRICES IN GHANA**

**BY**

**RITA KORYO NGMERTEY**

**(ID NO. 10636721)**

**A LONG ESSAY PRESENTED TO THE SCHOOL OF GRADUATE STUDIES IN  
PARTIAL FULFILLMENT OF THE AWARD OF DEGREE OF MASTER OF  
BUSINESS ADMINISTRATION IN FINANCE**

**DEPARTMENT OF FINANCE**

**JULY, 2019**

## DECLARATION

I hereby declare that this project is my own work and effort and that it has not been submitted anywhere for any award.

.....

RITA KORYO NGMERTEY  
(10636721)

DATE



### **CERTIFICATION**

I hereby certify that this research project has been submitted for examination as the University supervisor.

.....  
DR. PATRICK ASUMING  
(SUPERVISOR)



## **DEDICATION**

I dedicate this work to my Parents Mr. Patrick Tetteh and Mrs. Alberta Tetteh, and my siblings for all the love, support and encouragement throughout my educational journey.

May the good Lord continually bless you, grant you long life and good health so that you enjoy the fruit of your labor.

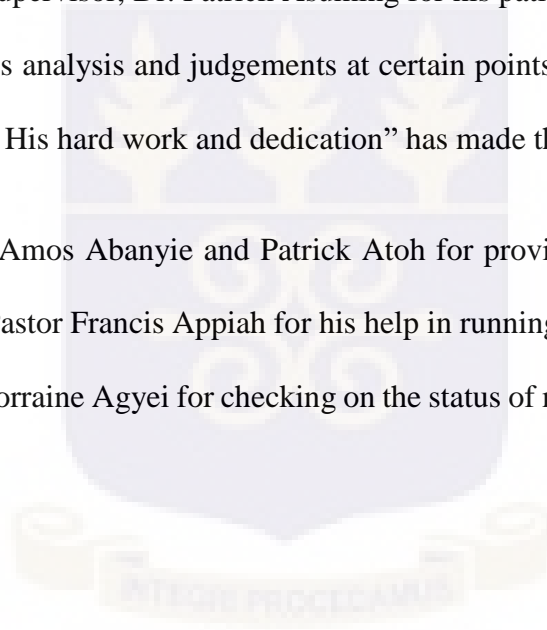


## **ACKNOWLEDGEMENTS**

My enormous gratitude goes to the God Almighty for the possibility to be part of this program and for seeing me through the difficult times. It is only by His grace that I have sailed through and I am forever grateful.

I am grateful also to my supervisor, Dr. Patrick Asuming for his patience and input to ensure that this paper takes shape. His analysis and judgements at certain points served in getting “me to go beyond my comfort zone. His hard work and dedication” has made this possible.

Special thanks to Daniel Amos Abanyie and Patrick Atoh for providing support throughout the duration of my study, to Pastor Francis Appiah for his help in running the time series analysis and to Prince Agyekum and Lorraine Agyei for checking on the status of my academic work from time to time.



## Table of Contents

DECLARATION .....	i
CERTIFICATION .....	ii
DEDICATION .....	ii
ACKNOWLEDGEMENTS .....	iii
LIST OF TABLES .....	vi
ABSTRACT .....	vii
CHAPTER ONE .....	1
INTRODUCTION .....	1
1.1 Background to the study .....	1
1.2 Research Problem .....	2
1.3 Research Objectives .....	3
1.4 Research Hypothesis .....	3
1.5 Justification for study .....	4
1.6 Scope of the study .....	4
1.7 Organisation of thesis .....	5
CHAPTER TWO .....	6
LITERTURE REVIEW .....	6
2.0 Introduction .....	6
2.1 Factors Affecting the Price of Gold .....	6
2.1.1 The economic situation of Ghana .....	6
2.1.3 Supply and Demand of Gold .....	6
2.1.4 Monetary policy direction .....	7
2.1.5 Inflation .....	7
2.1.6 Global economic situation .....	8
2.1.7 Real interest rate .....	8
2.2 History of Gold Mining Industry in Ghana .....	9
2.3 Gold Marketing in Ghana .....	11
2.4 Relationship between Macroeconomic Variables and Gold Prices .....	12
CHAPTER THREE .....	15
METHODOLOGY .....	15
3.1 Research Design .....	15
3.2 Sample Size .....	15

3.3 Sources of Data .....	15
3.4 Variable Selection and Description .....	16
3.4.1 Exchange Rate (EXR) .....	16
3.4.2 Interest Rate (INTR).....	17
3.4.3 Inflation rate (INFL) .....	17
3.4.4 Crude Oil Prices .....	17
3.5 Data Analysis Methods and Techniques .....	18
3.6 Estimation Model .....	18
3.7 Estimation Strategy .....	19
3.7.1 Unit Root Test (Stationarity Test) .....	19
3.7.2 Co-integration Test .....	19
3.7.3 Long Run and Short Run Effect .....	20
CHAPTER FOUR .....	22
DATA PRESENTATION, ANALYSIS AND DISCUSSION .....	22
4.1 Introduction .....	22
4.2 Descriptive Statistics of Variables .....	22
4.3 Stationarity Test of Variables .....	23
4.4 Cointegration Test Results .....	24
4.5 Results and Analysis of Long Run Model .....	25
4.6 Results and Analysis of Short Run Model .....	27
4.7 Diagnostic and Stability Test .....	29
CHAPTER FIVE .....	31
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS .....	31
5.1 Introduction .....	31
5.2 Summary .....	31
5.3 Conclusions .....	32
5.4 Recommendations .....	33
REFERENCES .....	34

**LIST OF TABLES**

Table 4.1: Descriptive Statistics Variables .....	22
Table 4.2: Test Result of Augmented Dickey Fuller .....	23
Table 4.3: Johanson Cointegration Test Results.....	24
Table 4.4: Long run Results Coefficients .....	26
Table 4.5: Short run Results Coefficients .....	28
Table 4.6: Diagnostic and Stability Test.....	30



## ABSTRACT

“The purpose of this study is to examine the effect of macroeconomic variables on gold prices in Ghana”. The study used “made use of monthly data” sourced from “Bank of Ghana, Ghana statistical service and” World Bank website. The time series estimation techniques were adopted in order to examine the effect of macroeconomic variables on gold prices The study shows that Exchange rate significantly “affect Gold prices in the long run. Crude oil prices, Inflation and Interest rate did not significantly affect economic growth in the long run. The study” also found that that Crude oil prices and its immediate two lagged values in the short run “significantly and positively affects Gold prices. Exchange rate, the third lagged value of Crude oil prices, Inflation and its three lagged values, and interest rate did not significantly affect Gold prices in the short run. It is thus “recommended that investors take advantage of the” results from the study to “their investment strategies” by considering both the external environment and as well the internal environment of the country.

It was further recommended that domestic firms learn from the foreign firms that are experienced through a collaboration in the supply chain where there is the tendency that foreign firms transfers the technological know-how and management to local suppliers they deal wi.th, so as to enhance the technological transfers and skills.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background to the study

Ghana has been endowed with significant mineral deposits of which gold “is by far” being the most important mineral mined (Bermudez- Lugo, 2006). Ghana is still ranked as the “world’s 10th and Africa’s 2nd largest producer of gold, with current production estimated in excess of 2.81Moz” as at June 2018; rising from 2.54Moz in 2017 (Joseph & Wang, 2018).

Gold as a metal or mineral has both commodity and monetary attributes which makes it a very important natural mineral in the financial markets. Gold as a recognized international trade commodity is considered as a significant item in central bank reserves in the world economy and investment in it is seen as a very formidable venture for governments and private entities because of its good store of value (Nadeem et al 2014; Tran & Starr, 2007). Despite the value of this precious mineral commodity, “its price remains closely watched as an indicator of changing risk perceptions”.

According to Nadeem et al. (2014), the price of gold is a very “good indicator to evaluate” the economic health of both developed and developing economies. When gold prices are high, investors assemble them to prevent them from being subjected to inflation hence indicating an unhealthy economy; whilst in the opposite, investors will switch “to other profitable investments like bonds, real estate”, among others indicating a healthy economy due to the low gold prices (Nadeem et al., 2004). As established by some literature, gold prices are for diversifying portfolios, hedging and risk mitigation. Le and Chan (2011) indicated that investing in gold reduces financial market risk. In view of this, many investors are likely to invest in the commodity for the benefit

of their companies among many other reasons. One inevitable point opined by Mamcarz (2015) is that the decision to invest in gold rests not on only knowing its price, but also the factors that influences gold price fluctuations. Sharing in the viewpoint of the above researches, it is therefore very “important to understand the” fluctuations in gold prices and the macroeconomic variables that play a role in it (either positively or negatively); since “gold price is a strong indicator of the” well-being of the economy.

## **1.2 Research Problem**

The fluctuations in gold prices are very critical to investor knowledge, as these will influence the level of investment into this beneficial commodity for a country. The identification “of the relationship between macroeconomic” factors and gold prices makes it possible to explain changes in gold prices in the past and to make forecasts. This is of great importance for “both speculators and investors” committing capital in the long term. Several research works across the globe have brought to the pool of knowledge on the factors that affect gold prices. Research works by Wang et al. (2011), Le and Chang (2011), Levin and Wright (2006), Nadeem et al. (2014), Tully and Lucey (2007) in countries like Pakistan, USA, and the Asia, have touched on different “macroeconomic variables such inflation, oil prices, interest rates, exchange rate and” others to have relationships with gold prices; however, report from Ghana is lacking.

Ghana is a notable country rich in the precious mineral gold in Africa. The gold as a commodity and its “prices play a significant role in the” determination “of the gold prices” in the country together with other commodities such as oil, cocoa and timber. Though gold as a commodity is significant in Ghana’s developing economy, literature and previous research works on the commodity have not focused on how its prices fluctuate and what relationship it has with other

“macroeconomic variables such as interest rates, exchange rates, inflation, oil prices and” other “macroeconomic variables. Most of the research” works including that of Tweneboah and Adam (2008), Adu (2012) among others have focused on the effect of gold prices as a macroeconomic variable on stock prices. This has led to a dearth of information on how macroeconomic variables impact or affect gold prices in the country. Therefore, “this study seeks” to address the identified gap in research studies with reference to the commodity by looking at the impact of selected “macroeconomic variables on the gold prices in” Ghana.

### 1.3 Research Objectives

“The objective of the study is to find out the effects of macroeconomic variables on” gold prices in Ghana. The study will specifically aim at:

1. Analysing “the impact of exchange rate on gold prices”.
2. Analysing the impact of “crude oil prices on gold prices”.
3. Identifying the “impact of interest” rate on the “gold price”.
4. Ascertaining “the impact of inflation on the gold prices”.

### 1.4 Research Hypothesis

In view of the objectives of this study, four research hypothesis are assumed. These include:

1. **Hypothesis Assumed (H<sub>0</sub>):** Gold prices do not depend on exchange rate in Ghana.
2. **Hypothesis Assumed (H<sub>0</sub>):** Gold prices do not depend on crude oil prices in Ghana.
3. **Hypothesis Assumed (H<sub>0</sub>):** The interest rate does not affect gold prices in Ghana.
4. **Hypothesis Assumed (H<sub>0</sub>):** The inflation rate does not affect gold prices in Ghana.

### **1.5 Justification for study**

In justifying the importance “of this study the following are expected that”;

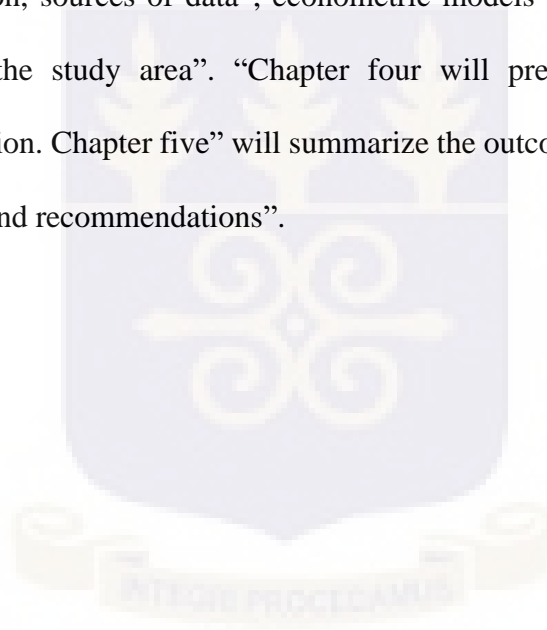
1. The findings “of this study” will help identify the “main macroeconomic factors that” affects gold prices “in Ghana, taking into consideration” inflation rate, “exchange rates, crude oil prices and interest rates”.
2. The study seeks to provide reliable findings to investors and the government policy makers in gold investment “using more recent data points” (2009 - 2018) “especially considering the recent drastic changes in the Ghanaian” macroeconomic variables and how it affects the fluctuations “in the prices of gold”.
3. The findings of this “study will add to the pool of literature on the” commodity in question and bridge the gap that exists in literature with respect to gold prices fluctuations in Ghana
4. The “findings of this study will serve as a” baseline research for students and “as a reference material” for use in future studies by other researchers.

### **1.6 Scope of the study**

This study will investigate “the effect of macroeconomic variables on” gold prices. It has been noticed that “a number of researchers in various countries have found significant relationships between macroeconomic variables and gold prices” (see Nadeem et. al., 2014; Hashim et al., 2017; Sukri et al., 2015). These studies used multiple regression “models which incorporate macroeconomic variables as explanatory factors” being the independent variables. The “following methodological approach is adopted in this study for establishing the relationship between macroeconomic variables and” gold prices in Ghana.

## **1.7 Organisation of thesis**

This research “is organized into five main chapters”. “The first chapter” will introduce the study which will comprise “the background of the study, the problem statement, the objectives, research questions”, brief methodology, significance, organisation and limitation of the study. “The second chapter” will review “the relevant literature, both theoretical and empirical”, on how macroeconomic variables and gold prices relate. Chapter three will concentrate on the methodology used, which will provide in-depth information on the research design, research strategy, “study population, sources of data”, econometric models “and analysis techniques, as well as the profile of the study area”. “Chapter four will presents the results, analyses, interpretation and discussion. Chapter five” will summarize the outcome of the research work and provide the “conclusion and recommendations”.



## CHAPTER TWO

### LITERATURE REVIEW

#### 2.0 Introduction

“This section looks at the literature review for the study”. It is made up of the elements affecting gold prices, the “history of Gold Mining” Industry in Ghana, Gold Marketing in Ghana and studies on the “relationship between macro-economic variables and” gold prices.

#### 2.1 Factors Affecting the Price of Gold

The factors provided below affects the movement in prices of Gold. These factors presented are the closer ones to gold prices.

##### 2.1.1 The economic situation of Ghana

The US Dollar for Gold is an indicator of the rate of exchange of Ghana cedi's in the market for foreign exchange internationally, and is negatively related with gold prices internationally. When there is a fall in US Dollar, the value of the Ghana cedis appreciate and the gold value decreases, investors therefore do not invest much into gold. This results into a lower demand for Gold.

##### 2.1.3 Supply and Demand of Gold

Demand for Gold is mainly to consume, deposit and invest. Normally gold prices are “determined by international economic” development. “When there is a rise in an economy”, gold demand also increases as well. The central banks holdings of official gold are “used as a guard against financial risks”. For investors that are regular “gold is an investment and is used” as a hedge in opposition to inflation. The World gold council said that there was an increase in demand for gold by 15 percent during “the first half of 2016 to 2,335 tons” and demand for investment increased by 16 percent. This has been the highest since 2009. “However, gold supply increased by 1 percent

during the first half of 2016, which” was the slowest in supply of gold from the first half of 2008. This growth in supply is less than the growth in demand, and became “one of the reasons for the” rise in gold prices in 2006.

#### **2.1.4 Monetary policy direction**

The specific implementation of monetary policy includes increasing the deposit-reserve ratio, lifting the discount rate and so on. The implementation of monetary policy may also have an impact on the supply of money. Increasing the money supply can lead to a decline in the purchasing power of the currency. “A decrease in the purchasing power of the currency, which in turn” will cause “the price of gold” rises. Conversely, a decrease in the supply of money may result in the purchasing power “to increase and the price of gold the” fall. On one hand, tightening monetary policy is usually reflected in the market interest rate increases. Interest rates increases make the cart holding gold rise. This should weaken the demand for inventory.

#### **2.1.5 Inflation**

Gold has a function of building against “inflation. Gold hedging function in inflation is expected or has occurred when investors reflect” on “a lot of investment funds from the bond stock market into the gold market, leading to gold” price rises. The reason gold and its derivatives is used as a hedge to inflation is that its price moves in opposite direction of the value of the dollar. Therefore, if inflation “reduces the value of the dollar, the price of gold” rises. “The important factor effecting the price of gold is the real interest rate. The real interest rate is the nominal interest rate adjusted” for inflation. In periods “when real interest rates” are low, “people are more willing to hold gold”.

### **2.1.6 Global economic situation**

Economic development leads to increased need for global liquidity. Therefore, this increases the scale of investment in various derivatives, thus contributing to a rise in gold prices. During an economic crisis, global liquidity is reduced, but because “gold is a safe-haven in” a period of uncertainty, international gold prices will rise. In addition, global economic development will increase the residents of gold consumption and investment needs. China and India have a tradition of gold consumption, as the two countries try to accelerate development of their economies, the demand for gold also increases. Because gold's consumer demand “is relatively stable and” safe-haven demand tends to lead to overshoot of the gold price, the overall effect is that when GGP is less ‘than expected or’ is “significantly slower than the previous period, gold” prices “will form short-term support, and” vice versa.

### **2.1.7 Real interest rate**

When the economy is overheated or inflation is rising, many central banks will raise interest rates and tighten credit. After the overheated economy and rising inflation are effectively controlled, the country will lower the interest rate. “If the interest rate of a certain currency rises, then the interest income from holding such a currency will increase”, “attracting investors to buy the currency”, so that the currency” will be favourably supported. On the contrary, the return to holding the currency will be weakened if domestic interest rates fall. “The price of gold is affected by interest rates, but it is mostly effected the real interest rate. The real interest rate after deducting” “inflation is the opportunity cost of holding gold”. In times when the real interest rate is negative, people are more willing to hold gold.

## 2.2 History of Gold Mining Industry in Ghana

Gold trade in Ghana was first recorded in the thirteenth and fourteenth centuries, “when open cut gold mining and gold smithing were one of the main tasks in the Asante kingdom”. In between the fifteenth and the seventeenth century, the world’s most important gold producer was Gold Coast;. This brought about the name “guinea” for British gold coins (Von Gnielinski, 1986). About 40,000 workers were working in the Asante mines around the peak production in the 1700 (Asamoah, 1996). The “18th and 19th century travel reports point to the vast riches of the Asante kings, as well as the versatility of their goldsmiths”. The gold mining activities in the country were stopped because slave trade had begun and the traditional source of workers from Benin had dwindled. “Modern mining begun with the redetection of gold in 1878 at Tarkwa, and later on at Obuasi with the foundation of Ashanti Goldfields in (1897), Prestea and Dunkwa”.

To show the extend of mining and the exploration of the jewellery material Anyemedu, (1991) expands on the extent to which mining was organised in the seventeenth century, where 450 mining co-operations were founded. Three thousand five hundred (3500) licenses for exploration were issued together with the construction “of a railway line between Obuasi and Takoradi” harbour, to transport goods and services (Gnielinski, 1986).

A huge “number of companies had to close down or to merge, and the production” of gold continued to stay at about 200,000 ounces per annum till 1930. “It was only when the pound sterling value of gold was inflated in 1931 that dormant mines were reopened”. The gold production after that increased “to 818,000 ounces in 1940” (Agbodeka, 1992). Up “until independence in 1957, the mines were relying on cheap migrant labour from the North and as a result saw no need” to increase labour “productivity through education and training. The Technical

Training Institute at Tarkwa was established” in 1952 for traineeship training. After independence in 1962 this “Institute was changed to School of Mines”. The school was offering a “3-year diploma course in Mining Engineering”. Certain mining traineeship subjects were introduced in 1962 for mine mechanics. The School of Mines in 1962 “became part of the University of Science and Technology” and they offered “degree courses in mining engineering” (Agbodeka, 1992). The government in 1965 instituted the “State Gold Mining Corporation”.

“The company took over five mines that had been left behind by foreign mining corporations. The mines had hit poorer gold reefs, and the owners were not willing to invest in the production in new reefs” (Schmidt-Kallert, 1994). From that moment on, poor management, “lack of qualified and experienced staff along with rising production costs” and low productivity led to “in a continuous decline of output”.

“In 1972, the government took ownership in all natural resource-based industries in the country, in particular a 55 percent share in the country’s largest gold mine”, Asante Goldfields (Von Gnielinski, 2008).

The minority owner UK-based Lonrho, was left with Technical management. However, there was a decline in “gold production from 533,000 ounces in 1972 to 232,000 ounces in 1982” due to lack of foreign exchange for the purchase of equipment and supplies.(Winfred, 1996). The rehabilitation of the mining sector was one of the core actions “in Ghana’s reform program”. The government of Ghana in 1996 passed a new Minerals and Mining bill to restore current mines and also attract foreign investors. The definite measures included a new fiscal regime, the supply of “foreign exchange for the purchase of machinery and equipment”, and the creation of the “Minerals Commission. The World Bank furnished finance and consulting assistance for the”

restoration of “the State Mining Corporation and for the upgrading and expansion of Ashanti Goldfields “(Anyenedu, 1991). The first foreign members, “Southern Cross, came in 1988”, after which “Teberebie and Bogosu in 1991, Gold” Fields Ghana in 1993 (Anyenedu, 1991), “and Barnex and Dunkwa in 1995” Ghana Chamber of Mines, (1996) also followed. Since then, gold production has soared.

### **2.3 Gold Marketing in Ghana**

“In an effort to create avenues for small-scale miners to sell” their products, “the Precious Minerals Marketing Corporation (PMMC) was established. Although vestiges of the organization go as far back as 1963, when the Diamond Marketing Corporation was established and shortly after incorporated by Legislative Instrument (LI) No. 401 of 1965 as a state corporation, the Precious Minerals Marketing Corporation Law (PNDC Law 219) of 1989 officially established the PMMC. The law granted the organization authority to buy and sell gold in addition to diamonds. Its mission is to buy from small-scale miners, and to sell precious minerals profitably in order to enhance foreign-exchange earnings from the sector. The corporation has some 750 licensed buying agents and subagents who travel” around the country, purchasing “gold from artisanal miners and then sell it back to the corporation; only” bars are procured by the Corporation. “This mandates that all customers get a whiff of gold in the form of fine powder before offering it for sale” (UN, 1996). The PMMC carries out a number of other business including the following in addition to Buying and selling: “The grading, assaying, valuing and processing of precious minerals, the appointing of licensed buying agents for the purchase of precious minerals produced by small-scale miners; and promotion of the development of precious minerals and jewelry industries in Ghana”.

## **2.4 Relationship between Macroeconomic Variables and Gold Prices.**

Weng et al., 2011 studied the short-run and the long-run correlation between Consumer Price Index “and the Prices of Gold in the United States and Japan”. The study used data from 1971 to 2010. The study adopted the time series approach, and found “that if there is a long run relationship between the Prices of Gold and inflation in United States and Japan”, then it can be said “that gold is a hedge against Inflation”. Selection of time and the selection of the market was stated in their study as “important keys of inflation hedge”. The study concluded “that gold is not an inflation hedge in” Japan’s case while in the case of United States “it is a good hedge against inflation”.

In a study by Levin and Wright (2006), “they studied the long and short run determinants of prices of gold. The study used gold lease rate, exchange rate, inflation, political risk and credit risk default” as independent variables. The study made use of data spanning from 1976 to 2005. The study found a “long run relationship between Inflation (CPI) and prices of Gold in the United States. This means that gold can be used to hedge inflation. The study further found a statistically significant relationship between United States Dollar exchange rate and the prices of gold”.

In studies by Dupuis et al., (2006) studied on the “anticipation of investors behaviour and intentions in near future for gold investment by considering the variables that influences gold prices like the United States dollar, consumer demand, inflation and production of gold”. It was realised that “gold and United States dollar has strong negative correlation”. When “US dollar appreciates, the prices of gold declines. Di Bartolomeo (1993) studied whether gold price dominates gold related equity securities i.e common stock in gold mining companies”. CAPEM model, “descriptive methodology, and linear regression models were used”. It was found in his

study that equities in “gold mining do not rely on the prices of gold”. But rather on “expectations of inflation, level of international economic and political instability”.

Gunes et al., (2010) made “an analysis of the impact of interest rate”, prices of oil and the Euro dollar “exchange rate on the gold price rises”. The “study made use of data” from 2000 to 2009 “to analyse the relationship among variables”. Ordinary Least Squares and the cointegration approach were used as the analytical techniques in this particular study. “Findings from the study indicates that there is a positive relationship between the prices of oil”, Euro-Dollar parity and the prices of gold. The study further “found a negative relationship between gold prices and rate of interest”. Thus when “interest rate declines, people reduces money” deposited in the bank and resort to investment in gold.

Sjaastad in 2004 studied on the “empirical relationship between gold price and major exchange rates”. Inflation and exchange rates were the two variables “used as explanatory variables. The study adopted the daily and monthly data from 1991 to 2004”. The Ordinary Least Squares approach and the market efficiency tests were used to analyse the data gathered for the study to ascertain the correlation among variables. “The study found that there is a negative significant relationship between exchange rate and prices of gold”.

Bapna et al., (2012), asserted that gold demand is sensitive and related with macroeconomic conditions in the world. The prices of gold is difficult to predict, anticipate and explain. The study looked at the impact of “Gross Domestic Product (GDP), Exchange rate”, Growth rate, interest rate and inflation on the prices of gold. The study employed the “unit root test, regression analysis method and the granger causality test” to make analysis of the data. The trend analysis was also used to analyse the trends among the macroeconomic variables. Data was collected from 2002 to

2011, which is a 10 year period span on quarterly basis. The study discovered that “fiscal deficit, exchange and forex reserve inflation rate” independently influences gold price on a large scale. On the other hand “GDP, BSE Sensex and the the NSE index” have a very low impact indepently on the prices of gold. The findings further shows that gold prices does not cause and affect the rate of exchange, “BSE Sensex, NSE Index, forex reserves and fiscal deficit, but gold” prices does “affect the rate of interest and inflation and vice versa”.



## CHAPTER THREE

### METHODOLOGY

#### 3.1 Research Design

This research is designed to be a “quantitative research as it involves a systematic empirical inquiry into how macroeconomic factors” (independent variables) affect gold prices (dependent variable) “in Ghana, using mathematical and computational techniques”. The study though quantitative in nature will be “an explanatory research because it seeks to determine the effects of macroeconomic factors on” gold “prices in Ghana. The use of statistical data and mathematical techniques is essential because it is hoped that the findings yield an unbiased result that can be extrapolated to some extent. Hence, the process of measurement of the macroeconomic factors and the” gold prices is “vital since it provides the fundamental connection between the two variables”.

#### 3.2 Sample Size

This study which is an “empirical analysis of the effect of macroeconomic variables on gold” prices will be “carried out using quarterly data”. “The sample period span is from” 2009-2018 and the study is carried out using 40 quarterly observations (translating into 160 monthly observations). The study will be limited to this period as a result of the redenomination of the Ghanaian currency in 2008, as this will ensure consistency in measurement. The “macroeconomic variables to be considered include inflation rate, exchange rate, crude oil prices and interest are the” independent variables.

#### 3.3 Sources of Data

“Data for the study will be mainly obtained from secondary sources’. Available “monthly data series that were collected include inflation rate, exchange rate, crude oil prices and” interest. These

data “will be collected from secondary sources such as the Ghana Stock Exchange, the Ghana Statistical Service, the Bank of Ghana” and World Bank websites.

The Cedi –US “dollar exchange rate and interest rate will be obtained from Bank of Ghana. Inflation rates” will be also “obtained from the Ghana Statistical Services. Data on the crude oil prices” will be collected from the World Bank Indicators website. Quaterly data will be used for “consistency and a more credible result”, as Quaterly data to be collected will “provide enough data points over the stipulated period”.

### **3.4 Variable Selection and Description**

The aim of this research is to outline “the effects of macroeconomic variables on gold prices in the” Ghanaian economy. Four of the selected “macroeconomic variables used in this study have” been identified from various literature to pose an effect to “gold prices and are correlated with each other. A brief description of the variables is presented” in the subsections below.

#### **3.4.1 Exchange Rate (EXR)**

“This is the price of a currency in terms of other currency”. The “US dollar is the most traded currency in Ghana, hence its inclusion in the macroeconomic variables in this study. The dollar to cedi exchange rate is very important as it determines the cost of imports and exports as well as other foreign transactions in the country”. In “this study, we use the Ghana cedi expressed in terms of the US dollar (that is, cedi-dollar exchange rate). Since Ghana is not in autarky, changes in the exchange rate affect the import demand, competitiveness and profitability of companies via changes in cost of production as well as changes in expected cash flow. Where the economy is import-driven, a depreciation of the Ghana cedi increases cost of production which depresses future cash flows and profits”.

### **3.4.2 Interest Rate (INTR)**

“Interest rates in a country tend to influence domestic economic activities. In that, low interest rates encourage capital expenditures by individuals and businesses because their cost of borrowing will be low. These expenditures often improve the economy in a country through increased employment, increased production and trade”. The “91-day Treasury Bill will be used as a proxy for the interest rates in Ghana since Treasury Bill serves as the opportunity cost of holding shares” or money. “High interest rate makes cost of borrowing high hence negatively impacting on economic activity. Increases in the cost of loans of listed companies resulting from high lending rates undoubtedly put a depressing effect on corporate profit and dividends. Thus, increases in interest rates have indirect impact on” gold prices.

### **3.4.3 Inflation rate (INFL)**

“Inflation measures the rise in price of goods and services. Hence, a higher inflation rate reduces the purchasing power of each unit of currency”. Increases in “inflation increase the cost of living thus channeling scarce resources meant for investment to consumption. This decreases the demand for investment and” possibly gold prices.

### **3.4.4 Crude Oil Prices**

Ghana imports most of the crude oil that is consumed in the country even though crude oil is produced in the country to some extent. Hence it is significant to “include crude oil prices in the study”. This is because the world oil prices have an effect on “industrial production and profitability”. The crude oil is considered to be a factor for inflation. As crude oil prices increase, the economy will always falls into a trough which leads to an “upward pressure on inflation”.

People then tend to invest in gold as means “to hedge against inflation”. It can therefore be inferred that there exists “a relationship between gold and crude oil prices”.

### 3.5 Data Analysis Methods and Techniques

The “quantitative data will be analyzed based on a time series model to identify the relationship that exists between macroeconomic factors and gold prices”. In analyzing the data obtained three techniques will be used including Stationarity analysis, unit root analysis and the long-run and short-run analysis.

### 3.6 Estimation Model

To be able to arrive at “the effect of effect of macroeconomic variables on gold prices, the study “specifies the following models:

$$GPR = f(EXR, CROP, INF, INT) \dots\dots\dots (1)$$

Where: GPR represents Gold Prices; EXR stands US dollar to Ghana Cedi exchange rate; CROP represents Crude Oil Price, INF stands for Inflation, and finally INT stand for Interest Rate.

The model that will be estimated explicitly is:

$$GPR_t = \alpha_0 + \alpha_1 EXR_t + \alpha_2 CRO_{it} + \alpha_3 INF_t + \alpha_4 INT_t + u_t \dots\dots\dots (2)$$

Where  $\alpha_0, \alpha_1, \alpha_2, \alpha_3,$  and  $\alpha_4$  are the parameter estimates,  $\mu_i$  is the stochastic error term, t is the sample period.

### 3.7 Estimation Strategy

#### 3.7.1 Unit Root Test (Stationarity Test)

“In the use of time series, most macroeconomic variables are likely to be non-stationary and as a result, regression with non-stationary series is likely to generate” spurious “regression not suitable for making correct inferences”. “The study tested for stationarity using the Augmented Dickey Fuller (ADF) tests for unit root”.

“ADF test is run with or without a trend at both levels and first difference”. The ADF test can be expressed as below;

$$\Delta y_t = \alpha_0 + \alpha_1 t + \delta y_{t-1} + \sum_{i=1}^m a_i \Delta_{t-1} + v_t \dots \dots \dots (3)$$

“where;  $y$  is a vector of time series variables under consideration in the regression,  $t$  denotes time trend,  $v$  denotes the” stochastic term,  $m$  denotes the optimal lag length,  $\Delta$  denotes first difference operator, “The test is conducted with a null hypothesis of  $H_0: \delta = 0$  as against an alternative hypothesis that  $H_1: \delta < 0$ . The null hypothesis here again, states there is presence of unit root in the series whiles the alternative hypothesis states there is no unit root in the series”. To determine the optimal lag “length, possible models are estimated” using information criteria and making sure “there is no serial correlation”.

#### 3.7.2 Co-integration Test

After performing the unit root tests for stationarity, “co-integration analysis is also employed to determine the long run relationship of the variables” in the model. “Two or more series are said to be co-integrated”, if they exhibit a well-established “long run relationship or a common trend”. Hence when two or more series are not co-integrated, there would be spurious regression problems

with almost meaningless analysis to be made. However, “if a long run relationship exists between two variables and the variables” are rising as a result of them being trended, there would always be a common trend that would link them together. “A co-integration test is best carried out for series after testing for stationarity to determine the long run relationship among the variables” in the model. The study tests for co-integration using the Johansen method.

### 3.7.3 Long Run and Short Run Effect

The study also formulated a long-run model to test for the long-run effects between the explanatory variables and the dependent variable and as well to analyse the short-run effects. The long-run model is specified below:

$$\ln GPR_t = C' + \sum_{i=1}^a \lambda'_i \ln DEXR_{t-i} + \sum_{j=1}^b \mu'_j \ln DCRO_{t-j} + \sum_{k=1}^c \pi'_k \ln DINF_{t-k} + \sum_{m=1}^e \rho'_m \ln DINT_{t-m} + \varepsilon_t \dots\dots\dots (4)$$

The study also used the ECM model specified below to explain the short-run relationships.

$$D \ln GPR_t = C'' + \sum_{i=1}^a \lambda''_i D \ln DEXR_{t-i} + \sum_{j=1}^b \mu''_j D \ln DCRO_{t-j} + \sum_{k=1}^c \pi''_k D \ln DINF_{t-k} + \sum_{m=1}^e \rho''_m \ln DINT_{t-m} + \varphi ECM_{t-1} + \varepsilon_t \dots\dots\dots (5)$$

With all the parameters already explained, the short-run ECM model distinguished itself from the long-run model by regressing the variables at their first difference. Where the parameter  $\varphi$  “measures the adjustment speed” towards equilibrium “in the long-run, the” term  $ECM_{t-1}$  denotes

short-run disequilibrium adjustments of long-run error term estimates as argued by Twumasi (2012) citing Banerjee et al. (1993).



## CHAPTER FOUR

### DATA PRESENTATION, ANALYSIS AND DISCUSSION

#### 4.1 Introduction

This section looks at the data presentation, analysis and discussion. It is made up of the descriptive statistics of variables, stationarity test of variables, “cointegration test, the long run and short run” analysis and the diagnostic test.

#### 4.2 Descriptive Statistics of Variables

The study conducted analysis on “the descriptive statistics of variables” under study, and the results are presented below; it is realised that Gold prices had a mean value of 1159.469, with a minimum value of 760.76 and a maximum of 1170.13. It also recorded a standard deviation of 292.137. It is also realised that Exchange rate received a mean value of 1.357 with a minimum of 0.975 and 1.551. It also recorded a standard deviation of 0.181. Crude oil prices also received a mean value of 87.998 “with a minimum value of 43.29 and a maximum value of” 134.79. It also recorded a standard deviation of 134.79. “Inflation on the other hand” recorded a mean value of 14.224 with a “minimum value of 8.72 and a maximum value of” 20. It also recorded a standard deviation of 3.9122 Interest rate realised a mean value of 16.551, “with a minimum value of 8.5 and a maximum value of” 27.8. It also recorded a standard deviation of 6.976.

Table 4.1: Descriptive Statistics Variables

Variable	Mean	St. Dev	Minimum	Maximum
GPR	1159.469	292.137	760.76	1170.13
EXR	1.357	0.181	0.975	1.551

CRO	87.988	24.392	43.29	134.79
INF	14.224	3.9122	8.72	20
INT	16.551	6.976	8.5	27.8

### 4.3 Stationarity Test of Variables

The Augmented Dickey-Fuller analysis test was used to conduct the stationarity test for the independent and the dependent variables used for the study. From the ADF results, the null hypothesis which indicates the “presence of unit root in the variables” used could not be rejected. This indicated “that the variables were non-stationary at” that level. The variables were first differenced and then the “null hypothesis of the unit root” was rejected at both “5% and 1% level of significance. It is concluded that all the variables” that were “used in the research study were integrated at first order” at first difference.

Table 4.2: Test Result of Augmented Dickey Fuller

<b>Variable</b>	<b>Constant only</b>	<b>Constant and Trend</b>
<i>lnNGPR</i>	0.061	-2.458
<i>lnEXR</i>	- 3.497*	-2.642
<i>LnCRO</i>	-1.014	-1.294
<i>lnINF</i>	-0.749	-2.206
<i>lnINT</i>	--0.292	-2.798
<b>lnNGPR</b>	<b>-6.261**</b>	<b>-6.345**</b>

lnEXR	-3.431*	-4.323*
LnCRO	-3.577*	-3.578*
lnINF	-12.326**	-12.725**
lnINT	-3.977**	-4.421**

*Output from Stata:13, \*\* and \* represents the rejection of null hypothesis at 1% and 5% levels of significance respectively.*

#### 4.4 Cointegration Test Results

“Given that the variables used in this research work were integrated of the same order, co-integration analysis were performed to estimate” whether there exist a long-run and “short-run “relationships amongst the variables. Co-integration analysis suggest that the linear combination of the variables should be stationary. Johansen maximum likelihood of co-integration was employed in this research study. Table 3 and Table 4 indicates the Trace Statistics and the” Maximum “Statistics of Johansen Co-integration test respectively”.

It is “realised that the null hypothesis of no” rank (rank zero) is rejected at 5 percent significant level both at the trace statistics and maximum statistics. This means that “there is the existence of cointegration among the variables” and hence “a long run equilibrium of the variables in the study” can be inferred.

Table 4.3: Johanson Cointegration Test Results

<b>Maximum Rank</b>	<b>Maximum statistics</b>	<b>5%CV</b>	<b>Trace statistics</b>	<b>5%CV</b>
0	36.4195	33.46	96.7738	68.52

1	26.2425	27.07	60.3543	47.21
2	18.8681	20.97	34.1118	29.68
3	11.8426	14.07	15.2437	15.41
4	3.4011	3.76	3.4011	3.76
5				

*Output from Stata:13*, \* represents the rejection of null hypothesis at 5% levels of significance respectively.

#### **4.5 Results and Analysis of Long Run Model**

The study conducted the long run estimates of the model since cointegration was established among the variables under study. The results for the long run estimates are presented in table 4.4.

From table 4.4 it is evident that “there is a negative effect of Exchange rate on Gold prices in the long run in” Ghana. The relationship is significant. The Coefficient of -0.9907 means that there is an inelastic response of Gold “prices to Exchange rate”. Thus there is less than proportionate response of Gold “prices to changes in Exchange rate”. Therefore all things being equal, a percentage increase in Exchanges to 0.9907 percent decreases in Gold prices. The possible “reason behind this is that as the exchange rate goes up, the domestic currency” depreciates. Therefore purchasing Gold for domestic consumption in terms of the “foreign currency will become more expensive”. “The study is consistent with the study” by Ndem et al., 2014, who “found a negative and significant” effect of exchange rate on gold prices. The study is also “consistent with the” study by Nurulhuda, 2014, who “also found a negative relationship between Exchange rate and Gold prices”.

“The results shows a negative effect of Crude oil on Gold prices”. The Coefficient of - 0.0029 simply means that there is an inelastic response of “Crude oil prices on Gold prices”. Thus there is a less than proportionate “response of Gold prices to changes in Crude oil prices”.

Inflation also shows a positive and insignificant effect on Gold prices. The Coefficient 0.0620 simply means that there is an inelastic response of Inflation on Gold prices. Thus there is a less response of Gold prices to changes in Inflation. Therefore “all other things being equal, a percentage increase in” Inflation leads to 0.0620 percent increases in Gold prices. This relationship is consistent with the study by Nurulhuda, 2014, who also found no “significant relationship between Exchange rate and Gold prices”. However this contradicts the studies by Warda et al., 2014 and Sindhu, 2013, “who found that there is a” significant effect on Gold prices.

Interest rate on the other hand also “has a positive and significant effect on Gold prices in the long run. The Coefficient of” 0.0025 means that there is an inelastic response of Interest rate on Gold prices. Thus there is a less response of Gold prices to changes in Interest rate. All other things being equal, a percentage increase in “Interest rate leads to” 0.0025 percent increases in Gold prices.

Table 4.4: Long run Results Coefficients

	<b>Coefficient</b>	<b>Std. Error</b>	<b>T</b>	<b><i>p</i> &gt; (<i>t</i>)</b>
<i>Constant</i>	0.0637	0.0138	4.61	0.000
<i>LnEXR</i>	-0.9907	0.2852	-3.47	0.002
<i>LnCRO</i>	-0.0029	0.0506	-0.06	0.954
<i>LnINF</i>	0.0620	0.0961	0.64	0.525
<i>LnINT</i>	0.0025	0.0500	0.05	0.959

*ARDL based on SBC*

---

\* and \*\* represents “the rejection of null hypothesis at 5% and 1% levels of significance respectively”.

**4.6 Results and Analysis of Short Run Model**

The study looked at the “short run dynamics among the variables” using the Error Correction of the ARDL approach. The R squared of 0.78102 means that the model explains up to 78.1% “of the variations in Gold prices”. “The coefficient of the error term is negative and significant” at one percent level. The statistical significance as well as the size of the coefficient with regards to the error term shows the extent at which the model has the tendency after a short run shock to return to the “long run equilibrium. The” results shows a high “speed of adjustment in the long equilibrium to short run shocks” every year. Thus the long run equilibrium adjusts by 243 percent after a short run shock every year. Table 4.5 presents the estimated short run results “based on the Error Correction Model”.

It is realised from the table that “Exchange rate in the short run also have a positive and insignificant relationship with” Gold prices. The coefficient value of 1.1493 signifies that there is an elastic responds of Gold prices to changes in Exchange rate.

It is realised that Crude oil prices and lagged period in the short-run have a positive significant effect on Gold prices. The coefficient of 0.2056 implies an inelastic “response of Gold prices to changes in crude oil prices”. The coefficient of 0.4103 and 0.2701 shows that there is an inelastic “response of Gold prices to changes in Crude oil prices in the short run”. The study found that a one percent increases in the current value of Crude oil prices leads to 0.2056 percent increases in Gold prices in the short run. The coefficients of 0.4103 and 0.2701 shows that a percentage

increases in the first two lags of Crude oil leads to 0.4103 and 0.201 respectively. However the lag 3 of “Crude oil has no significant effect on Gold prices”. This contradicts the study by Ndem et al., 2014, who “found a negative and significant effect of crude oil prices on gold prices”.

It is also evident from table 4.5 “that there is a negative and insignificant effect of” the current value of Inflation on Gold prices. Thus there is an inelastic “response of Gold prices to the” current value of Inflation. An increase in the current value of inflation, however leads to 0.0816 percent decrease in Gold prices in the short run. However the three immediate lagged values of Inflation have a positive and insignificant effect on Gold prices.

In the short run Interest rate is found to have a negative and insignificant effect on Gold prices. The coefficient of -0.0158 means that there is an inelastic “response of Gold prices to changes in” Interest rate. Thus a one percent change in Interest rate leads to 0.0158 percent decreases in Gold prices.

Table 4.5: Short run Results Coefficients

	<b>Coefficient</b>	<b>Std. Error</b>	<b>T</b>	<b><i>p</i> &gt; (<i>t</i>)</b>
$\Delta \ln EXR$	1.1493	0.8507	1.35	0.189
$\Delta \ln CRO$	0.2056	0.1053	1.95	0.063
$\Delta \ln CRO_{-1}$	0.4103	0.1116	3.68	0.001
$\Delta \ln CRO_{-2}$	0.2701	0.1141	2.37	0.026
$\Delta \ln CRO_{-3}$	0.0349	0.0905	0.38	0.705
$\Delta \ln INF$	-0.0732	0.2254	-0.32	0.748
$\Delta \ln INF_{-1}$	0.0816	0.2103	0.39	0.701
$\Delta \ln INF_{-2}$	0.2234	0.1880	1.19	0.246

$\Delta \ln INF_{-3}$	0.1487	0.0930	1.60	0.123
$\Delta \ln INT_{-1}$	-0.0158	0.9256	-0.17	0.865
$ECM(-1)$	-2.4385	0.4128	-5.91	0.000
<b><i>R-Squared</i></b>	<b>0.78102</b>			

***ARDL based of SBC***

\* and \*\* represents the rejection of null hypothesis at 5% and 1% levels of significance respectively.

#### **4.7 Diagnostic and Stability Test**

From table 4.7 it is evident that the probability value of test on heteroskedasticity is 3.436, which implies the non-rejection of the null hypothesis that there is no heteroskedasticity. Hence a heteroskedasticity is not a problem in this model.

The study performed a normality test to also ascertain the normal distribution of variables under study. Thus the study employed the “Jarque-Bera Normality Test. The results show a Jarque-Bera normality test” results of -1.830 with a probability of 0.410. This simply means “that the null hypothesis that the data is not normally distributed is rejected” and hence a conclusion “that the data is normally distributed”.

Finally it is evident in the Breusch-Godfrey test that the computed F-Statistics of 0.014 is insignificant since it has a probability value of 0.907. This simply “means that there is no existence of Autocorrelation in the model”. Thus there is a constant variance of the residuals.

Table 4.6: Diagnostic and Stability Test

		<b>F-Statistics</b>	<b>Probability</b>
<b>Heteroskedasticity</b>	Breusch-Pagan-Godfrey	3.436	0.064
<b>Normality Test</b>	Jarque-Bera Normality Test	-1.830	0.410
<b>Autocorrelation</b>	Breusch-Godfrey LM-Test	0.014	0.907

---

*Output from Stata: 13*



## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

This section presents the “summary, conclusions and recommendations for the study”.

#### 5.2 Summary

The study was conducted on “the effect of macroeconomic”c variables on gold prices in Ghana. The study specifically looked at the impact of “exchange rate on gold prices, impact of crude oil prices on” gold prices, “impact of interest rate on the gold price, impact of inflation on the gold prices”. The study made use “of the time series approach, using the Augmented Dickey Fuller” test of cointegration, Johanson cointegration test, and the “Auto Regressive Distributed Lag model for the long and the short-run relationships”. The study sought to investigate the effect of Macroeconomic variables on Gold prices in Ghana. The researcher used the time series analysis approach in analysing the data. The key findings are presented below;

The study performed a test of stationarity among variables using the ADF test and the “results indicated that all the variables are integrated of order one”, that is  $I(1)$ . This resulted into the use of “Johnson Cointegration, and the results showed the existence of” cointegration and hence the use of the “Autoregressive Distributed Lag Model” in investigating the long and short run relationships of the independent variables on economic growth. The Cointegration test results from the Johanson cointegration analysis indicated the null hypothesis (rank 0) of no rank is “rejected at 1 percent significant level” both at the trace statistics and maximum statistics, therefore “existence of cointegration among the variables and hence a long run equilibrium among the variables in the study”.

The study has shown that Exchange rate (EXR) significantly affect Gold prices negatively in the long run. Crude oil prices also negatively and insignificantly affected Gold prices in the long run. The study also revealed that inflation has no effects on Gold prices in the long run. However there is a positive and “insignificant relationship between Interest rate and Gold prices in the long run”. The study has revealed that Exchange rate in the short run insignificantly and positively affects Gold prices. The current value of Crude oil prices “was found to affect Gold prices positively in the” short-run. The two immediate lagged values of Crude oil prices was also “found to have a positive and significant effect on Gold prices in the short run”. The third “lagged value of Crude oil prices has no significant effect on” Gold prices in the short run. The current inflation negatively and insignificantly affected Gold prices. The three immediate lagged values of inflation did not significantly affect “Gold prices in the short run”. The error term of the error correction model has also shown the tendency of the economy to automatically adjust “to equilibrium in the long run” with regards to occurrence of “short run shocks”.

### **5.3 Conclusions**

The study has shown that Exchange rate significantly “affect Gold prices in the long run”. Crude oil prices, Inflation and Interest rate did not significantly affect economic growth in the long run. The also concludes that Crude oil prices and its immediate two lagged values in the short run significantly and positively affects Gold prices. Exchange rate, the third lagged value of Crude oil prices, Inflation and its three lagged values, “and interest rate did not significantly affect Gold prices in the short run”. The model has a the tendency of the economy to automatically adjust “to equilibrium in the long run” with regards to occurrence of “short run shocks”.

#### 5.4 Recommendations

Since the study found a “negative relationship between” Exchange rate “and Gold prices in the long run”, it is recommended that the government of Ghana should take advantage of the outcome so as to fix and fight the black market and control the inflationary rate in the economy.

“It is also recommended that investors of gold take advantage of the” results from the study to “their investment strategies by considering both the external environment and as well the internal environment of the” country. There is a situation that shows that when the rate of interest rises it likely to results to a rebound in real prices of gold. It is also noted that investors who hold long positions in commodities have that expectations for improvement in inflation and exchange rate. The results from the study will guide investors of gold in Ghana to consider more on the variables that influences gold prices, especially changes in exchange rate as was “found to be statistically significant in the long run”.

The study also highlighted the effect of “some selected macro-economic variables” on Gold prices in Ghana, future studies could incorporate some other variables that are related to the macroeconomic “factors that affect Gold prices such as Stock index and Growth rate”. This will give Gold investors the ability to forecast gold prices and earnings in the future.

## REFERENCES

- Adam, A. M., & Tweneboah, G. (2008). Macroeconomic factors and stock market movement: Evidence from Ghana. *Available at SSRN 1289842*.
- Adu-Boahen, K. (2012). The impact of European presence on slavery in the sixteenth to eighteenth-century Gold Coast. *Transactions of the Historical Society of Ghana*, (14), 165-199.
- Agbodeka, F. (1992). *economic history of Ghana from the earliest times*. Ghana Universities Press.
- Anyemedu, K. (1991). Export diversification under the economic recovery program. *Ghana: The political economy of recovery*, 209-220.
- Asamoah, A. (1996). *Socio-economic development strategies of independent African countries: the Ghanaian experience*. Ghana Universities Press.
- Banerjee, A., Dolado, J. J., Galbraith, J. W., & Hendry, D. (1993). Co-integration, error correction, and the econometric analysis of non-stationary data. *OUP Catalogue*.
- Bapna, I., Sood, V., Totala, N. K., & Saluja, H. S. (2012). Dynamics of macroeconomic variables affecting price innovation in gold: a relationship analysis. *Pacific Business Review International*, 5(1), 1-10.
- Bermúdez-Lugo, O. (2006). The mineral industries of The Gambia, Guinea-Bissau, and Senegal. *US Geological Survey. Minerals Yearbook*. U.S.
- Di Bartolomeo, C., Barker, P., Petty, M. C., Adams, P., & Monkman, A. P. (1993). A photolithographic technique for patterning spin-coated polyaniline films. *Advanced Materials for Optics and Electronics*, 2(5), 233-236.

Effect of Macroeconomic Variables on Stock Market Returns Ghana: An Analysis Using

Arbitrage Pricing Model. Institute of Distance Learning, Kwame Nkrumah University of Science and Technology, Kumasi.

Fu, F., & Wang, Q. (2011). Removal of heavy metal ions from wastewaters: a review. *Journal of environmental management*, 92(3), 407-418.

Hashim, S. L., Ramlan, H., Razali, N. H., & Nordin, N. Z. (2017). Macroeconomic Variables Affecting the Volatility of Gold Price. *Journal of Global Business and Social Entrepreneurship (GBSE)*, 3(5), 97-106.

Joseph, T., Nyarko, Y., & Wang, S. Y. (2018). Asymmetric information and remittances: evidence from matched administrative data. *American Economic Journal: Applied Economics*, 10(2), 58-100.

Katarzyna M. (2015). Long-term determinants of the price of gold. *Uniwersytetu Ekonomicznego w Katowicach* No. 252.

Lampert, W., & Sommer, U. (1996). *Ekologia wod srodladowych*. Wydawnictwo Naukowe PWN.

Le, T. H., and Chang, Y. (2011). Oil and Gold: Correlation or Causation? Depocen Working Paper Series No. 2011 (22), MPRA Paper No. 31795 .

Levin, E., & Wright, R. (2006). Short-run and Long-run Determinants of the Price of Gold. World Gold Council, Research Study No. 32.

Lucey, B. M. (2011). What do academics think they know about gold. *The Alchemist*, 62, 12-14.

Mamcarz, K. (2015). Long-term determinants of the price of gold. *Studia Ekonomiczne*, (252), 80-94.

- Nadeem, T., Dashtinezhad, S., Liao, C., & Iftode, L. (2004). TrafficView: traffic data dissemination using car-to-car communication. *ACM SIGMOBILE Mobile Computing and Communications Review*, 8(3), 6-19.
- Nadeem, W., Zakaria M., Kayani F.N., (2014). Impact of Macroeconomic Factors upon Gold Prices in Pakistan. *Pakistan Journal of Social Sciences (PJSS)* Vol. 34, No. 1, pp. 383-395.
- Nadeem, W., Zakaria, M., & Kayani, F. (2014). Impact of Macroeconomic Factors upon Gold Prices in Pakistan. *Pakistan Journal of Social Sciences (PJSS)* Vol, 34, 383-395.
- SCHMIDT-KALLERT, E. (1994). Ghana, Perthes Länderprofile, Geographische Strukturen, Entwicklungen, Probleme.
- Shukri, W. N. W., Bidin, N., Affandi, S., & Bohari, S. P. (2015). SYNTHESIZE OF GOLD NANOPARTICLES WITH 532 NM AND 1064 NM PULSE LASER ABLATION. *Jurnal Teknologi*, 78(3).Adu, D. A. (2012).
- Sjaastad, O., & Bakketeig, L. S. (2004). Caffeine-withdrawal headache. The Vågå study of headache epidemiology. *Cephalalgia*, 24(4), 241-249.
- Tran, K., & Starr, M. (2007). *Monetary Policy in Vietnam: An SVAR Analysis of the Role of Gold*. Working Paper (Americian University).
- Tully E., Lucey B.M. (2007). A power GARCH examination of the gold market, *Research in International Business and Finance*, 21 (2007), pp. 316–325.
- Twumasi, R. A. (2012). *The impact of fiscal policy on economic growth in Ghana* (Doctoral dissertation).
- Von Gnielinski, S. (1986). *Ghana: tropisches Entwicklungsland an der Oberguineaküste*. Wissenschaftliche Buchgesellschaft.

Wang, K. M., Lee, Y. M., & Thi, T. B. N. (2011). Time and place where gold acts as an inflation hedge: An application of long-run and short-run threshold model. *Economic Modelling*, 28(3), 806-819.

