Analysis of spillover effects amongst gold prices, stock prices and foreign exchange market in case of Pakistan

Submitted by

Waqar ali.

Supervised by

Dr. Saud Ahmed Khan.

Pakistan Institute of Development Economics (PIDE)

Analysis of spillover effects amongst gold prices, stock prices and foreign exchange market in case of Pakistan

Supervised by:

Dr. Saud Ahmed

Submitted by:

Waqar Ali

Department of Business Studies

Pakistan Institute of Development Economics, Islamabad.

2019

Analysis of spillover effects amongst gold prices, stock prices and foreign exchange market in case of Pakistan

A Thesis presented to

Pakistan Institute of Development Economics, Islamabad

In fulfillment of the requirement for the degree of

Masters

in

Business Administration

(1.5 years)

Waqar Ali

PIDE2017FMBA(1.5)12

Final Approval

This Thesis Titled

Analysis of spillover effects amongst gold prices, stock prices and foreign exchange market in case of Pakistan

By

Waqar Ali

Has been approved

For the Pakistan Institute of Development Economics, Islamabad

External Examiner: _____

Supervisor: _____

Dr. Saud Ahmed

Assistant Professor,

PIDE, Islamabad.

Head of Department: _____

Dr. Nadeem Ahmed Khan

Head, Department of Business Studies,

PIDE, Islamabad.

Certificate:

It is certify that Mr. Waqar Ali has carried out all the work related to this thesis under my supervision at the department of Business Studies,

Pakistan Institute of Development Economics, Islamabad.

Supervisor:

Dr. Saud Ahmed

Assistant Professor,

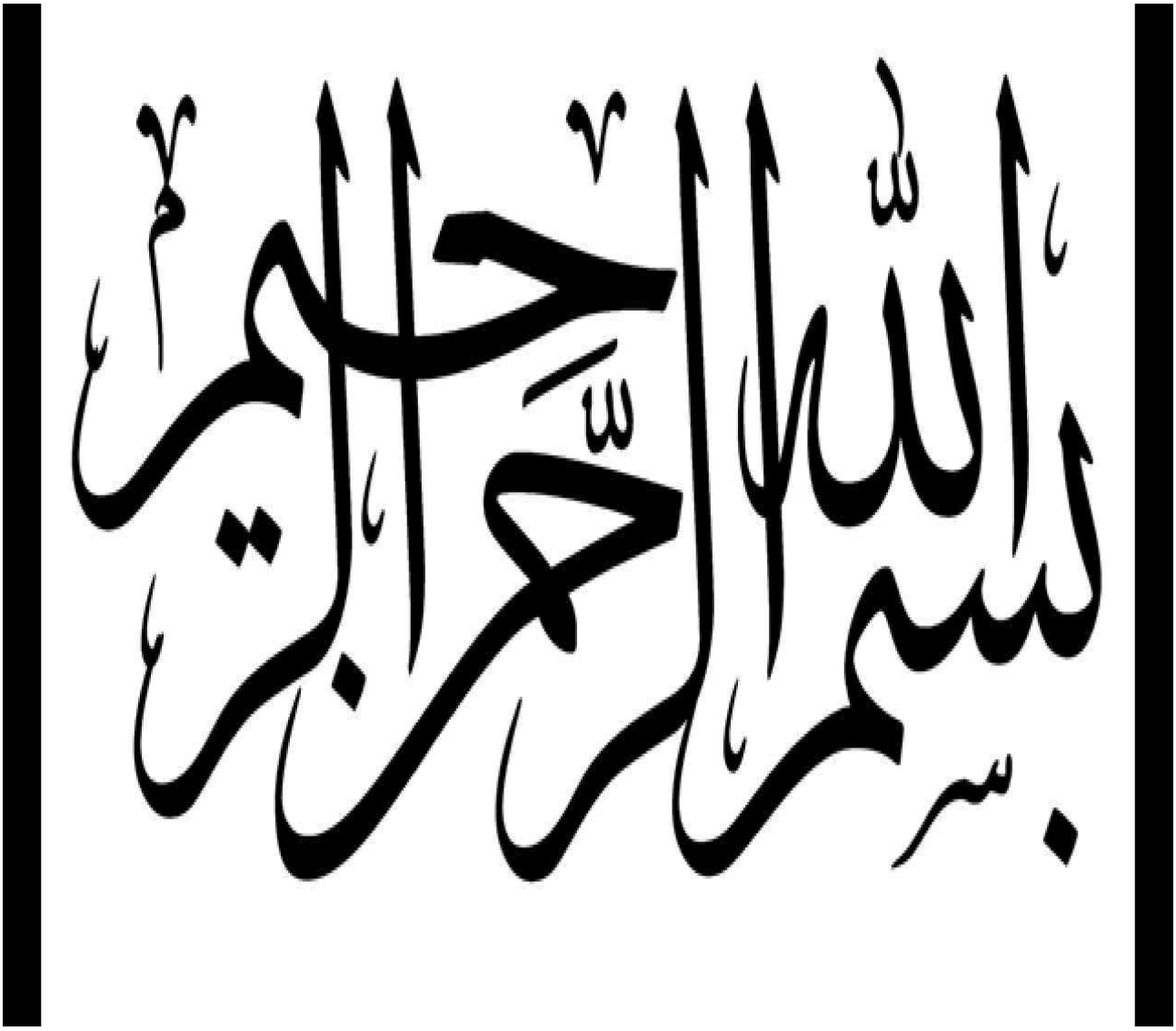
PIDE, Islamabad.

Submitted through:

Dr. Nadeem Ahmed Khan,

Head, Department of Business Studies

PIDE, Islamabad.


بسم الله الرحمن الرحيم

DECLARATION

I **Waqar ali** solemnly declare that this thesis entitled **"Spill-over effect among Gold market, Stock market and Forex market in case of Pakistan"** submitted by me for the partial fulfillment of Master of Business Administration is my own hard work under the full supervision of my respected supervisor. Furthermore, this thesis has not been submitted simultaneously to any other university for any other degree.

Waqar ali

DEDICATION

This humble effort is dedicated to my loving parents, who brought me here where I am today. Their love, affection, devotion, prayers, moral and financial support especially when I was facing the ups and downs of my life, energize me to do something extraordinary.

ACKNOWLEDGEMENTS

Everything in the world stats with the name of ALLAH Almighty all praises for Him, whatever I am today and what I will be in future is all due to His blessings on me. I thank ALLAH for the strength and guidance that helped me to complete the thesis

I thank all my teachers, parents, siblings, cousins, class fellows, university fellows and staff at PIDE who helped me and supported me. I was a raw person before this thesis, never had done research. It was the kind generosity and hard work of my supervisor Sir Suad Ahmed Khan that made me a researcher. Any question that I had in mind, I asked Dr. Suad Ahmed Khan and he readily gave me answers and gives a lot of time. I am very thank full to my supervisor without them it is impossible to complete my research.

My class fellows and university fellows were a great help. They never let me down and whenever I felt down they pushed me to raise myself. I specifically thanks to all friends Sayed Arif Halil, Tariq Jan, Irfan Iqbal, Adil khan and Ijaz Uddin khan give me the confidence and strength to achieve my goals. I thank to Rizwan Ahmed and Numan Ahmed P.H.D students who can help me in my research.

The care, the affection and support that family provides plays a vital role. I am honored to have such parents who always supported my education both financially and morally. I also thank my cousins Izhar Shah and Ayaz khan, who always asked me about the progress in my thesis and prayed for it completion.

Waqar Ali

ABSTRACT

The objective of my study is to investigate the mean, volatility and cross spillover effect amongst Gold market, Stock market and Forex market in case of Pakistan. For this study we can use the daily data from the period of Jan, 1, 2014 to Oct, 15, 2018. The data is taken from Business recorder. The variables used in this study are gold price, stock price and US dollar exchange rate. Using ADF augmented dickey fuller test for stationary, normality test, serial correlation test and GARCH (1,1) for the estimation of volatility spill-over effect between these selected markets. The results indicates that Mean spillover effect between gold market and stock market and the effet is un-directional and there is a Volatility spillover effect between these two markets and the effect is bi-directional and also cross volatility spillover effect between gold market and stock market. In case of gold market and forex market no Mean spillover effect is there. There is a Volatility spillover effect between stock market and gold market and also bi-directional cross volatility spillover effect between these two markets. In case of stock market and forex market the result shows that there is no Mean spillover effect and there is a volatility spillover effect between stock market and forex market. Cross volatility spillover effect is there and the effect is effect is bi-directional.

Table of Contents

Aknowleddgements.....iii

ABSTRACT.....iv

CHAPTER 1 ..... **1-6**

1.1 Back ground of the study 1

1.2 Research question 5

1.3 Contribution and research gap 5

1.4 Objective of the study 5

1.5 Significant of the study 5

CHAPTER 2 ..... **7-17**

2.1 Introduction 7

2.2 Empirical literatures 7

CHAPTER 3 ..... **18-23**

3.1 Econometric Methodolgy and Model Specification 18

3.2 Data 19

3.3 Augmented Dickey Fuller for Stationary 19

3.4 Return series 20

3.5 ARCH (q) Model 20

3.6 GARCH (1,1) Model 21

3.7 GARCH (p,q) Model 22

CHAPTER 4 ..... **24-49**

4.1 Result and discussion 24

4.2 ADF test result for stationary 24

4.3 Descriptive statistics 27

4.4 Test for serial correlation 28

4.5 Test for LM ARCH effect 30

4.6 Modeling for spill-over effects using GARCH (1,1) Model 31

CHAPTER 5 ..... **50-53**

5.1 Conclusion 50

5.2 Key finding 50
References .....
List of Tables .....
4.1 ADF Test for stationary at level 24
4.2 ADF Test for ststionary at first difference 25
4.3 Descriptive statistics of return series 27
4.4 Test for serial correlation (Gold) 28
4.5 Test for serial correlation (Stock) 29
4.6 Test for serial correlation (USD) 29
4.7 The empirical test for the presence by return of ARCH effect 30
4.8 Return of gold modeled by return from gold 32
4.9 Return of stock modeled by return from stock 33
4.10 Volatility in the gold modeled by volatility in stock 34
4.11 Volatility in the stock modeled by volatility in gold 35
4.12 Measuring the return of gold modeled by volatility in the stock 36
4.13 Return of stock modeled by the volatility in the gold 37
4.14 Return of gold modeled by return from USD 38
4.15 Return of USD modeled by return from gold 39
4.16 Volatility in the gold modeleld by volatility in the USD 40
4.17 Volatilty in the USD modeled by volatility in the gold 41
4.18 Return of gold modeled by the volatility in the USD 42
4.19 Return of USD modeled by volatility in the gold 43
4.20 Return of stock modeled by return from USD 44
4.21 Return of USD modeled by retun from stock 45
4.22 Volatility in the stock modeled by volatility in the USD 46
4.23 Volatility in the USD modeled by volatility in the stock 47
4.24 Return of stock modeled by volatility in the USD 48
4.25 Return of USD modeled by the volatility in stock 49

Chapter 1

Introduction

1.1 Background of study

Exploring co-movement means to analyze whether the return and/or volatility of one series affects the return and/or Volatility of other series. More technically it checks whether change in first two moments of one Series has effects on the first two moments of other series. Conventional market players and Portfolio managers are interested to explore co-movements of individual firms with in the Market; it may help to specify the optimal portfolio. Exploring the direction of information Transmission is pre-requisite in portfolio diversification technique Edirengton (1979).

Engle et al (1990) present two hypotheses about volatility spillover effect. One of which is the Heat Wave hypothesis; it says that the volatility has only country specific autocorrelation. The other hypothesis is called Meteor Shower hypothesis according to which the volatility spillovers across markets. The object of the study is to trace the path of information transmission among individual firms and utilize this information to propose optimal against market risk.

Volatility is a condition where the conditional variance changes between particularly low and high values. In the financial market, expressive that how much one variable will change in respond to a change in some other variable is helpful. This study analyzes the volatility movement relation with gold price and US dollar exchange rate. The U.S. dollar stock market is the finest important market in the world. From the history, gold and silver were used as currencies in the past. . In early 70,s some foreign banks use US dollar as a reserve because most of the countries uses US dollar for trade purpose. Most of the banks uses gold as a reserve same

like some banks uses US dollars for reserve. They spent more in gold to reserve their asset during the unstable economic conditions. Gold is known as a hedge against variations in the U.S. Dollar market. In the past, when the USD dollar falls down, the gold prices became constant. When decreased in the U.S. dollar, thus the investors would buy more gold to secure their money. While increased in the U.S. dollar, so the investors would invest in U.S. dollar and disregard gold. Hence, there is a negative link between U.S. dollar and gold price.

Gold is a subtle metal used as money. The gold standard was used since 19,s. In 19th century currency value is fixed according to the gold value that is reserve in in central bank or state bank. Price of Gold and American dollar were linked and valued based on supply and demand. Gold is used to measure and minimize the risk of inflation. If the gold price changes that is effected by different factors in which U.S dollar index is one of them. In the literature, gold was informed to be correlated with many assets especially with U.S. dollar. Gold prices and dollar price are negatively correlated with each when gold prices increase automatically Dollar price decrease. Both of them are strongly correlated. Investors can prefer the gold as compared with the foreign currency. The forecasting of gold prices is important for financial market. Prices of gold change quickly from period to period. They are not constant. (pingel et al. 2016).

There is an inverse relationship with Dollar price and gold value while gold is a supreme metal that express the relation with currency market value. Dollar is money that is used for international trade most of world countries done their payment transaction or export import transaction in Dollar because dollar is used as international currency. Recently PAK china trade agreement done by using local currency that is better for both countries economy. Basically the purpose of relation between gold value and dollar value that have inverse relation with each other but gold is used to decrease the risk of dollar market rate. If Market value of dollar goes

down huge amount of dollars used to pay for the purchase of gold. Automatically gold value increases when dollars exchange rate going down. (Purohit et al. 2015).

Gold is one of the precious metal that is ductile, conductive, heavy, non-destroyable, bright, and appealing metal. For several centuries, gold has continued its purchasing power as a significant saving and investment instrument. In the early times, gold designed the basis of the monetary system. At that time US dollar is used for backup instrument with the Bretton Woods organization system.

Main component of gold is so attractive that attract investor's to invest in gold. The valuable metal tends to tolerate its value over time. Many even say one ounce of gold purchases the same amount of bread, as it did at any time throughout history. In last few years prices of the gold increases gradually while dollar price decline. This decline in dollars price concerned investors, managers and media attention. Gold has become a hot and standard investment chance in the last few years. More and more people are extremely considering making gold a portion of their portfolio. (Erdogdu, 2017).

People deliberate the yellow metal as an object of beauty and symbol of wealth. The gold is an important role in the investment and consumer world. Gold is not only considered as a main form of currencies in all countries. It has an important impact on the value of those currencies too. Close correlation are exist amongst the value of gold and the currencies. In which are dealing in foreign exchange. Foreign exchange market and gold market attracts the investors and offers better chances of investment. The gold provides a safe shelter to the investor and consumers. Gold is a superior from all other metal. The developed and developing countries are frequently observing the prices actions of gold and its relationship with other financial instrument. That's why; many of such nations are formulating their economic policies by

considering the variations in gold prices. US dollar is considered as the world's spare currency, value of gold is also shown in USD. If dollar price increases or decreases that affect the gold price because gold and USD (U.S Dollar) have an inverse relation with each other. (Nandakumar at el. 2017).

Depreciation is based on the law of one price when there is long-established relationship between US dollar and gold. If gold is denominated in US dollar, dollar devaluations concur with increasing gold prices in order to exclude arbitrage opportunities. (Pilbeam et al. 2015).

In past, the silver, gold and browns are used for currency exchange or buying and selling. In past times the gold prices remained when the USD rates goes down. In that condition the investors purchase gold for protecting the price of dollar that is decreasing. At the same time when dollar prices going to increase than investor purchase dollars and sell the gold. It would not be suitable to determine that the US dollar and price of gold goes into inverse direction. There are some internal and external factors that also affect the gold and dollar prices. (Ismail et al 2016).

According to Sinton the causal impact of currency transfer rates and stock price indices on gold value. Gold is a mineral that cannot be formed through the production process but the gold is obtained from mining. Gold is viewed as a place of shelter and counter-repetitive venture vehicle. The investors can invest in gold is a precious metal that is used for reserves in banks backup. Gold is a safe way of investing money; it is also used to save money from decreasing and decreasing currency price value risk. Increasing occur in the prices of the gold investor selected to invest in gold against capital market. If the price hike gold can give good returns results.

Generally, stock market and gold prices move in opposite direction. If the stock market falls, the gold always drifts to higher. The investor withdraw their investment from gold in that condition

when the gold prices go down and invest the same in stock market which increase the value of stock market due to a heavy investment.

According to Sjaastad, (2005) analyzed that the empirical and theoretical relationship between the price of gold and exchange rate. In Bretton Wood international monetary system the exchange rate is fixed. After the floating interchange rates between the main currencies, a major source of price instability occurs in gold market. Increase and decrease in dollar price have strong effect on gold prices in different country currencies.

According to Rahayu et al. (2014) analyzed that the USA exchange rate, the oil price and price rises rates affect the value of gold in Malaysia. These are the factors which affect the prices of gold in Malaysia.

When the gold price was fell from RM156 per gram to RM141 per gram in the 2013. In that case if the prices of gold go down the people visit the gold shops and buy more gold before the price of gold up again. The peoples are well known about the current price of gold, they invest in gold their saving when the gold price increases they get more amount of money after selling the gold.

1.2 Research Question:

What is the nexus between the forex market and gold market?

What is the relationship between the stock market and gold market?

What is the nexus between the stock market and forex market?

1.3 Contribution and research Gap:

After keen observation about the relationship amongst gold market, stock market and forex market. We found that there is no academic research exist in the context of Pakistan focus these markets, such as the impact of forex market on gold market and stock market. Therefore in the best of my knowledge this study will bridge the gap

1.4 Objectives of the study:

To investigate the relationship of exchange rate and volatility spillover between exchange rate and gold prices in Pakistan perspective.

1. To check the effect in US dollar exchange rate on gold prices in Pakistan.

2. Examine the effect in US dollar exchange rate on stock prices in Pakistan.

3. To checks the nexus between the stock price and gold prices in Pakistan.

1.5 Significant of the study:

The aim of our research is to explore the relationship amongst the US dollar exchange rate, stock prices and gold prices. Than how the exchange rate of US dollar cause the gold prices and stock prices in Pakistan. There is vast paper which discusses the relationship amongst exchange rates, stock prices and gold price. But my research is based on Pakistan perspective. That study provides information about the impact of exchange rate on gold price and stock prices which is beneficial for investor. This paper also provides information about than how the US dollar exchange rate can cause the price of gold and stock prices in Pakistan. In general we can see that if there is a fluctuation occurs in the exchange rate of US can causes the price of gold and also the stock prices. When the US dollar goes up the gold price also increase. There is a direct relationship between US dollar and gold prices.

CHAPTER 2

LITERATURE REVIEW:

2. INTRODUCTION:

This chapter included the details explanation of the relevant literature of the gold prices and exchange rate. In this chapter there are different studies which discuss the impact of US dollar exchange rate on gold prices in different countries. Literature review discuss the author names, objectives of the study, different Models and there result.

2.1 Empirical literatures:

Hasan et al. (2014) examine those factors which have impact on the prices of gold in Malaysia. In This research the researcher used Multiple Regression Model. The model used to estimate the nexus between the variables. Inflation rates, exchange rates and crude oil are used as independent variables. The dependent variable was gold prices. There result show that the crude oil prices is positively significant on gold prices. While the inflation rates and exchange rates are negatively significant on gold prices.

Purohit et al (2015) analyzed the impact of recession of 2008 on the nexus between US dollar and prices of gold in India. To check the long-run relations between the US dollar and prices of gold in India using Johansen co-integration test. To examine the lead-lag relationship amongst these variables using the Granger Causality test.

They found that during in the recession period the relationship between exchange rate of US dollar and gold price were been impacted. Their study also concludes that US dollar exchange value plays important role in the prices of gold the fluctuations of US dollar can affect the gold prices in India.

Geete (2016) conducted a research to find the influence of US dollar exchange rate and gold prices on the stock exchange indices. The study shows that both the gold prices and US dollar exchange rate has a positive influence on the stock market indices. With the help of statistical software SPSS multiple regression has been applied. The study also gives information that gold and Nifty are positively correlated and there is a negative relation between Nifty and US dollar price.

Ismail et al. (2016) the study is about volatility spillover effects. That study explores that how the information of one market is transmitted to another market. The Financial crisis in US has an effect on foreign gold market by some transmission channels. For that the researcher used trivariate generalized autoregressive conditional hetroscedasticity (GARCH) model. The result shows that there is a unilateral causality but not two-way causal direction.

The foreign gold market affects the US index and Malaysian (KE) uni-directional. During the financial crisis the US index has impact on the Malaysian (KE). The study also shows that there is volatility spill-over effect between these markets.

Nandakumar et al. (2017) examine the relations between US exchange rate and prices of gold in India. The annual data of gold prices and US exchange rate from 1970 to 2015 to know about the relationship. Unit root test, Johansen co-integration test, Granger causality test, Vector error correction model these econometric tools was used to observing the long run relations between US dollar exchange rate and prices of gold. The result of the study explores the long run co-integrating relation between US exchange rate and gold price.

Mukhuti and bhunia (2013) examined relations between Indian equity market index and prices of gold in India. The data was collected from the period of 1991 to 2012. Bivariate and multivariate co-integration test are used for estimation.

The result of bivariate co-integration test show no co-integration relationship between two equity markets indices and prices of gold and the result of the multivariate co-integration test show that there is steady co-integration relations between two equity market indices and prices of gold.

Sinton (2014) study about to define the causality linkage and co-integration relationship amongst US dollar exchange, price of gold and Jakarta stock market indices of Indonesia. Using the data from 2004 to 2013 was collected. The variables used in this study are exchange rate, price of gold and stock market indices. Using Granger causality and co-integration test. The result explore that US exchange rate, gold price and equity market indices are not co-integrated and the Granger causality test show no causality impact from prices of gold to stock indices and US exchange rate.

Ismail et al. (2016) analyzed a research about volatility spillover between US dollar index and gold markets. Daily returns of US dollar index and gold price was collected from the period of 2000 to 2015. BEKK GARCH model were used for estimations. The study show that spillover and negative shocks are exists from gold to US dollar index. There is strong negative linkage the prices of gold and US dollar index. The fluctuation occurs in prices of gold due to US dollar index.

Sjaasted (2005) determined the empirical and theatrical relations between price of gold and major exchange rates. The study explores that after the termination of the Bretton-Wood system, in this system the rate of exchange was fixed.

The moving of exchange rates among the considerable currencies that has the great impacts on the international gold market. The increase and decrease of the US dollar have the robust effect on the gold price and the other recognized currencies.

Afsal and Haque (2016) investigated that the interdependences between stock market and price of gold in Saudi Arabia. In this study both the multivariate and univariate (GARCH) model are used. GARCH (1,1) model is used to observe the persistence level of the volatility. It was concluded that there do not exist dynamic interrelationship between stock and gold prices in Saudi Arabia.

Apergis and papoulakos analyzed the research about the connection amongst the nominal, real exchange rate, Australian dollar against the gold price and US dollar. The daily data from 2000 to 2011 were used. The Error Correction and Generalized Autoregressive Heteroskedastic (GARCH) models are used for estimation.

The result gives proofs in favor of the interrelationship amongst the nominal and real rate of exchange of Australian dollar with the gold price and US dollar.

Erdogue (2017) examined the dynamic influence of the gold price in USA and also determined the essential micro-economic variable that plays the most important role in this process. Monthly data from 2003 to 2016 were used in the present study. Generalized Autoregressive Heteroskedastic (GARCH) models are used to estimate the volatility.

The result shows that negative correlation is present between the US dollar and gold prices. The negative correlation is high between US dollar and gold prices.

The study also investigate that there is a positive co-relation between silver, gold and prices of oil.

Pilbeam et al. (2015) conduct a research about the relationship between the different exchange rates and gold market. The daily data from 1979 to 2013 were used. GARCH-in-mean SVAR models are used.

The result shows that after one day when there has depreciation occur in the exchange rates have negatively affected the prices of gold. In most of the cases after two day that turns to be positive. Gold price is used as monetary unit in US dollar after the deprecation occur in the US dollar.

Subhashini and Poornima, (2014) examined the causality relation and co-integration relationship amongst exchange rate, gold prices and crude oil. The weekly data from 2009 to 2013 were used for estimation the causality test and co-integration test was used. The various factors like cured oil and exchange rate that affect the gold prices.

The result shows that currency had a positive impact on gold prices and cured oil. Whenever there is increase occur in the currency the crude oil and gold prices also increased.

Gungor et al. (2013) they conduct a research about impact of volatility in gold price market on the ISE (100) index. The daily data from 2009 to 2012 was collected from ISE index and also daily gold prices were used. For estimation the MGARCH model are used.

The result shows that that is volatility spillover effect between these two markets and the effect is bi-directional. When there is shocks occur in one market these shock effect the other market.

Shahbaz et al. (2016) analyzed a research about the impact of gold prices, prices of oil and their related volatilities on the equity markets of the develop economies. The data is form the period (2008 to 2015) was used in this paper. The nonlinear ARDL approach has used for the finding of long-run relationship and short-run relationship.

the study investigate that there has a positive impact of gold prices on the stock market prices of the large developing countries like Brazil, China, India, Russian economics and also shows that the Gold price negatively affect the equity markets of Malaysia, Thailand, Chile, Mexico and Indonesia. The prices of oil negatively affected the equity markets of the all developing

economies. In the long-run and short-run gold and Oil volatilities show a negative effect on the equity markets of the all emerging economies.

Shen (2014) study about that how the American dollar index affects the global gold prices. From the period of 1995 t0 2014 the data of the gold prices and US dollar index was collected. To study the effect of US dollar index on the global gold prices. The Co-integration Test, Augmented Dickey Fuller test and the Error-Correction Model are used for estimation.

The empirical study explores that before the finical crisis of 2007 and after the finical crisis of 2007 the US dollar index is negatively related to global gold prices. When there is increase occur in the US dollar index, it cause the global gold prices the gold prices decrease. If the US dollar index decreases the gold prices increased. There are inverse relationship between US dollar index and the global gold prices.

Kiohos and Sariannidis (2010) conduct a research about the short-run effects of the energy (crude oil) on the gold and the financial (bond, currency and equity) markets. The daily data was collected from the period of January 1, 1999 to August 31, 2009. To test the relationships the GJR-GARCH model was used.

The result explore that the energy market positively influences on gold market. The financial (stock, currency, and the equity) markets show the negative impact on the gold market. The result also shows that the US dollar and yen exchange rate volatility significantly influence the volatility of the gold market.

Sujit and Kumar (2011) analyzed a research for the tasting of complex and dynamic relationship amongst the economic variables such as exchange rate, stock returns, oil prices and gold prices. The daily data from 1998 to 2011 were used. Co-integration technique and (VAR) vector autoregressive model are applying to capture the dynamic and the stable relationship amongst

those variables which is used in the study. The results explore that changes occur in other variables highly affect the exchange rate. The stock market has minimum character in the influence of the exchange rate.

XUAN et al. (2012) conduct a research about the estimations of gold price by examining the four (4) keys variables influence the price of gold, such is silver, inflation, and USA dollar trade weighted index and crude oil price. The data was collected from 1971 to 2011 from (IFS) International Financial Statistics and (GFD) Global Financial Data. Multiple linear regression model and simple linear regression model are used to study the relation amongst the selected variables.

The result investigate that there is a significant but positive relationship amongst silver, inflation and crude oil with the prices of gold. Finally, the result also suggested that there is a significant but negative relationship of gold price and USA dollar weighted index with each other.

Le and Chang (2011) analyzed a research about the dynamic relationship amongst the gold price, crude oil and financial variables (exchange rate, interest rate and stock price). The monthly data from 1986 to 2011 were used. The (ARDL) autoregressive distributed lag model is employed to capture the short and long period relationship and the dynamic interactions between the variables and secondly the (OLS) ordinary least square model is used to estimate the co-integration relationship.

The result revealed that Japanese stock price and gold price show positive effects on the interest rate in the long period, while in the rise of gold price suggested depreciating impacts on the Japanese yen versus major currencies.

ZIZUN (2017) studied the relationship among the gold prices, exchange rate, inflation rate, interest rate, and the crude oil price in Malaysia. Quarterly data was collected from 2000 to 2016. Vector autoregressive (VAR) model are used for estimation.

the result explore that Inflation rate have significant and positive relationship with the gold prices in Malaysia and the interest rate show significant and negative relationship the gold prices in Malaysia.

Phuong Tang (2017) analyzed a research about the relationship amongst US dollar, oil price, Euro, gold price and equity market index in the European Union. The data was collected from the period of 2003 to 2016. Simultaneous equations model are used for the identification of these relationship.

The result explores the relations amongst US dollar, oil price, Euro, gold price and equity market prices are found in this study. Firstly, the oil price shows negative impact on the gold price and positive impact on the equity market prices. Secondly, oil price and US dollar positively affect gold price. Thirdly, both the gold price and equity market prices show positive impact on US dollar. Finally, Euro has a positive influence on the oil price and also negative influence on the gold price and equity market prices.

Bayramoglu et al. (2011) conduct a research about the factors that cause the prices of gold. The monthly data from the period of 1992 to 2010 are used. USA inflation rate, USA real interest rate, US exchange rate and oil prices have been estimated by the MGARCH and CCC models.

The result suggested that there was the highest correlation between US exchange rate and gold prices, while there was a positive correlation between the oil and gold prices.

Abidin et al. (2015) examined the relationship between the price of gold and microeconomic factors in case of Malaysia. Gold price has a dependent variable and the microeconomic factors

such as ringgit exchange rate, real Malaysian (GDP) and inflation rate of Malaysia was used as independent variables. The quarterly data from the period of 2005 to 2014 was used in their paper. The aims of the study have to check the interrelationship between the gold price and microeconomic factors in Malaysia. The Multiple Linear Regressions (MLR) and Correlation coefficient were used with the help of SPSS software.

The result explore that there has a significant but positively interrelationship between the gold price and crude oil price, while there was a significant but negatively relationship between gold price and ringgit exchange rate. There was a positive interrelationship between the gold price and real Malaysian (GDP), while there was a negative relationship between inflation rate and gold price.

Gokmenoglu and Fazlollahi (2015) investigated that whether the volatility of the oil price, gold price, and (OVX) oil price and (GVZ) gold price have significant impacts on the (GSPC) stock index or not? The ARDL cointegration test has used to determine the long-run relationship amongst oil price volatility and gold price volatility and S&P500 stock market price index.

The result shows that all variables have long-term influence on the S&P500 stock index. Long-run and short-run gold price has shown the highest effects on the stock index.

Yi Pan et al. (2017) conducted a research about the relation between the gold price and the exchange rates. The weekly data has been used from 1995 to 2016 in this study. Ordinary least squares (OLS) model and (QR) quantile regression model were used to check the interrelationship between the exchange rates and gold price.

Finally, the result suggested that there was a positive relationship between the price of gold and exchange rate. Although, that relationship depends upon the strength of the currency, while there was a negative relations between the gold price and exchange rates of the weak currencies.

OMAG (2012) conducted a research about the relationship between the gold prices and the selected financial markets in turkey. The data period was from 2002 to 2011. Regression model was used and to analyzed the relationship between these variables.

The result suggested the positive relationship between the gold price and the Istanbul BIST 100 index, and there was a positive interrelation between the exchange rate of the US and the Turkish Lira.

C. Ciner (2001) investigated the long-term linkages between the silver and the gold prices. Daily data was collected from the period of 1992 to 1998 in their study. Johansen Co-integration test are used for estimation.

The result explored that there was a stable linkages between the silver and the gold prices.

Weng (2011) investigated the effect of rising in the gold, crude oil prices, and the variation of exchange rate to equity price indices in the perspectives of japan, Hong Kong, US, Malaysia and Singapore. Data was used from the period of 2000 to 2010. Johansen's cointegration test and unit root test was used for the estimation.

The result explores that gold prices, crude oil prices, exchange rate and equity markets are interrelated with each other.

Karbor et al. (2014) analyzed a research about the relationship amongst stock, gold and foreign exchange markets. The daily data from the period of 2012 to 2014 are used. Granger causality test was used to check the causality relationship amongst stock, gold and foreign exchange market.

The result explored that the stock prices caused by the exchange rate and gold price, while there was the bilateral links between the exchange rate and gold price.

Feroz et al. (2017) conducted a research about to examine the dynamic linkage amongst exchange rate, oil, gold price, and stock returns in the case of Pakistan markets. Monthly data was used from the period of 2005 to2015. (VAR) vector auto regression model was used to examine the variations or shocks.

The results how significant shock or variation in exchange rate, oil price, gold price due to stock market returns.

Chapter 3

RESEARCH METHODOLOGY

3. MODELING VOLATILITY AND EXPLORING SPILLOVER EFFECT:

Volatility modeling is one of the issues approached by the financial econometrics. Predictability of time varying volatility is the basic aim of financial econometric modeling. In financial markets risk is a synonym of volatility. The main objective of the econometrics, that modeling of time series is to compute the conditional mean; some theoretical models are employed to compute conditional variance is called volatility. These models are used to examine the past behavior of volatility, future forecasting of volatility, analyzing series of asset return by suppose the volatility clustering, leverage impact and determination.

The spillover effect also termed as co-movement or information transmission. Exploring spillover effect means to investigate whether return or volatility of one financial market affects the other market's return or volatility. It is quite important to analyze information transmission between the financial markets, due to information transmission the dynamic linkages developed between the financial markets. Padhi and Lagesh (2012) found that Information transmission mechanisms persists through return and volatility, it plays an important character in determining the issuance and financial integration across the international financial markets. The understanding and predictability of spillover effect and volatility modeling are significantly crucial for asset allocation, approaches of global hedging and pricing of internal securities.

3.1 Econometric Methodology and Model Specification:

To explain the movement of conditional variance over the period of time, Engle (1982) introduced Autoregressive conditional hetroscedastic (ARCH) model. Although, the ARCH

model is an important contribution in econometric techniques, it has some difficulty like long lag length and

non-negativity restriction on parameters. Bollerslev (1986) proposed generalized autoregressive conditional heteroskedastic (GARCH).

3.2 Data:

This study uses the information for US dollar exchange rate, Gold prices and Stock price. The daily time series data used in this research from the period of January 1, 2014 to October 15, 2018. The US dollar exchange rate, gold prices and stock prices data was collected form Business Recorder. The purpose of the study is to test the relationship amongst US dollar exchange rate, stock prices and gold prices in case of Pakistan

3.3 Augmented Dickey Fuller for Stationary:

Dickey & Fuller (1979) introduced the test. The augmented dickey fuller test is a unit root test; therefore it is used for stationary. Most of the time series data are non-stationary at level. To examine the stationary of the time series data we can use the ADF test.

Generalized form

$$\Delta \sum_{j=1}^{k-1} \beta_j \, \Delta x_{t-j} + \epsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

The equation indicate that

Δ= showing the difference

βj where β_1……..β_k= estimation based on the T-stat Test.

ε_t= show the error term.

3.4 Return series:

The financial series at level are trendy in nature. It is impossible to compute a fit model if the series is trendy . To deal with trend we used the log difference return.

$Rt = log(lt/lt\text{-}1)$

Rt= Financial time series at level i.e. stock index, gold price and exchange rates at the end of time t.
Rt-1= First lag of financial time series.

3.5 ARCH (q) Model:

Robert F. Engle in (1982) proposed the Autoregressive conditional hetroscedastic (ARCH) model. This model overcomes all short comings which exists in previous models. In this model Engle, proposed conditional mean and conditional variance equations. Empirically the conditional mean equation follows ARMA (p, q) procedure and the conditional variance depends on the square of past values of error procedure et.

The general description of ARCH model is

Conditional mean equation

$$Rt = \alpha 0 + \beta Xt + et \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where $et \sim N(0, \sigma t^2)$

Conditional variance equation

$$\sigma_t^2 = \theta_0 + \Sigma_{i=1}^{q} \theta_i \varepsilon_{t-1}^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where $\theta 0 > 0$, $\theta i = 0$ i= 1,2,……., q

In conditional mean equation Rt indicates the return which is linear function of Xt. $where$ β indicates the vector of parameters. Empirically βXt describes ARMA (m, n) process with distinct specifications. In some of the cases it may be ARMA (0, 0). According to the "Efficient Market

Hypothesis (EMH)" Rt shows mean reverting behavior and it is unpredictable. In conditional variance equation the restriction on coefficients is that they must be non-negative.

3.6 GARCH (1, 1):

GARCH (1, 1) is frequently used in financial econometric literature for volatility modeling. Sajid et al. (2012) used the ARMA-GARCH for the computation of inflation and inflation unpredictable . Saud and jabeen (2014) used GARCH model to find out "Exchange rate volatility by macroeconomic fundamentals in Pakistan". The GARCH (1, 1) is the modest form in dispersion models family. The GARCH (1, 1) provide most robust estimations than other volatility models. GARCH (p, q) mostly use when data is very large and require higher lags.

The general representation of GARCH (1, 1) is

Conditional mean equation

$$Rt = \alpha 0 + \beta Xt + et \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where $et \sim N(0, \sigma t^2)$

Conditional variance equation

$$\sigma_t^2 = \theta_{0+} \theta_1 \epsilon_{t-1}^2 + \varphi_1 \sigma_{t-1}^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where $\theta_0 > 0, \theta_1 \geq 0, \varphi_1 \geq 0$

These are the restrictions $\theta 0 > 0$, $\theta 1 = 0$, $\varphi 1 = 0$ of non-negativity on coefficients of the conditional variance equation. Here Rt indicates the return series of the stock market index. Equation (4) the conditional mean equation follow ARMA (p, q) process. εt the is Error series

with the normal distribution of zero mean and σt conditional variance. GARCH (1, 1) model introduce by (Bollerslev, 1986).

Found of the statistical properties for the un-conditional moment of the residual (εt). ($\theta i + \varphi_j < 1$) is enough and necessary condition shows the persistence of shock to volatility, it satisfies the wide sense stationary condition. The unconditional variance is Var (εt) = E (σt^2) $= \theta_0/1- \theta_1- \theta_1)$. The fourth moment of error (t) is ($3\theta^2 + 2\theta_1 + \varphi_1^2$)

It is csufficient and necessary condition and the kurtosis is more than 3.

3.7 GARCH (p, q) Model (For Exploring Spillover Effect):

Conditional Mean equation

$$R_{t,k} = \alpha_0 + \beta X_t + \pi_1 R_{t,s} + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where $et \sim N(0, \sigma t^2)$

Conditional Variance equation

$$\sigma^2_{t,k} = \theta_0 + \Sigma^q_{i=1}\theta_1 + \Sigma^p_{i=1}\varphi_j \sigma^2_{t-1} + \pi_2 R^2_{t,s} \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$R_{t,k}$ indicates the return series of (K) market. $R_{t,s}$ represents the return series of (S) market. That is used a regressor in the conditional mean equation of return series of the (K) market. Π_1, Describes the parameters of return series of (S) market. $\sigma^2_{t,k}$ Denotes the conditional variance of (K) market. $R^2_{t,s}$ specifies the squared return series of (S) markets that is used as a regressor in the conditional-variance-equation of return series of (K) markets. Π_2, Determines the parameters of squared return series of (S) market.

We find out the co-movements between these markets by using the following technique of the Hamao et al, (1990). According to the Hamao, the residuals of one return series introduce as a regressor in the conditional mean equation of the other return series for mean-spillover effect.

For the volatility spill-over affect the squared residual of one return series introduce as a regressor in the conditional-variance-equation of the other return series.

In this instead of using the residual and the squared residuals we can use the return series and the squared return series of the time series data. . According to "The Efficient Market Hypothesis (EMH) return are unpredictable and show mean reversion behavior". To examine the mean spill-over effect between two series, the one market return series is introduced as a regressor in the return series of other market. For the volatility spill-over effect the squared of the return series of one market is introduced as a regressor in the conditional variance equation of the other market.

Chapter 4

4. Results and Discussion:

In this chapter we can discuss about the models which are used in our research for estimation and also the results of the models, first is the (ADF) Augmented-dickey fuller test for stationary,2nd the Normality test,3rd test for serial correlation,4th test for ARCH effect,5th the GARCH (1,1) model.

Results of (ADF) Augmented Dickey Fuller test for stationary:

The table expresses the individual results of the Augmented Dickey Fuller Test for three variables included in this research.

Table: 4.1 ADF Test:

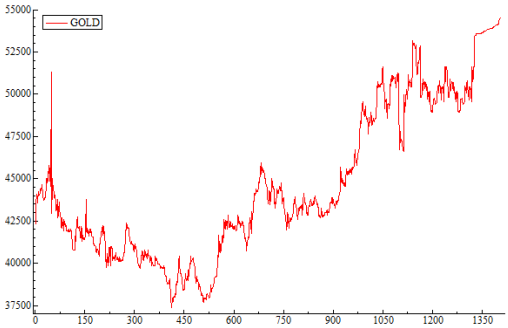
Variables	ADF Critical value at 1%	ADF Critical value at 5%	AT LEVEL
Gold prices	-2.56572	-1.94093	0.634496
US Dollar	-2.56572	-1.94093	1.94782
Stock price	-2.56572	-1.94093	0.916425

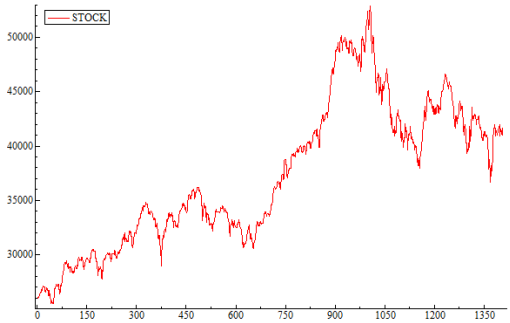
H_O: The series is not stationary.

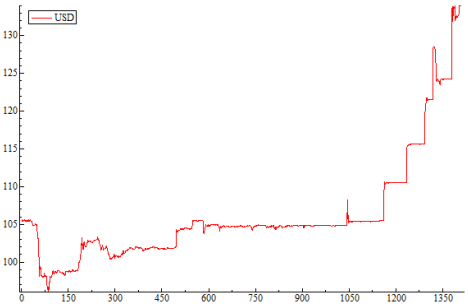
$H_{1:}$ The series is stationary.

The Table shows the ADF test result. Accept the $H_{O:}$ the series is not stationary al level. The calculated value of all variables Gold prices, US dollar and Stock prices is less than ADF Critical values.

Visualizing the Series:







The time series plot of all series show that all the aeries are not showing mean reverting behavior. The series are trendy and fluctuating over the time. And there is changes occur in time to time and these plots show that all the time series data is no-stationary at level.

Results of (ADF) Augmented Dickey Fuller test for stationary:

Table 4.2: ADF test:

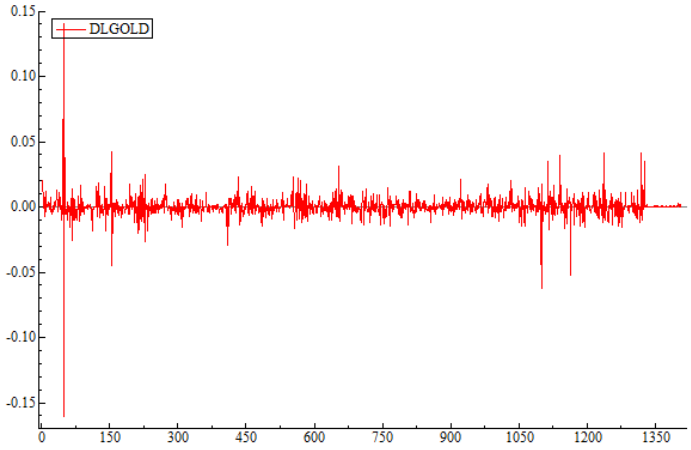
Variables	ADF Critical value at 1%	ADF Critical value at 5%	First Difference
DL(Gold prices)	-2.56572	-1.94093	-46.2017
DL(US Dollar)	-2.56572	-1.94093	-36.2794
DL(Stock price)	-2.56572	-1.94093	-20.4521

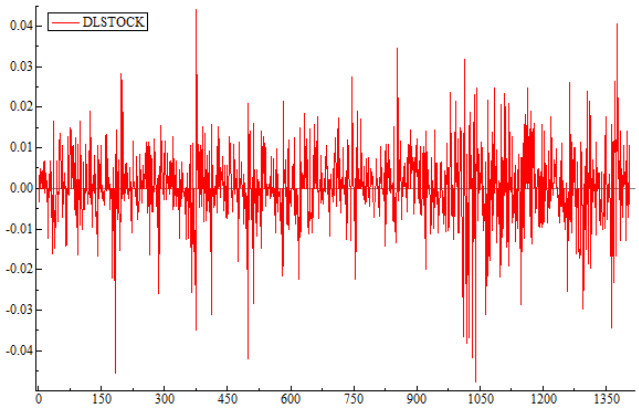
H_O: The series is not stationary.

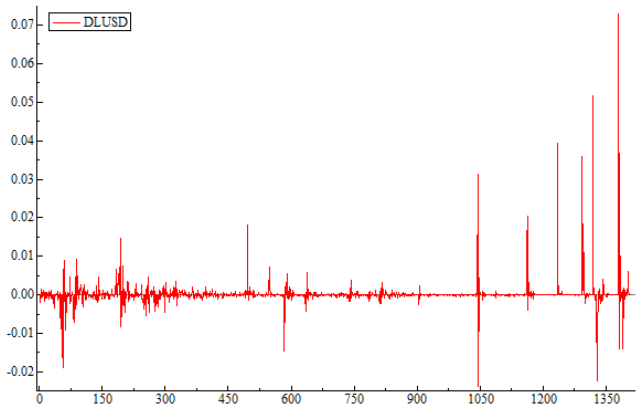
$H_{1:}$ The series is stationary.

The Table explores the ADF test result. The time series data is stationary at first difference.in this condition we can accept the H_1, because the calculated value of all variables DL Gold prices, DL US dollar and DL stock prices is greater than ADF Critical values.

Visual Inspection of Return series:







Now the return series of all variables showing the mean reverting behavior that is fluctuating around the zero-mean value. Although, there are volatility clustering and regions of high and low spread which indicate that the variance is not constant over time instead now conditions on time.

Table 4.3: Descriptive statistics of return series of (Gold, Stock and USD)

P.V is in the parenthesis

Variables	Min	Mean	Max	Std Dev	Skew Stat	EK Stat	J-B Stat
Return of GOLD	-0.160	0.0001	0.140	0.0090	-1.33 0.00000002	117.4 0.0000	0.00008 0.0000
Return of STOCK	-0.047	0.0003	0.044	0.0088	-0.39 0.0000	3.944 0.0000	948.6 0.0000
Return of USD	0.024	0.0001	0.073	.0036	9.905 0.0000	179.0 0.0000	0.000001 0.0000

The mean of Return of GOLD is about zero that technically speaking the expected value of the return series is zero. It means the series is now showing mean reverting behavior. The Skewness p-vale is less than 5% of level of significant so accept the H_1. The series is not symmetric. Our E-Kurtosis p-value is less than 5% of level of significant. Therefore we can reject H_0 and conclude that the series is not normal and the positive sign show that the series is Leptokurtic. The Jarque-Berra p-value is less than 5%. The p-value shows that the series is not normal.

The mean of Return of STOCK is about zero that technically speaking the expected value of the return series is zero. It means the series is now showing mean reverting behavior. The p-value of Skewness is less than 5% show that our series is non-symmetric. And E-Kurtosis and the Jarque Berra p-value is less than 5%of level of significant in both condition we can reject H_0 and accept

$H_{1,}$ and conclude that our series is not normal and the positive sign reveal than the series is Leptokurtic.

The mean of Return of USD is near to zero so we can say that the expected value of the return series is zero. The series is showing mean reverting behavior. The results of the table show that the Skewness p-value less than 5% level of significance, accept H_1. Our series is not symmetric and also the positive value indicates that our series is positively skewed. The E-kurtosis p-value is less than 5% rejected H_0 and concludes that the series is not normal and the series is Leptokurtic. The Jarque-Berra p-value is also then 5% level of significance this show that the series is not normal.

Table 4.4: Tests for the serial correlation: (GOLD).

$H_{O:}$ No serial correlation.

$H_{1:}$ Series have serial correlation.-

Q-statistics on Raw Data		
Q (5)	75.3728	[0.0000000]**
Q (10)	78.3861	[0.0000000]**
Q-statistics on Squared Data		
Q (5)	320.734	[0.0000000]**
Q (10)	320.779	[0.0000000]**

The above results of Q-statistics for the raw data indicate that the raw data have serial correlation. The p-value is less than 5% level of significance. And our squared data we can also

accept the H_1 that the series is auto-correlation. It means that both the raw and squared data can dependent on their pervious values.

Table 4.5: Tests for the serial correlation: (STOCK).

Q-statistics on Raw Data	
Q (5)	22.6517 [0.0003934]**
Q (10)	29.8489 [0.0003934]**
Q-statistics on Squared Data	
Q (5)	75.1102 [0.0000000]**
Q (10)	132.532 [0.0000000]**

According to the above table we can accept the H_1 in both raw and squared data because our p-value is less than 5% level of significance therefore we can determine that our series have serial correlation. It means that both the raw and squared data can dependent on their previous data points.

Table 4.6: Tests for the serial correlation: (USD)

Q-statistics on Raw Data	
Q (5)	1.53443 [0.0158036]*
Q (10)	2.65440 [0.0210805]*
Q-statistics on Squared Data	
Q (5)	13.9733 [0.0210805]*
Q (10)	21.0087 [0.9884297]

The result of the Q-statistics for raw data explore that the raw data have serial correlation because the p-value is less than the 0.05. But the Q-statistics for squared series show that the series does not have serial correlation because the p-value has greater than 5%level of significance.

Testing for the ARCH effects:

The descriptive statistics show that there has the presence of ARCH process in the time series data. Therefore, to test the ARCH process the tests statistic is given below.

Table 4.7: THE Empirical Tests for presence of ARCH Effects:

LM ARCH test for (GOLD)				
ARCH	1-2 test :	F (2,1401)	263.61	[0.0000]**
ARCH	1-5 test :	F (5,1395)	123.30	[0.0000]**
ARCH	1-10 test :	F (10,1385)	62.653	[0.0000]**

LM ARCH test for (STOCK)				
ARCH	1-2 test :	F (2,1401)	21.255	[0.0000]**
ARCH	1-5 test :	F (5,1395)	11.440	[0.0000]**
ARCH	1-10 test :	F (10,1385)	8.5953	[0.0000]**

$H_{0:}$ Series is no ARCH effect.

$H_{1:}$ Series has subject to ARCH effect

The tests statistics for ARCH LM are reported in the above table. The null hypothesis of no ARCH effect has been rejected. And accept the alternative hypothesis H_1, it is concluded that

there has ARCH effect in both series. It means that the variance of series is not constant over time. Therefore to capture the ARCH effect a methodology proposed by the Tim-Bollersleve in 1992 has been adopted which calls for the application of GARCH (p, q) model and theoretically it has been proved that GARCH (1, 1) model. The GARCH (1, 1) model is sufficient to capture the higher order of the ARCH effect. So, the estimation will be based on GARCH (1,1) modeling.

Modeling for spill-over effects using GARCH (1,1).

The spillover effect is a condition in which the return of the one market can be significantly affected by the return of the other market. There are three types of spill-over effects which are given below.

(1) Mean spill-over effect.

(2) Volatility spill-over effect.

(3) Cross volatility spill-over effect.

Mean spill-over effect.

Table 4.8: Return of Gold modeled by Return from Stock

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	-0.000	0.000	-0.489	0.624
CondM-STOCK GARCH(1,1) (M)	1.628	0.270	6.027	0.000
AR(1)	-0.688	0.270	-2.547	0.011
MA(1)	0.695	0.274	2.538	0.011
Cst (V) x 10^6	0.022	0.074	0.296	0.767
ARCH(Alpha1)	1.000	0.323	3.087	0.002
GARCH(Beta1)	0.761	0.037	20.34	0.000
Student (DF)	2.231	0.086	25.85	0.000

The estimated GARCH model shows that the return of the gold has been affected by the return of the stock. The estimated coefficient on return from the Stock indicates that the coefficient is positive and significant. It shows there is a Mean spillover effect from Stock market to the Gold market.

Table 4.9: Return of Stock modeled by return from Gold

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	1.543	0.123
CondM-GOLD GARCH(1,1) (M)	0.426	0.432	0.985	0.324
AR(1)	0.247	0.113	2.173	0.030
MA(1)	-0.080	0.116	-0.695	0.486
Cst (V) x 10^6	7.888	3.967	1.98	0.047
ARCH(Alpha1)	0.207	0.076	2.712	0.006
GARCH(Beta1)	0.746	0.094	7.867	0.000
Student (DF)	3.394	0.426	7.969	0.000

The above result of the estimated GARCH model explore that the return of the Stock has not been affected by the return of the gold. It means that no mean spillover effect from gold market to stock market and the result also indicates that unidirectional spillover effect from the gold market to stock market.

Volatility spill-over effect.

Table 4.10: Volatility in the Gold modeled by volatility in the Stock

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	4.630	0.000
AR(1)	0.011	1.238	0.009	0.992
MA(1)	0.040	1.197	-0.033	0.973
Cst (V) x 10^6	0.744	0.185	4.011	0.000
DLSTOCK^2 (V)	-0.0018	0.000	-61.57	0.000
ARCH(Alpha1)	0.112	0.033	3.342	0.000
GARCH(Beta1)	0.854	0.045	18.92	0.000
Student (DF)	3.444	0.386	8.906	0.000

The result of the above table after estimation show that the there is a volatility spillover effect from the stock market to gold market. There effect is negative and significant.

Table 4.11: Volatility in the Stock modeled by volatility in the Gold

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	0.857	0.391
AR(1)	0.265	0.107	2.468	0.013
MA(1)	-0.094	0.108	-0.875	0.381
Cst (V) x 10^6	11.481	3.840	2.990	0.002
absDLGOLD (V)	0.009	0.002	-3.494	0.000
ARCH(Alpha1)	0.181	0.059	3.067	0.002
GARCH(Beta1)	0.744	0.073	10.10	0.000
Student (DF)	3.944	0.544	7.245	0.000

The result of this table indicates that volatility in the stock market is due to volatility in the gold market. We can say that there is a volatility spillover effects from the Gold market to Stock market but effect is negative and significant. The effect is uni-directional and there is a negative relationship between these two markets.

Measuring the return from the cross volatility.

Table 4.12: Return of Gold modeled by the volatility in the Stock

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	4.630	0.000
AR(1)	0.011	1.238	0.009	0.992
MA(1)	0.040	1.197	-0.033	0.973
Cst (V) x 10^6	0.744	0.185	4.011	0.000
DLSTOCK^2 (V)	-0.001	0.000	-61.57	0.000
ARCH(Alpha1)	0.112	0.033	3.342	0.000
GARCH(Beta1)	0.854	0.045	18.92	0.000
Student (DF)	3.444	0.386	8.906	0.000

The mean return of Gold is affected by the volatility in the Stock. The coefficient of the volatility in the mean equation of the gold is significant therefore the volatility in the Stock have a significant impact on the retune of the gold. And we can say that there is a cross volatility from Stock market to Gold market.

Table 4.13: Return of stock modeled by the volatility in the Gold

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	1.804	0.071
AR(1)	0.248	0.117	2.120	0.034
MA(1)	-0.080	0.118	-0.680	0.496
Cst (V) x 10^6	7.838	3.731	2.101	0.035
DLGOLD^2 (V)	0.002	0.002	0.902	0.367
ARCH(Alpha1)	0.206	0.071	2.865	0.004
GARCH(Beta1)	0.742	0.090	8.241	0.000
Student (DF)	3.431	0.416	8.242	0.000

The result shows that return of the stock is not affected by the volatility in the gold. The coefficient of the volatility in the mean equation of the stock is insignificant therefore the volatility in the gold does not have any significant impact on the return of the stock. There is uni-directional spill-over effect.

Mean spill-over effect:

Table 4.14: Return of Gold modeled by Return from USD

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	1.521	0.128
DLUSD (M)	-0.000	0.000	-0.707	0.479
AR(1)	0.640	0.235	2.726	0.006
MA(1)	-0.660	0.229	-2.885	0.004
Cst (V) x 10^6	0.017	0.071	0.237	0.812
ARCH(Alpha1)	1.000	0.316	3.159	0.001
GARCH(Beta1)	0.761	0.037	20.22	0.000
Student (DF)	2.231	0.083	26.68	0.000

The estimated GARCH model gives the above results. The result shows that the return of the gold has not been affected by the return of the USD. The coefficient is negative. So, we can say that no mean spill-over effect from forex market to Gold market.

Table 4.15: Return of USD modeled by Return from Gold

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	11.02	0.000
CondM-GOLD GARCH(1,1) BOUNDS (M)	-0.001	0.302	0.043	0.996
AR(1)	0.519	0.049	10.42	0.000
MA(1)	0.031	0.096	0.323	0.746
Cst (V) x 10^6	0.073	0.013	5.402	0.000
ARCH(Alpha1)	0.041	0.007	5.657	0.000
GARCH(Beta1)	0.677	0.067	10.07	0.000
Student (DF)	5.980	1.391	4.298	0.000

The result shows the there is no significant impact from the return of gold to the return of USD. There is no mean-spillover effect from gold market to forex market.

Volatility spill-over effect.

Table 4.16: Volatility in the Gold modeled by volatility in the USD

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	0.904	0.365
AR(1)	0.363	0.303	1.198	0.231
MA(1)	-0.415	0.288	-1.439	0.150
Cst (V) x 10^6	0.489	0.037	12.92	0.000
DLUSD^2 (V)	-0.000	0.000	-3.613	0.000
ARCH(Alpha1)	0.146	0.010	13.81	0.000
GARCH(Beta1)	0.850	0.008	100.8	0.000
Student (DF)	2.969	0.232	12.77	0.000

The above table indicates that the volatility of USD effect the volatility in the gold. The coefficient is negative and significant. The result shows that there is a volatility spillover effect from Forex market to Gold market. The negative sing shows that there is an inverse relationship between gold market and forex market.

Table 4.17: Volatility in the USD modeled by volatility in the Gold

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	-0.000	0.000	-4.673	3.506
AR(1)	0.404	0.129	3.114	0.001
MA(1)	-0.260	0.158	-1.63	0.101
Cst (V) x 10^6	0.051	0.047	1.08	0.276
ConV-GOLD GARCH (1,1) BOUNSD (V)	0.000	0.000	54.10	0.000
ARCH(Alpha1)	0.127	0.090	1.407	0.159
GARCH(Beta1)	0.770	0.054	14.04	0.000
Student (DF)	5.930	1.691	3.506	0.000

The above result explore that there is significant impact from volatility of gold to volatility of USD. And we can say that volatility spillover effect from gold market to forex market. The effect is positive and highly significant.

Measuring the return from the cross volatility.

Table 4.18: Return of Gold modeled by the volatility in the USD

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	0.904	0.365
AR(1)	0.3637	0.303	1.198	0.231
MA(1)	-0.415	0.288	-1.439	0.150
Cst (V) x 10^6	0.489	0.037	12.92	0.000
DLUSD^2 (V)	-0.00	0.000	-3.613	0.000
ARCH(Alpha1)	0.146	0.010	13.81	0.000
GARCH(Beta1)	0.850	0.008	100.8	0.000
Student (DF)	2.969	0.232	12.77	0.000

The above table shows that the return of the gold is affected by the volatility in the USD. The coefficient of the volatility in the mean equation of the gold is negative and significant. Therefore the volatility in USD has a significant impact on the return of gold and there is a cross volatility spillover effect from Forex market to gold market.

Table 4.19: Return of USD modeled by the volatility in the Gold:

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	-0.000	0.000	-1.584	0.113
AR(1)	0.494904	0.275	1.799	0.072
MA(1)	-0.369627	0.354	-1.044	0.296
Cst (V) x 10^6	0.007078	0.008	0.815	0.415
DLGOLD^2 (V)	0.0000526	0.000	8.225	0.000
ARCH(Alpha1)	0.170431	0.134	1.263	0.206
GARCH(Beta1)	0.777703	0.046	16.57	0.000
Student (DF)	5.623052	0.533	10.53	0.000

The result of the above table indicates that the mean return of the USD is affected from the volatility in the gold. The coefficient is positive and significant therefore the volatility in the gold has a significant impact on the return of USD and there is a cross volatility spillover effect from gold market to forex market. The effect is bi-directional.

Mean spill-over effect:

Table 4.20: Return of Stock modeled by return from USD

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	1.845	0.065
DLUSD (M)	-0.062	0.042	-1.469	0.142
AR(1)	0.250	0.117	2.128	0.033
MA(1)	-0.084	0.119	-0.704	0.481
Cst (V) x 10^6	7.518	3.924	1.916	0.055
ARCH(Alpha1)	0.199	0.074	2.666	0.007
GARCH(Beta1)	0.753	0.095	7.918	0.000
Student (DF)	3.425	0.419	8.165	0.000

The result of the above table explore that there is no spill-over effect from forex market to stock market. The return of the stock has not been affected by the return of the USD. The estimated coefficient on the return from the USD shows that the coefficient is negative and insignificant.

Table 4.21: Return of USD modeled by return from Stock

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.001	0.652	0.514
cndM-STOCK GARCH(1,1) (M)	0.046	62.264	0.007	0.999
AR(1)	0.453	1.140	0.397	0.690
MA(1)	0.028	2.226	0.012	0.012
Cst (V) x 10^6	0.069	0.212	0.326	0.744
ARCH(Alpha1)	0.039	0.286	0.138	0.889
GARCH(Beta1)	0.701	1.329	0.527	0.597
Student (DF)	5.982	12.207	0.490	0.624

The estimated GARCH model gives the above result that the USD return has not been affected by the return of the stock. The estimated coefficient on the return from the stock shows that the coefficient is insignificant and there is no mean-spillover effect from stock to forex market.

Volatility spill-over effect.

Table 4.22: Volatility in the Stock modeled by volatility in the USD

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	1.713	0.087
AR(1)	0.243	0.116	2.093	0.036
MA(1)	-0.075	0.117	-0.641	0.521
Cst (V) x 10^6	8.167	3.697	2.209	0.027
DLUSD^2 (V)	-0.024	0.005	-4.503	0.000
ARCH(Alpha1)	0.204	0.069	2.960	0.003
GARCH(Beta1)	0.744	0.086	8.599	0.000
Student (DF)	3.438	0.418	8.218	0.000

The above table indicates that there is volatility spillover effect from forex market to gold market. The coefficient of the volatility is negative and significant. So we can say that there is information transmitted from one market to another market.

Table 4.23: Volatility in the USD modeled by volatility in the Stock

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	-0.000	0.000	-1.846	0.065
AR(1)	0.314	0.822	0.3826	0.702
MA(1)	-0.104	0.818	-0.127	0.898
Cst (V) x 10^6	0.042	0.008	5.009	0.000
ConV-STOCK GARCH (1,1) BOUNSD (V)	-0.000	0.000	-30.66	0.000
ARCH(Alpha1)	0.093	0.015	5.865	0.000
GARCH(Beta1)	0.782	0.017	44.68	0.000
Student (DF)	5.982	1.058	5.653	0.000

The result of the table shows that the coefficient of the volatility is negative and significant therefore we can say that volatility spillover effect from stock market to forex market and the effect are bi-directional.

Measuring the return from the cross volatility.

Table 4.24: Return of Stock modeled by the volatility in the USD

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	1.713	0.087
AR(1)	0.243	0.1164	2.093	0.036
MA(1)	-0.075	0.117	-0.641	0.521
Cst (V) x 10^6	8.167	3.697	2.209	0.027
DLUSD^2 (V)	-0.024	0.005	-4.503	0.000
ARCH(Alpha1)	0.204	0.069	2.960	0.003
GARCH(Beta1)	0.744	0.086	8.599	0.000
Student (DF)	3.438	0.418	8.218	0.000

After the estimation the above table result shows that the return of the stock is affected by the volatility in the USD. The coefficient of the volatility in the mean equation of the stock in negative and significant therefore the volatility in the USD have a significant impact on the return of the stock and there is a cross volatility spill-over effect from forex market to stock market.

Table 4.25: Return of USD modeled by the volatility in the Stock

Robust Standard Errors (Sandwich formula)				
	Coefficient	Std. Error	t-value	t-prob
Cst (M)	0.000	0.000	0.085	0.931
AR(1)	0.009	2.057	0.004	0.996
MA(1)	0.009	2.124	0.004	0.996
Cst (V) x 10^6	0.007	0.018	0.387	0.698
DLSTOCK^2 (V)	-0.000	0.000	-2.190	0.028
ARCH(Alpha1)	0.098	0.095	1.031	0.302
GARCH(Beta1)	0.798	0.044	18.03	0.000
Student (DF)	6.003	2.793	2.149	0.031

The mean return of the USD has affected by the volatility in the stock. The coefficient of the volatility in the mean equation of the USD is negative and significant. The volatility in the stock has a significant impact on the return of the USD. There is a cross volatility spillover effect from stock market to forex market and the effect is bi-directional.

CHAPTER 5

Conclusion:

The aim of this study is to examine the spill-over effect amongst Gold market, Stock market and forex market. For this study the daily data has collected from Business Recorder from the period of Jan, 1, 2014 to Oct, 15, 2018. The time series data is use in this study. First we check the data is stationary or non-stationary for this using the ADF unit-root test. The result indicates that the data is non-stationary at Level. The data has been stationary when we have taken first difference of the data. Then the test for normality the result indicates that the data is not normally distributed. After that the test for auto-correlation for all variables use in our study. Both the gold and stock shows that there is an auto-correlation, its means that these variables are dependent on their previous lags. In the visual inspection of the return series shows that there is an ARCH effect in the data. But the empirical test for the LM-ARCH was done to known about that if there is ARCH effect or not. The result of this test explore that there is ARCH effect in Return of Stock and Gold and no ARCH effect is seen in the USD. So, the estimation is based on GARCH (p,q). This model is one of the best to capture the ARCH affect. GARCH model is using to examine the Mean, Volatility and Cross Spill-over effect amongst the gold market, stock market and forex market.

The important results of this research are given below. Which we can analyzed after the estimation.

In case of Gold market and Stock market:

Mean-Spillover effect:

The coefficient of the stock is significant and positive but the coefficient return of the gold is insignificant so there is a Uni-directional Mean spill-over effect from stock market to gold market and from gold to stock market.

Volatility Spill-over effect:

The coefficient of volatility of stock is significant in volatility equation of gold. The coefficient of variance of gold is also significant in variance equation of stock. Therefore we can say that there is volatility spill-over effect between these two markets and the effect is bi-directional.

Cross Volatility Spill-over effect:

The mean return of the gold is affected by the volatility in the stock the coefficient is significant. But the return of the stock is not affected by the volatility in the gold the coefficient is insignificant. We concluded that there is a Uni-directional cross volatility spill-over effect from gold to stock market and from stock market to gold market.

In case of Gold market and Forex market:

Mean-Spillover effect:

The coefficient of the retune of the USD is insignificant and negative in the mean equation of the gold. On the other hand the coefficient of return of the gold is insignificant. The result explore that there is no Mean-spillover effect between these two markets.

Volatility Spill-over effect:

The coefficient of the volatility of USD is significant and negative. But the Gold coefficient is positive and significant. There is volatility spill-over effect from gold to forex market and from forex market to gold market. Both the markets are inversely related with each other.

Cross Volatility Spill-over effect:

The return of the gold is affected by the volatility in the USD and the coefficient is negative and significant the negative sing shows that when there is fluctuation occur in USD exchange rate the impact is negative on gold market. The return of the USD is affected by the volatility in the gold and the coefficient is positive and significant. So the result shows that there is a bi-directional spill-over effect from gold market to forex market and from forex to gold market.

In case of Stock market and Forex market:

Mean-spillover effect:

There is no mean-spillover effect from stock market to forex market and from forex to stock market. The return of the stock has not been affected by the return of the USD and also the return of the USD is not affected by the return of the stock.

Volatility Spill-over effect:

There is a volatility spillover effect from stock market to forex market and from forex to stock market. Both the coefficient of volatility is negative and significant. The negative sing shows that if the information is transmitted from one market to another market. The flow of the information of one market has negative impact on the other market.

Cross Volatility Spill-over effect:

The return of the stock is effect by the volatility in the USD and the coefficient is significant and negative. In case of USD and stock the return of the USD is has been affected by the volatility in the stock the coefficient is negative and significant. Therefore we concluded that there is a cross-volatility spill-over effect from stock market to forex market and from forex market to stock market. Bi-directional effect is there.

Policy Recommendation:

Spillover effect is pre-requisite for hedging; we found spillover effect between gold and forex markets. It indicates that information is transmitted from one market to another market.it suggested that a portfolio diversification of gold and forex may reduce risk associated to these markets. The spillover effect is also found between gold and stock markets, its means that the information transmitted between these two markets. It suggested that a portfolio diversification of gold and stock may reduce risk associated to these markets.

References:

Afsal, E. M., & Haque, M. I. (2016). Market Interactions in Gold and Stock Markets: Evidences from Saudi Arabia, *6*(3), 10.

Apergis, N. (2013). The Australian Dollar and Gold Prices. *The Open Economics Journal*, *6*(1), 1–10. https://doi.org/10.2174/1874919401306010001

Aylin Erdoğdu. (2017). The Most Significant Factors Influencing the Price of Gold: An Empirical Analysis of the US Market. *Economics World*, *5*(5). https://doi.org/10.17265/2328-7144/2017.05.002

Beckmann, J., Czudaj, R., & Pilbeam, K. (2015). Causality and volatility patterns between gold prices and exchange rates. *The North American Journal of Economics and Finance*, *34*, 292–300. https://doi.org/10.1016/j.najef.2015.09.015

BF-2012-0905944.pdf. (n.d.).

Chen, K., Wang, M., & Pan, Y. (2017). Revisiting the price of gold and exchange rates with quantile regression model, 19.

ciner, C. (2001). On the long run relationship between gold and silver prices A note. *Global Finance Journal*, *12*(2), 299–303. https://doi.org/10.1016/S1044-0283(01)00034-5

Contuk, F. Y., Burucu, H., & Güngör, B. (2013). EFFECT OF GOLD PRICE VOLATILITY ON STOCK RETURNS: EXAMPLE OF TURKEY, *5*(1), 22.

Geete, V. (n.d.). A Study on Impact of Gold Prices and Dollar Prices on Stock Market Indices with Special Reference to Sensex Nifty, *01*(01), 6.

Gokmenoglu, K. K., & Fazlollahi, N. (2015). The Interactions among Gold, Oil, and Stock Market: Evidence from S&P500. *Procedia Economics and Finance*, *25*, 478–488. https://doi.org/10.1016/S2212-5671(15)00760-1

Ibrahim, S. N., Kamaruddin, N. I., & Hasan, R. (2014). The Determinants of Gold Prices in Malaysia. *Journal of Advanced Management Science*, *2*(1), 38–41. https://doi.org/10.12720/joams.2.1.38-41

Kiohos, A., & Sariannidis, N. (2010). Determinants of the asymmetric gold market. *Investment Management and Financial Innovations*, *7*(4), 9.

Le, T.-H., & Chang, Y. (n.d.). DYNAMIC RELATIONSHIPS BETWEEN THE PRICE OF OIL, GOLD AND FINANCIAL VARIABLES IN JAPAN: A BOUNDS TESTING APPROACH, 30.

Mukhuti, S., & Bhunia, A. (n.d.). Is it true that Indian gold price influenced by Indian stock market reaction?, 6.

Nair, G. K., Choudhary, N., & Purohit, H. (2015). The Relationship between Gold Prices and Exchange Value of US Dollar in India. *EMAJ: Emerging Markets Journal*, *5*(1), 17–25. https://doi.org/10.5195/EMAJ.2015.66

Oma, A. (n.d.). AN OBSERVATION OF THE RELATIONSHIP BETWEEN GOLD PRICES AND SELECTED FINANCIAL VARIABLES IN TURKEY, 12.

Ping, P. Y., Ahmad, M. H. B., & Ismail, N. B. (2016a). Volatility spillover effect study in U.S. dollar and gold market based on bivariate-BEKK model (p. 060006). Presented at the ADVANCES IN INDUSTRIAL AND APPLIED MATHEMATICS: Proceedings of 23rd Malaysian National Symposium of Mathematical Sciences (SKSM23), Johor Bahru, Malaysia. https://doi.org/10.1063/1.4954611

Ping, P. Y., Ahmad, M. H., & Ismail, N. (2016b). Analysis of volatility spillover effects using trivariate GARCH model. *Reports on Economics and Finance*, *2*, 61–68. https://doi.org/10.12988/ref.2016.612

Ranjusha. N, Dr. Devasia. M. D, & Nandakumar. V. T. (2017). Cointegrating Relation Between Exchange Rate And Gold Price. *Zenodo*. https://doi.org/10.5281/zenodo.1043230

Raza, N., Jawad Hussain Shahzad, S., Tiwari, A. K., & Shahbaz, M. (2016). Asymmetric impact of gold, oil prices and their volatilities on stock prices of emerging markets. *Resources Policy*, *49*, 290–301. https://doi.org/10.1016/j.resourpol.2016.06.011

Recent rise in the prices of commodity has become a major concern for the world economy. (2011), 10.

Sadeghi, S. K., Sanoubar, N., Marvasti, M. B., & Karbor, R. (2014). The Relationship among Gold, Stock and Foreign Exchange Markets: Evidence from Iran. . . *Asian Journal of Research in Business Economics and Management*, *4*(1), 7.

Shen, Z. (n.d.). How the US Dollar Index Affects Gold Prices, 38.

Sinton, J. (2014). An Empirical Investigation of the Causal Relationship between Gold Price, Exchange Rate Changes and Jakarta Composite Index, 10.

Sjaastad, L. A. (2008). The price of gold and the exchange rates: Once again. *Resources Policy*, *33*(2), 118–124. https://doi.org/10.1016/j.resourpol.2007.10.002

Subhashini, S. (2012). AN EMPIRICAL INVESTIGATION OF THE CAUSAL RELATIONSHIP BETWEEN GOLD PRICE, EXCHANGE RATE AND CRUDE OIL, 7.

Sujit, K. S., & Kumar, B. R. (n.d.). STUDY ON DYNAMIC RELATIONSHIP AMONG GOLD PRICE, OIL PRICE, EXCHANGE RATE AND STOCK MARKET RETURNS, 21.

Tang, P. (n.d.). THE RELATIONSHIP BETWEEN GOLD PRICE, EURO, US DOL- LAR, OIL PRICE AND STOCK MARKET, 44.

Toraman, C., Başarır, Ç., & Bayramoğlu, M. F. (n.d.). Determination of Factors Affecting the Price of Gold: A Study of MGARCH Model. *Business and Economics Research Journal*, 14.

Volume 12 (1) Article-8.pdf. (n.d.).

Zizun, L. (n.d.). DETERMINANTS OF GOLD PRICE IN MALAYSIA, 97.