Hedging by diversification-an analysis of stocks, bonds, and gold-evedence from Pakistan markets

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“DUA”

O Allah! Do not make our hearts diverge after you guided us and grant us from yourself mercy, indeed you are the Bestower.

A thesis submitted to **Pakistan Institute of Development Economics, Islamabad** as partial fulfillment of the requirements for the award of the Master degree in Business Administration.

Dedication

I wish to dedicate this research thesis to my late beloved mother,

She taught me to conserves and prepared me to face the challenges with Belief and humility, when I was six years old. She was persistent source of inspiration to my life. Although, she is not here to give me strength and support. I always feel her existence that used to need me to struggle to accomplish my objectives in life.

DECLERATION

I ***Syed Arif Hilal*** sincerely declare that this thesis entitled ***"hedging by diversifications: an analysis of gold, bond yield, and stocks; evidence from Pakistan markets"*** submitted by me for the award of a Master degree in Business Administration is my own personal struggle under the supervision of my most skillful supervisor. Furthermore, I ensure that this study is original and to the best of my knowledge that this work has not the copyright of other except where such work has been cited in the text.

Syed Arif Hilal

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ABSTRACT

This study examines the hedging by diversifications for the analysis of gold, bond yield, and stock in case of Pakistan markets. This study utilizes secondary data, and collects first January, 2014 to fifteen November, 2018 from yahoo finance, invsting.com, and business recorder. The various tests are used, which are stationarity, normality, serial correlation tests, and ARCH effects test through LM ARCH test in the study. Moreover, in this study the MGARCH and Diagonal BEKK-GARCH family model are employ with Gauss method for estimating the optimal hedge ratios for the construct of six portfolios diversifications. Thus, we hedged the six portfolios of gold/bond yield, gold/stock, bond yield/gold, bond yield/stock, stock/gold, and stock/bond yield have designed. The results suggest that there are just one best portfolios, which is gold/stock in this study. Hence, investors and portfolio managers can achieve more benefits, when they hedge stock against gold. Although, they can also get benefits from hedge of gold/stock. There are also three hedged portfolios of (i) gold; bond, stock, (ii) Stock; gold, bond, and (iii) bond; gold, stock have designed in the study but the results investigate that there are no benefits from these portfolios, these are worthless. Finally, the empirical findings illustrate that gold and stock can be hedged and to reduce the portfolio risk in case of Pakistan markets in this study. Hence, our study delivers an important indication to the international, domestic investors, and portfolio managers in diversifications of portfolio and management of risk.

Keywords: Hedge; Gold; Bond yield; Stocks; Portfolios Diversifications.

CHAPTER NO: 1

INTRODUCTION

1.1 What is hedging?

When people decided to hedge, they protect assets against for upcoming negative event. If we buy cars insurance, that means we are hedging ourselves against damage to car or fires or other future disasters. When individual investors, corporations and portfolio managers are using hedging techniques to reduce various risk. However, in the financial markets, hedging may become more complicated than the other simple paying insurance company. So, the meaning of hedging versus investment risk is strategically via an instrument in the financial market to reduce the risk of any hostile price fluctuations and financiers may hedge an investment by creating new one. The hedging is an investment to secures our finances from the bad situation. Because of hedging to minimize the chances that our assets will lose the value. Hedging is the method to reduce the risk of losses due to price fluctuation. Finally, hedge doesn't have any specific feature of decreasing losses in the time of market stress but asset might reveal optimistic correlation in sometimes and a negative correlation in normal times. (Baur and Lucey, 2009). We strive to hedge return of gold, bond yield, and stock with each other in this study.

There are different fields of literature to which hedging of gold and analysis of gold, stocks, and bonds. Steven et al. (2009) investigated the correlations among stocks, bonds, and gold. They analyzed that gold commodity is a significant asset category and usually has been recognized as a safe haven and investors can get positive returns from their investments. Spillover index has been used to observed, whether or not the gold returns and volatilities able to foresee the fluctuations of NYSE stock and bond market. The interdependence between gold and stock, and gold and bond, whether or not that the variations in gold prices can able to use as a forecaster for

stock and bond prices. stock and bond prices. Gold had a low negative correlation with stocks and bonds on the point of view of portfolio construction.

Hatice and Zafer (2013), studied that gold is the special asset to reduce risks of portfolio, typically in the times of unfavorable market situations in turkey, besides it they suggested that gold had hedging properties. However, the impact of gold and dollar prices on the equity market indices, that both the dollar and gold prices were having a positive effect on the stock market (Vishal Geete, 2014). Gold is a global currency. Peoples were invested more in gold for reserve their asset during volatile economic conditions. They identified that gold could be hedged against fluctuations in the NYSE market (Ping et al, 2016). Taufiq et al. (2007 and 2014), they studied that gold could not be performed efficiently and could not be hedged throughout the time of financial crisis due to the bidirectional interdependence between gold returns and equity as equity market instability. On the other side, they suggested that gold could be hedged against return of stock in a steady financial condition.

According to Shaique et al. (2014), gold is the safest haven for the investment and stock markets are examined highly volatile. Author's main objective was to analyze the impact of gold price and KSE-100 index to identify the relationship between gold and the stock market. Magdalena (2013) studied the potential advantage and risk coming from precious metals investment by the prism of investors from Austria, Slovakia, and Slovenia, taking into consideration that the performance of the main stock exchange indices and the exchange rate in these three countries. The Author's main objective of the research is to recognize the part of precious metals can play in investor's portfolio. According to the (Monjazeb and Maryam, 2012) to observed that investors are decleared to the important persons at the stock market who's pursue to raise returns from their investment. Investment in equities are assessed one of the investment opportunities. Some elements are influence the returns on investment, one of the most important variables are macroeconomic. Authors analyzed the effects of such variables i.e., gold and oil

prices impact on stock returns of the banks, which are listed on the stock market.

Another researcher specified, that stock market performance has a significant impact on the economic development of a country. Stock markets are assumed to be influenced by various financial and macroeconomic variables such as gold and oil prices, increase in prices/inflation, rate of interest, rate of exchange, and the rates of unemployment etc. the studied was tried to found the impact of financial and macroeconomic variables on Karachi Meezan index 30. (Syed wajahat, 2016). On the basis of the studied of (Dejan et al. 2018), that Russia country is one of the best major energy and valuable metals manufacturers in the rest of world, they tried to discovered shock and volatility transmission from both directions while its influence on Russian RTS and of the six merchandises with each other such as, the brent oil, natural gas, gasoline, gold, platinum, and palladium. Lukas Hein (2015), studied the financial catastrophe in 2008 was certainly to manifested the excessive class of interrelationship between distinct asset types and exchange markets, the researcher aimed to investigate the relation spillover between four distinct asset classes such as equity, gold, oil, and foreign exchange.

Gold and other precious metal markets have currently retrieved particularly from finance researchers, it is straightforwardly explained by the investors to make hedge assets for portfolio diversifications, because risks associated with the markets and they invest in stocks instead by the financing in the alternative asset classes on the basis of (Arouri et al. 2011). The interrelations between the USD rate of exchange and gold market, if gold is utilized for hedge versus the ultimate rates of exchange of the dollar. However, if the rate of dollars is diminishing, it will take more dollars to purchase gold due to this the gold value could be increased (Girish et al. 2011).

Demand for gold has mostly increased in East Asian countries such as China, India, Japan, Korea etc. The researcher's aim to analyze the relationship between gold price and other three crucial financial market factors such as a bond, equity and domestic credit for the ASEAN

countries (Sayyed Mahdi, 2008). Gold is one of the most malleable and beautiful of metals, history by humans there have been active gold markets for over 6000 years. The researchers purposed to investigate the relationship between gold and stocks and to check that as gold represents as a hedge against china's stock market (Ke and Wang, 2017). The Authors have been studied the effective linkages of the gold and silver with each other, the valuable metals can be utilized for help to buy back the currency and either these two metals have been employed as for the money/currency. These precious metals can play an important part in diversifying at risk and it is being an attractive investment for the investors (Brain and Edel, 2004).

In the other previous research that gold has a potential to decrease systematic risk when it added to the portfolio of stock, gold performance is strong during the recession. It is included consistently a safe haven as a by-product of the financial crisis. Furthermore, gold as an inflation hedge and also a currency hedge against the dollar, and it can be used as a mean of portfolio diversification (Barrend Pule, 2013). On the basis of Pakistani research perspective, gold is used as the investment approach by the government body, hedging of funds, and different investors etc. Gold remains a fruitful hedge against for increases in prices and the more economic dilemmas, prices of gold also raise by the inflation. The higher return on investment in gold motivated vast investors (Shahbaz et al. 2011).

According to the Indian researcher (Mishra et al. 2009), the price of gold in India is consistently increasing because of its massive demand in the country due to full security and it as reserved by the central bank, and there is no credit risk connected with the gold. Moreover, gold is able to retain its liquidity also at the time of financial crisis such as inflation, political instability etc. Even gold is to make a diversified portfolio. Gold has supposed to occurred unrelated along another types of assets, in which have significant quality in the time of development in which the relationships raised fairly between especial types of asset, the above mentioned are the important role of the gold. The researchers examined, that gold is supposed to

the protection used for the stocks in United State, United Kingdom, and Germany, and as well as considered the safe haven used for the bond-yield, therefore the features of this protection is for the short time (Dirk and Brian, 2010).

1.2 Research Gap:

To the best of my knowledge, we want to hedge the financial assets i.e. bond and stock, and precious metal i.e. gold with each other in case of Pakistan financial markets. Before there is no studied in case of Pakistan. We want to know, whether these three variables will hedge with one another or not? Because this information is very useful for investors and portfolio managers. Hence, we studied for the sake of investors and other policymakers that which kind of portfolio diversifications will favorable for them?

1.3 Research Questions:

- Can we hedge gold against bond yield?
- Can we hedge gold against stocks?
- Can we hedge bond yield against gold?
- Can we hedge bond yield against stock?
- Can we hedge stock against gold?
- Can we hedge stock against bond yield?
- Which is the best option for portfolio investment?

1.4 Objectives of the study:

- We want to check whether we hedge gold, stocks, or bonds the Pakistan perspective.
- we want analyze that whether gold, bonds or stocks can be hedged against each other or not? And can reduce the Pakistan financial market risks or losses?

- We compute the optimal hedge ratios of gold to bond yield, gold to stock, bond yield to gold, bond yield to stock, stock to gold, and stock to bond yield to decide which we can hedge on the basis of empirical results in chapter 4.

1.5 Significance of the study:

There is the huge number of research papers and literature about the studies of hedging. However, even there is no analysis on Pakistan market perspective related to the topic i.e., can we hedge gold, stocks, or bonds with each other, this is also the GAP of our research study. This study is very significant for the investors, policymakers and portfolio managers whether they are domestic or foreigner. It is also important especially in bad financial conditions fall in the country, i.e. high inflation, uncertainty about economic situations, financial crisis, the uncertainty of natural disasters and political instability. Risk reduces due to portfolio diversification and hedging, investors are more interested and motivated in the investment in the financial assets.

1.6 Why hedging is important?

Hedging protects us from risk, if we bought stock and we presumed that the price of this asset would arise but our desired to secure this asset from the losses, if the stock prices falls. We would hedge these risks with on the put option. However, we have to right buy and also can sell this financial asset on the similar price. Although, If the price decreases, we decide to put exercise for the back of money which we have invested. There is another strategy of hedging is diversifications. We have two assets that do not fall and rise together. If one asset collapses, so we will not lose the other, e.g. most investor has own bonds to reduce the risk of stocks. When stock prices decrease, bond values rise. On the other hand, the values of bonds decrease when stock prices also decrease that both are the risky investment. Some examples of the gold, we desire to secure ourselves against the affects from increase in price, if we hedge the gold. Gold

retains its worth whenever decrease of dollar. Gold is hedge for the downfall of dollar, because dollar is the international currency in rest of the world. If the dollar breakdown, so the gold will be the original currency in the global world. Gold was the form of money and as a good hedge against high inflation. Many people or investors invest in a gold i.e. gold hedge against stock losses. Some researchers investigated that gold prices become increase for 15 days after crashes of the stock market. Moreover, if we think the gold price will rise, so we can buy gold as a direct investment because demand of the gold will increase and supply will decrease, that means gold is not a hedge. Hedging is important when;

- We take benefits of today's rates for the upcoming three or more years.
- Hedging allows us, to guarantee for the value of the future sales.
- Because of hedging, removing today's instability of currency markets.
- Hedging allows us to flexibility to decide whether to buy at market rates.

1.7 Plan of the Study:

Chapter 1 includes Introduction, what is hedging, definitions and explanations, research questions, research gap, objectives of the study, significance of the study, and importance of hedging.

Chapter 2 includes Literature review, introduction, empirical literature, and explanation of the results, research hypothesis.

Chapter 3 includes Research methodology: introduction, stationarity test, normality test, serial correlation test, ARCH test, MGARCH model, DBEKK model, optimal hedge ratios.

Chapter 4 includes Results and discussions: introduction, figures and tables, interpretations of all tests results, optimal hedge ratios by DEBEKK model.

Chapter 5 includes Introduction, summary, recommendations and future research gap.

References.

Appendix.

CHAPTER NO: 2

LITERATURE REVIEW

2.1 Introduction:

In this chapter included the very detail explanation of the related work of literature of safe haven or hedging of gold, portfolio diversification. There are different theories, models and approaches that can be used to interpret the hedging gold, stocks, bonds. However, there are a lot of models and approaches were used to resolve the absolute nature of the hedging, portfolio diversification of these three types of asset, i.e. (gold, stocks, and bonds).

2.2 Empirical literatures:

Gencer & Musoglu (2013) analyzed the volatility transmission and spillover effects among gold, stocks, and bonds. Their study confirmed a bi-directional shock and volatility transmission between gold and Turkish stock market, while there was a uni-directional transmission between gold and Turkish government bonds based on the bivariate BEKK-GARCH model. Moreover, there was a negative correlation between gold investment against stocks. Finally, they found and illustrated that gold is a unique asset for portfolio diversification.

Sumner et al. (2009) examined the interdependence among gold, stocks, and bonds. They used the spillover index methodology calculated by using vector autoregressive model (VAR) and with that two lags of variables have been used. Authors have been analyzed that the correlations among the returns and volatilities between returns of the gold and the returns of stock market are weakly negative, and returns of gold are negatively correlated with bonds returns. On the other hand, stocks and bonds have a positive and strong correlation. Moreover, stock return volatility has been shown positive correlation with both the gold and bonds. In their

results expressed that gold could be hedged against the other assets and could be reduced a portfolio's volatility.

Sujit & Kumar (2011) investigated the effective connections of the price of merchandises included gold, unrefined oil, rate of exchange, and return of equity market by employed a vector autoregressive VAR model. In their study, they have utilized dual models to be expressed the effective interrelationship, in their premier model they have taken gold index in the U.S dollar, on the other hand they have taken gold index in euro. They have taken WTI stock market spot price (dollars per barrel) in the first model and the second model they have taken Europe Brent spot price (dollar per barrel), these variables were utilized through test of the granger causality. However, in their outputs suggested that rates of exchange have directly influence on the prices of gold, oil and the equity market indices, that instabilities in the prices of gold are hugely depends on the gold by itself then oil and rest of further indices. Furthermore, instability in the gold price influence the WTI stock market index.

Beckmann et al. (2012) analyzed; Is gold have really the characteristics of the hedging or the safe security or not? They were used two type of models, one was the BFGS and the second was GARCH-1,1 model for the existing heteroscedasticity, followed the econometric framework of (Baur and Lucey, 2010). They also estimated the tested for linearity against non-linearity. They projected that the gold of Indonesia, Russia, and Turkey provided a robust hedged concerned, but expressed that gold could not be hedged in instance of China, and Germany. Although, gold seemed to achieve weak hedging role in the period of monthly observations. In the case of India and UK, gold is a strong and has secure haven quality, and the coefficient estimated to be significantly negative because both of the countries is the major gold consumers. Finally, they investigated that gold could provide both of the hedging and also secure haven property and the gold market remains very crucial for the policymakers, investors, and useful for portfolio diversification.

Worthington & Pahlavani (2006) examined that the investment of gold as the inflationary from hedge for the constant long-run relations of the gold and monthly prices of inflation with each other in the United State, on the basis of unit root test for the timing to be estimated of significant breaks, preferably to assumed exogenous. The authors mention in their paper, that structural change comes in many time series for some causes which are the financial crisis, variations in institutional arrangements, policy diversify, and also management modification. Finally, in their empirical results suggested that there was great indication of the constant long-run interdependence of the gold price and inflation with each other in both of the post conflict of 1970s, that made for significant structural variations of the gold market in the United State and inflationary rules. Moreover, according to the authors that the price of gold and the inflation can be moved reliable in the long-run, and they also indicated that investment in the gold could be served as the inflationary hedged.

Tan & Kwan (2016) investigated the volatility spillovers and linkages in Asian stock markets, they model the return volatilities of the 12 benchmark indexes by using vector autoregressive model (VAR) with 4 lags, they followed the model of (Diebold and Yilmaz, 2009, 2012). VAR-BEKK framework technique requires a distinct variance form in the multivariate general autoregressive conditional heteroskedasticity GARCH type model. They analyzed that in the special case of Philippine and Thailand stock markets, which occurs similar correlation levels in the return volatility with the Chinese before and after the crisis. The coefficients between China and Japan is negative before 2010, and after 2010 the shrank is almost zero.

Samanta & Zadeh (2009) to examined the co-movements among the returns of instabilities of the gold prices, real exchange rates for dollar, oil prices and the stock prices on the basis of vector autoregressive model and by using spillover index. In their results showed, that the sample observations were not symmetric, nor mesokurtic and the probability distributions were also non-normal. Authors indicated that cross effects present among the variables, in the case of gold there

have the significant effect of the lags values of the exchange rates and the Dow-Jones industrial index and the similar as for the oil prices. However, in the instance of the exchange rate and the DJ index there has some significant impact on the lags values of the stock prices. Furthermore, they have conducted the co-integration test among the variables on the basis of Johansen's methodology. In their results suggested that co-integration has existed among those variables. Finally, they suggested that the price of stock and the price of gold are moved together, but the price of oil and the rates of exchange to be affected through another variables.

Diebold & Yilmaz (2009) Studied to estimate the interrelationship of returns asset or volatiltity of global equity markets. They analyzed the distinct estimation of returns and volatility spillovers, they studied for both the crisis and non-crisis, which included movements and bursts in spillovers. In the analysis of 19 global markets, they found confirmed some different behavior in the dynamic spillovers versus volatility spillovers, in the return spillovers showed a softly rising trend but there were no bursts while in the volatility spillovers showed no trend but there have been clear bursts.

Pakira et al. (2013) investigated the impact of gold price and exchange rates in India, the daily data have been used through unit root, test of Johansen cointegration, and the granger causality test. They proposed in their study, that the exchange rate movements will influence international trades, thus affect the stock market. In their results expressed, that the co-integration exists for the long term, while the results of the multivariate cointegration test showed the relationship between Indian gold price, rates of exchange and Sensex for the long terms but that multivariate cointegration test did not accept the null hypothesis. Furthermore, in the pairwise causal test results revealed i.e., there wasn't causal dependency amongst Indian gold price-Sensex, Sensex-gold price, exchange rates-Sensex, Sensex-exchange rates because the probability is more than alpha value. Finally, that showed there is no bi-directional causal

relationship present between gold price and exchange rates as the probability value is less than alpha value.

Charlotte Christiansen (2003) examined the volatility spillover effects in European bond markets which are affected due to the volatility in U.S., and European bond markets. The Author differentiated between global, regional and local volatility impacts by applied GARCH-type model for both the mean and volatility spillover from the U.S., European bond markets into separate countries. Moreover, the mean spillover impacts have been occurred to be negligible while volatility spillover impacts have been occurred to be crucial. The Author analyzed that the Economic and Monetary Union (EMU) countries (include Denmark) regional influence have been expressed to be most crucial by the local impacts. On the other hand, global impacts have been expressed to be almost in-significant. Furthermore, for the non-EMU countries own country impacts have been appeared to be stronger, but the European impacts smaller and the U.S. impacts larger. Finally, the EMU countries have been expressed to be less influenced by the U.S. bond market, subsequently the initiation of the euro. Author has found affirmation that there are differences between the volatility of the bond markets of EMU countries and non EMU countries.

Aleemi et al. (2013) studied the role of gold prices, rate of exchange, and rate of interest on consistent inflation in Pakistan for both in the long and short-term periods, they used time series data through Johansen co-integration and vector error correction methodology. In their results have shown that gold prices and interest rate were significantly positive along the inflation in the long run. They also suggested that an increase in gold price and also interest, so that will indicate in the rise in inflation in Pakistan while the exchange rate has found insignificant to affect inflation, but in the short run the exchange rate is appeared to have a negatively significant impact on inflation. So, when the increase in the rupee will consequently decreases in the inflations.

Bayram et al. (2014) studied the financial market risk and gold investment related to the stock market evidence from turkey. In the study, they want to identify that, if gold as a hedge asset in times of crisis. Authors utilized the GARCH, TARCH model by used daily data from 2005 to 2014, and Augmented Dicky-Fuller (ADF) test which is used for the stationarity of the time series data. Finally, they suggested that gold could be secured and has also the held property of the safe haven, and no significant correlation was found between gold and the equity markets. Gold can be hedged against market risk in the portfolio for the Turkish country.

Rehman et al. (2010) analyzed the significance returns and the volatility movements of the KSE-100 with international index, foreign portfolio, and foreign direct investment, by utilized multivariate EGARCH model. Data has been collected from KSE-100 and Global index from 2005 to 2010. They investigated the diversification chances for international investors during the crisis. Finally, they suggested that the negative movements of return of KSE with global index, international investors can take benefits of diversification by hedging process against the price movement in the local stocks.

Aftab et al. (2013) examined the gold hedge against currency and equity of twelve Asian countries by used DCC-MGARCH model for to test, that gold link with currency and equity. They were used weekly data from 1995-2013. In their results revealed that gold can play a role as diversifying not hedging of Asian equity markets. On the other side, gold can hedge in the currency market against exchange rate. Finally, they suggested that gold can be a safe haven against the currency in the selected sample countries.

Jaiswal and Voronina (2012) studied the linkage between returns of gold and returns of stock from the big four countries i.e. Brazil, Russia, China, and India. Data range was from 2001 to 2010 and applied Pearson's, BEKK-GARCH type of model for to test the correlation between return of gold and return of stock. In their result expressed, that gold return and stock return have

been correlated but with low degree. Moreover, the correlation of different countries and economic sectors may affect investors decision in the option of investments allocation. There were also presented the spillover effects, both the unidirectional and bidirectional between the return of gold and return of stock. Finally, results revealed that gold is a well portfolio diversifier which plays a crucial role in hedging and also it could be fruitfully to predict the stock.

Chulia et al. (2015) investigated the six Latin American stock markets shock to the U.S. stock index, daily stock prices data were used from 1995 to 2015 by utilized vector autoregressive model (VAR). Each country indices measured by the market price which are traded on the stock market. They were taken the natural log of the original data and transformed the data into return series. Furthermore, they observed that diversification strategies are possible and could be exploited investments in the Latin American markets because of a shock to the United State market. However, it is a good strategy of diversification for both countries such as Chile and Brazil but in the times of crisis.

Thi Hong (2012) to examine hedged of gold against inflation in France and quoted in Paris, the data has been collected from 1949 to 2011. The author tested the relationships between gold and inflation in France for both the short and long term. However, for the study of the short-term relationship, the linear regression, correlation coefficients of Pearson and Spearman were used. Moreover, for the study of the long-term relationship, the tests of co-integration were used. Finally, in the results revealed that there was no significant relationship between the gold in Paris and inflation in France. The author analyzed that in Paris, gold is not a good hedged against France inflation.

Lim & Wijaya (2009) studied that there were two type of asset investment and economic stress time, such as gold and stock, crisis and after crisis situation in Indonesia. Their research aim was to choose for the investors about the best investment opportunity in a crisis and after the

crisis situation. They were used daily data of stock and gold prices, and applied some tests for normality, stationarity, test for variance, t-test. Finally, in their results showed that gold as a best investment choice against stock in the crisis condition but stock as a best investment choice against gold in the after crisis situation.

Finta et al. (2013) examined spillover effects between the US's NYSE market and the UK's LSE stock market, daily data were used from 2007 to 2013 for both the UK and US equity markets. Public holidays and the one-day market closed were removed from the selected sample, by utilized the vector autoregressive model (VAR). In the results showed that higher equity market volatility in the United State followed to higher volatility in the United Kingdom in the time of trading overlapping hours. Their results suggested for hedging strategies and also risk management.

Coudert & Raymond (2009) studied about the character of gold in the hedging against the stock or could be secured in the bear markets, monthly data were used for the gold and various indices i.e. France, UK, US, Germany, and G7 has been collected from 1978 to 2009. Covariance between the gold and the stock's returns were estimated through bivariate ARMA, GARCH-X. In the results revealed that gold can be hedged or safe haven against the stock index, and it can be held in the bear markets or recessions. The covariance between gold returns and stocks returns have been observed negative.

Nelly Fernando (2017) investigated to whether gold is a proper diversifier asset for the investors, it can be enhanced the adjusted risk for investor's portfolio, and optimal weight of gold to equity portfolio in Swedish country. The entire data was collected from 1968 to 2016 by utilized Sharp ratio and optimal allocation of gold was calculated on the base of well the diversified equity portfolio. There was a positive but weak correlation between equity and gold in the time of analysis, and for all the examined period the correlations were significant at a p-

value less than 0.05. However, in the results revealed that useful allocation for gold was depending on the time period. According to the author, that gold is a better diversifier for the investors in the Swedish country, the gold was more appropriate diversifier opportunity than the other precious metals like silver and platinum.

Hornbrinck & Olausson (2013) examined that how currency returns traded and related-with gold, and how can be usefully included in portfolios. The data were collected from the London bullion market from 1993 to 2013, and currency from Deutsche Bank. Utilized Spearman's correlation, diagonal BEKK-GARCH, and vector autoregressive model. In their paper found that there was a positive but low correlation between gold returns and currency. According to the authors, they suggested that in a portfolio when gold and carry trade strategy combining so it would be great and beneficially diversifier.

Wang et al. (2006) also investigated that gold could be act of the hedged in the inflation in Japan and United State of America? They were used the monthly data of CPI and prices in the US dollar and Japan yen from 1971 to 2006. The authors applied the unit root test for stationarity of the data and utilized linear and nonlinear test for co-integration and nonlinear regression model. According to the authors, they found after the studied that return of gold was unable to hedged in the high inflation for short period in both the US and Japan countries. Although, when the price of gold is fixed in the low momentum, while in the high momentum the return of gold was also unable to fully hedge against inflation. However, it would be able to hedge against inflation when the price of gold might not have fixed in the US country. Moreover, they suggested that in the long run gold has been partially hedged in Japan.

Graham Smith (2012) examined the relationship among gold prices and stock indices

for Japan and Europe countries, by used the data of 17 European markets and Japan were used from 1991 to 2001, and utilized correlation coefficient for analyzed the short run co-moments

between returns on stock and returns on gold. While correlation coefficients are generally calculated between returns on the basis of financial markets see: Kasa (1992). Whenever stock prices fall, so the gold prices increase. Moreover, the author suggested that there was a small but negative correlation between returns on the stock price and returns on the gold in the short run, while it was an insignificantly small but positive correlation for some series. Finally, the author found that in the long run, stock and gold price was not co-integrated.

Rui Huo (2016) analyzed the nature of interdependency among Chinese equity market, derivative, and international equity market, high frequency data were used the period from 2015 to 2016. Utilized vector autoregressive and GARCH type model. According to the author that spillover effects are important for managing the risk and beneficial of portfolio diversification, investing in both the commodity and equity/oil markets were the substantial opportunity for portfolio diversification. To minimize the risk, the portfolio manager should have to quantify optimal and hedging ratio, by the applied of GARCH and VAR-BEKK model to computed hedge ratios and portfolio weights. Finally, the author suggested that invests in oil or stocks, the investors have been able to gain benefits from diversification and also able to hedge risk when investors invest both the stock and commodities. The author analyzed in his/her overall empirical results indicated that without the losing the return, the commodity was a better portfolio diversifier of equity or oil and can be reduced or minimized the financial risk.

Pedro Raffy (2016) studied to spillover effects of commodities to Brazilian equity markets and analyzed the diversification possibilities. The daily data of the Ibovespa index and US dollars were used from 2000 to 2006 through the multivariate GARCH model. The research analyzed that there was a strong relationship between the Ibovespa index and the commodity price, it was observed that during the financial crisis, there was a strong increase in conditional variance between Ibovespa stock and commodity. On the other side, before and after the 2008 crisis,

conditional correlation between these two variables was small, which indicated that investments in the Ibovespa and in the commodities were developed risk strategy of diversification.

Cheng & Wing (2017) analyzed the relationship of china's gold and stock markets, by used the daily data gold and five stock indexes which are the Shanghai, Shenzhen, Capitalization weighted and SME board index from 2002 to 2017. DCC-GARCH model was estimated for these five bear markets. In the results showed, that the effects of hedging gold on China's equity market have been strengthening because of the gold investment demand increases. According to the authors, that gold has the property of safe haven for only the two bear markets and gold cannot be a good hedged property for non-bear markets.

Janor et al. (2013) investigated the spillover effects and hedging of gold, crude oil and stock markets of five ASEAN countries which are Malaysia, Singapore, Indonesia, Thailand, and the Philippines. They have used three variables in their study. The data of the five ASEAN stock returns were collected from 2000-2013, by utilized EGARCH and MEGARCH model. Furthermore, in the results showed that there was a significant but positive effect of oil price on all the five equity market indices, it means that any increase occurs in the oil prices would directly increase in the returns of equity indices. According to the authors, in the case of Malaysia and Singapore country, the effects of hedging cannot be held while in the case of the other three countries which are Thailand, Indonesia, and the Philippines, equity market can be provided a better hedging opportunity against the fluctuations in the oil market. On the other hand, they suggested that in the case of Philippines, Indonesia and Thailand gold can be a better hedge against fluctuations in the equity price. Finally, they indicated that gold could be secured and could be diversified only in the Thailand, Philippines, and Indonesia countries.

Khurshid & Kirkulak (2016) analyzed optimal weights and also hedge ratios for the portfolio of oil to stock holdings of Balkan equity market which are (Romania, Turkey, Bulgaria,

and Greece) included, and that how a good hedging strategy can be developed. The daily data have been used and collected from Balkan equity markets from 2000 to 2016, and utilized through VAR-GARCH model. In their results showed, due to the low correlation between oil and Balkan equity markets, thus there would be efficient opportunities of hedging and good portfolio diversification for the investors. Moreover, they suggested that investors can be invested in the Balkan equity markets rather in oil of their portfolio strategy and can also be hedged the investment risk of stock in their portfolios against oil asset.

Chiang et al. (2009) investigated the interdependency among gold price, bond price and stock price and also examined that these assets can be hedged or safe or even cannot be hedged. The daily closing data were taken and range from 2002 to 2009, by applied the multivariate GARCH model. In their results revealed, that gold has a good hedge and better diversification portfolio for equity investment. On the other hand, the linkage between gold price and oil price, thus gold has the property to store its value. They also suggested that gold can be safe for only bonds in the time of crisis. Furthermore, gold is a better instrument to hedge against the equity market just in the time of financial crisis, but even it is not a safe haven for equities after the financial crisis.

Milla Ilona (2016) studied about the precious metals that can act as portfolio diversifiers of the Swedish, Finnish, Danish, USA or Norwegian stocks. Daily data were taken from 1988 to 2016, utilized through GARCH type model to analyzed the portfolio diversifying of these five country's stocks. In their results showed that precious metals had potentially diversified in a portfolio of stocks for these five countries. However, especially in the high market volatility, he/she found the benefits of diversification for Sweden with gold, Finland with silver also benefits of diversification with platinum and for Norway gold with platinum can be diversified in a portfolio. Charles et al. (2017) also suggested in their empirical result that strategy of buy

and hold of these three precious metals can efficient for portfolio diversification, but depends on the political and economic conditions.

Following are the six-research hypothesis of the six-portfolio investment, and we want to hedge these three variables with each other, i.e. H_0 is the null hypothesis while H_1 is the alternative hypothesis.

2.3 Research Hypothesis:

H_0 = Gold cannot be hedged against bond yield.

H_1 = Gold can be hedged against bond yield.

H_0 = Gold cannot be hedged against stock.

H_2 = Gold can be hedged against stock.

H_0 = Bond yield cannot be hedged against gold.

H_3 = Bond yield can be hedged against gold.

H_0 = Bond yield cannot be hedged against stock.

H_4 = Bond yield can be hedged against stock.

H_0 = Stock cannot be hedged against gold.

H_5 = Stock can be hedged against gold.

H_0 = Stock cannot be hedged against bond yield.

H_6 = Stock can be hedged against bond yield.

CHAPTER NO: 3

RESEARCH METHODOLOGY

3.1 Introduction:

In this chapter we will discuss in details about three variables, data collection technique, synchronizing the data, checks the data for stationarity, normality. Applying some tests for stationarity by using augmented dickey fuller test (ADF). Checks the autoregressive conditional heteroscedasticity (ARCH) effects by using the Lagrange Multiplier (LM) test, autocorrelation test, and after taking d-log then we will utilize multivariate BEKK-GARCH type model for optimal hedging of the analysis of gold, bonds yield, and stocks for the six portfolio diversifications such as returns of gold hedging against returns of bond, gold returns against hedging stock returns, bond returns hedging against gold returns, bond returns hedging against stock returns, stock returns hedging against gold returns, and last one the stock returns hedging against bond returns.

3.2 Definitions and explanation of gold, stock, and bond:

Gold is a rare and pliable metal in nature. Historically it was a valuable metal and has been used as the intermediary exchange and reserved of capital, because it was one of the good conductors and very highly pliable, even in the present days. Gold was first put into operation in Great Britain in 1821s. It has been long used at irregular for coinage in one or another country. Today, gold is a crucial asset class but its tangibility is different from paper assets like stock, bond etc. Gold's tangibility allocates an important part of a reserve, but mostly in future contingencies such as politically, economically and high inflation because they cannot be predicted with certainty. The gold price is also especially associated with economic and political uncertainty; it has totally free of risk. Demand for gold is affected by a diversity of objects that

are influenced by the macroeconomic condition of a country and also globally. There are some reasons that why investors buy gold, some investors regard that gold is a strategic asset and can be used as a means of portfolio diversification, other regard gold is an inflation hedge and a currency hedge. (Barrend Pule Pule, 2013).

Where a person buys or sell and trade stocks of companies of any business days is called stock exchange or market. Stock market plays a very crucial part for the industries and also for the investors who want to invest in stock market to make maximum return. In Pakistan there were three stock exchanges such as Karachi stock exchange (KSE) was founded on 18 September in the year 1947 and was incorporated on 10 March in the year 1949, Lahore stock exchange (LSE) was founded in October 1970 and Islamabad stock exchange (ISE) was incorporated in October 1989. At those times, that three exchanges had distinct management, swap coherence, indices, and entry conditions etc., and there were no correlative associations with each other. After some time, these three types of stock exchanges were integrated together and construct a newly integrated exchange is known as Pakistan stock exchange limited (PSX), therefore the stock exchange was initiated its processes on 11 January in the year 2016, became this new name PSX.

Bond is an instrument of indebtedness of the bond issuer to the holders. It is a debt security under which the issuer owes the holders a debt and depending on the terms of the bond is obliged to pay them interest. Bond is a long-term debt instrument with an ultimate maturity periods, usually up to 10 years or more than 10 years and issued by a corporation or government. There are two most common types of bonds, which are municipal and corporate bonds. A municipal bond is a debt security instrument allotted by a provincial government or their other representatives, for to invest its investments expenses, e.g. roads, schools, airports, and seaports etc. While the corporate bond is a bond issued by a corporation, for to raising capital and to

expand its business. Finally, it is indicated that bonds are also the safe investment for the investors.

3.3 DATA COLLECTION TECHNIQUE:

In this study, we used the secondary and the time series data of the financial markets. The daily data of gold, bonds, and stocks have been collected and in the period from first January, 2014 to fifteen November, 2018. Total 1408 observations have been used in this study. Daily data of the variables have been collected from different websites, such as gold data has been collected from business recorder, the daily data of government bonds yield have been collected from investing.com, and the daily data of stock has been collected from yahoo finance as PSX-100 index. After the collection of data, then we synchronized the entire data, because there were missing in the data of the closing days of financial markets. Moreover, we have to check the data whether the data is stationary at level or not, if the data will not stationary at level so we will take d-log of the entire data such as the gold, bonds, and the stocks, and it will become the return series. i.e.

General equation of returns of gold, bond yields, and the stocks are the following.

$$\mathbf{r_t} = \boldsymbol{ln}\ \frac{\boldsymbol{P_t}}{\boldsymbol{P_{t-1}}} \quad \textbf{..... (1)}$$

where in the equation (1), it is for all the return series of gold, bond yields, and stocks. r_t represents the returns on gold, bond yields, and stocks with time t, Ln indicates the natural log, P_t is the price at time t, and P_{t-1} means the previous price of gold, bond yields, and stocks at time t. In the next section various tests and models are used in this study.

3.4 ECONOMATIRCS MODELS AND ITS SPECIFICATION:

In this study, we are using econometrics tools such as checking stationarity by using augmented

dickey fuller ADF test, normality test, checking autoregressive conditional hetroskesdicity ARCH effects in the series, and multivariate generalized autoregressive conditional hetroskesdicity. i.e. BEKK-GARCH type model through OxMetrics software. Following are the procedures:

3.5 Checks Stationarity:

First, we have to check stationarity by apply augmented dickey-fuller (ADF) test of the raw data whether to see that data is stationary at level or nonstationary. The stationary mean that the means, autocorrelation, and variance of the series are constant with the time. On the other hand, nonstationary mean that the means, autocorrelation, and variance of the series are change with the time. The procedure for the checking the raw data, we are using Ox-Metrics (econometrics and statistical software). Following are the general equations for stationarity.

$$\boldsymbol{X_t \sim I(0)} \ \ldots\ldots\ldots\ldots (\mathbf{2})$$

$$\boldsymbol{\Delta Y_t \sim I(1)} \ldots\ldots\ldots\ldots (\mathbf{3})$$

Where, in the second equation the ***I (0)*** represents that the series is stationary at level. While, in the third equation the ***I (1)*** represents that the series is stationary at first difference. Moreover, the graphs of the original data and of the series return are mentioned in the next chapter as results and discussion.

3.6 Theoretical Model:

In this study, we are using the three variables, we identify a model for these three variables in which we assume that the gold return is the function of the composite stocks and bonds. i.e.

$$\mathbf{r_{g,t} = F\ (r_{s,t}\ ,\ r_{b,t}\ )}$$

Where, $\mathbf{r_g}$ indicates gold return in Pakistan, $\mathbf{r_s}$ represent the stock return as PSX-100 index, and

$\mathbf{r_b}$ represent the bonds return as government bonds yield in Pakistan. Finally, **t** indicates the time.

3.7 Augmented Dickey Fuller test (Unit Root Test):

Augmented Dickey Fuller test ADF were developed by the American statisticians Wayne Fuller and David Dickey in the year of 1979. ADF test is used for determination of unit root in the series. ADF test is the simplest process for to test that series has unit root or not. The more negative number in the ADF test, the better the rejection of the null hypothesis. In the next page, the equation for to checks stationarity of the time series data employ in this study. So, the equation is:

$$\Delta Y_t = \beta_1 + \beta_{1t} + a y_{t-1} + \gamma \sum_{t=1}^{n} \Delta y_{t-1} + \varepsilon_t \ \ldots\ldots\ldots (4)$$

In the above equation, the presence of unit root for Y_t that indicates all three variables at over time t in the augmented dickey fuller regression test. The unit root test is initiated on the Y_{t-1} coefficient in the augmented dickey fuller ADF regression, and where the ε_t indicates the error term in the above equation of the unit root test, whether its null-hypothesis is that there has the unit root. Moreover, if the beta coefficient is significant i.e. less than zero, it means that y is rejected because it has unit root. Following is the null and the alternative hypothesis for the presence of the unit root in the Y_t variable. i.e. See (Sinton, 2013).

H_0: null hypothesis is that there is exists unit root in the time series, $\alpha = 0$.

H_1: alternative hypothesis is that there does not exist the unit root in the series. $\alpha < 0$.

Either:

H_0: The series is not stationary.

H_1: The series is stationary.

The above two hypothesis of the augmented dickey fuller test ADF are, one is the null and the second is alternative hypothesis. When the absolute ADF statistics value is greater than absolute critical value, so we will reject the null and we will go towards alternative option of the hypothesis that the series is stationary, while the absolute ADF test value is less than the absolute critical value, so we cannot be rejected the null and we will accept the null that the series is not stationary.

3.8 Test for Normality:

In this section, we check the normality of the return series for all the gold, bond yield, and the stock, whether the series are normally distributed or not. In the normality test it includes, mean, skewness, kurtosis, jarque bera are using in this study. There are also the two hypotheses for the normality test, we are discussed one by one with the two hypothesis and with its criteria.

3.8.1 Mean:

The central tendency of every single value is known as mean in the series. Adding these total observation, for example 1408 observation of this study and dividing by this number of the population. Following is the general equation of the mean.

$$\frac{\sum \mathbf{Xi}}{\boldsymbol{n}} \quad \ldots\ldots\ldots\ldots (\mathbf{5})$$

Where, X_i is the total population of the series, and n is the numbers of population. From the above equation, we can easily find out the average of the series.

3.8.2 Skewness:

It is the distribution in the series, whether the curve shows bend to the right or to the lift. When the curve bend toward right, it's called the positive skewed while when it is bend toward lift is known as negative skewed. The value of skewness may positive or negative. Furthermore,

there are two types of hypothesis for to test skewness, one is the null hypothesis and second is the alternative hypothesis. Hypothesis are in the next page.

H_0: Skewness is equal to zero, i.e. SK = 0

H_1: Skewness is not equal to zero, i.e. SK ≠ 0

When the skewed value is greater than zero, so its mean that the distribution is highly skewed. If the probability value is less than the alpha value, so we may reject the null, that the skewness is equal to zero. Whether, if the probability value is greater than alpha, so we cannot reject the null and we go toward the alternative hypothesis, that the skewness is not equal to zero.

3.8.3 Kurtosis:

It is the structure of peaks in the series distribution. If the series kurtosis is high, it's means that the series tails have heavy. While, if the series kurtosis is low, it's mean that the series have the light tails. However, if the kurtosis is equal to zero and that is K is generally equal to 3 i.e. (3-3 = 0), so we can say that the series distribution is normal. Following are the two hypothesis of the excess kurtosis. i.e.

H_0: Excess kurtosis is equal to zero, EK = 0

H_1: Excess kurtosis is not equal to zero, EK ≠ 0

If the excess kurtosis is less than zero, it will indicate that the tails tend to negative and it is known as platykurtic. While, if the excess kurtosis is greater than zero and the tails tend to positive is known as leptokurtic and its overall depend on the effect of the sample size of the series. On the other hand, if the peak is moderate of the series and the measure of the peakedness of the distribution and it is equal to zero is known as mesokurtic and the series is normally distributed.

3.8.4 Jarque Bera (JB) Test:

It is the LM test for goodness of fits of the series, whether that the series have kurtosis and skewness meet with the normal distribution or not, and the test follows Chi^2 with the 2 degrees of freedom. If the JB is equal to zero, we can say that the time series data is normally distributed. There are also two types of hypothesis, i.e.

H_0: Series is normally distributed

H_1: Series is not normally distributed

According to the Anil K. Bera and Carlos Jarque, the following equation for to test JB.

$$\boldsymbol{JB = \frac{n-k+1}{6}\left(\frac{S^2+1}{4}(C-3^2)\right) \ldots\ldots\ldots\ldots (6)}$$

Where, in the above equation **n** represents the observations or the df. **K** indicates the kurtosis of the series, and **S** indicates the skewness of the series. Above is the general kurtosis equation of the Jarque Bera test. Furthermore, If the JB value is greater than the alpha value at 5% significance level, so we may reject the null and says that the series is not normally distributed, while if the JB statistics value is less than the alpha value, otherwise we cannot be rejected the null and we can say that the time series data is normally distributed.

3.9 Serial correlation Test:

It is also known as autocorrelation, it is the relationship between the current value of the variable and the previous value of the variable over the time in the series. The repeating pattern of the autocorrelation affects the leading value. However, if the variable' autocorrelation value is equal to zero, so that the values are independent with each other. Whether, if the variable's autocorrelation value measured to be greater than zero or 1, so that the correlation is exists and depends on each other. See the following general equation.

$$X_{t-2}, X_{t-1}, X_t, X_{t+1}, X_{t+2} \ldots\ldots\ldots (7)$$

Where, in the above equation X_t is the current value in the series and X_{t-1}, X_{t-2} are the lags, while the X_{t+1}, X_{t+2} are the lead values. There are also the two hypotheses for the serial correlation test. i.e.

H_0: No autocorrelation

H_1: The series is serial correlated

If the probability value is less than alpha value at the 5% significance level, so we will reject the null hypothesis and we will choose the alternative hypothesis. Whether, if the p-value is greater than the alpha value, so we will not reject the null and we can say that there is no autocorrelation in the time series.

3.10 ARCH Test:

The process of autoregressive conditional hetroskesdicity (ARCH) was adopted by the American economist Engle's in 1982, to analyze the relationship of the volatility and of the level with each other. And the test is based on whether the squared residuals are auto correlated presented and the residuals are hetroskesdicity. We using the LM arch test for the test arch effects in the return series. There are the two hypotheses of the autoregressive conditional hetroskesdicity, i.e.

H_0: No ARCH effects

H_1: Series is subject to the ARCH effects

If the calculated value is less than the alpha value, so we will reject the null and we can say that series is subject to the arch effects, while on the other hand, if the calculated value is greater than the alpha value at 5% significance level, so we cannot reject the null and we can say that there are no arch effects in the return series. However, if there are present the arch effects in our series,

so we will go to the multivariate DBEKK-GARCH type model because in this study we investigate hedging of six portfolios.

3.11 Multivariate GARCH Type Model:

Multivariate GARCH type models specify the equations that for how the variances and covariances move over time. Modeling a covariance matrix is difficult because of the high dimensionality of the problem and the constraint that a covariance matrix must be positive definite. The important stage in multivariate GARCH modeling is to provide a realistic but parsimonious specification of the variance matrix ensuring its positivity. Obviously, a disadvantage of the multivariate approach is that the number of parameters to be estimated in the GARCH equation increases rapidly, which the limited number of assets that can be included (Minovic & Simeunovic, 2008). The multivariate GARCH model is not so simple like the univariate generalized autoregressive conditional hetroskesdicity model. in generally,

$$\boldsymbol{Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + \varepsilon_t} \ldots\ldots\ldots (\mathbf{8})$$

In the above equation, Y_t is the linear combination of its own past values on its lag, both the Y_t and X_t are stationary of the time series and ε_t is the error term or white noise. However, in the multivariate series the Y_t is not only having depend on the lags of same variables but also interest the lags of different variables. Suppose that conditional mean is zero, following is the general equation suggested by the (Bollerslev et al, 1988).

$$\boldsymbol{r_t = H_t^{1/2} \varepsilon_t} \ldots\ldots\ldots\ldots\ldots (\mathbf{9})$$

$$\boldsymbol{vech(H_t) = C + \sum_{i=1}^{p} Ai\, vech(\mu_{t-i}\, \mu'_{t-i}) + \sum_{i=1}^{q} Bi\, vech(H_{t-1})} \ldots \mathbf{(10)}$$

In the above equation, where μ_t represents $(N \times 1)$ return vector over the time = i, and H_t represents the matrix $(N \times N)$ of the conditional variance and co variance related to the error

term and μ_t. Furthermore, μ_t and error term (ε_t) is the procedure of the MV white noise having the co-variance matrix (I_N). Finally, the $(N \times 1)$ and C indicates the constant, i.e. $\frac{N(N+1)}{2\times1}$, and A, B are the square of $\frac{N(N+1)}{2\times1}$ matrices. H_t, that is H_1 represent the returns of the unconditional co-variance of matrices.

In general Matrix:

$$B=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix} n \times n$$

3.12 Optimal hedge ratio by using Diagonal BEKK-GARCH Model:

Investors have some kind of risk associated with the investment, they have to option to reduce the risk in an investment through hedging. If investors enter in to the hedge against losses, they can reduce the minimum amount of risk. We are hedging for the protection of future losses of different portfolios diversification. If we loss in one portfolio of the investment doesn't mean that we may loss in the other portfolio of the investment. Hedge means we just reduce the risk, not making such profits. On the other hand, optimal hedge ratios also called the minimum variance strategy of the portfolios. There are a lot of hedge ratios, but the most perfect and valuable is the minimum variance and its objective is the minimize variance of return on portfolio, (Ahmed, 2012). Hedge ratios have used and examined through the conditional variance and co-variance of the present and future returns, (Bollerslev at al., 1988).

DBEKK-GARCH Model:

Diagonal BEKK model was proposed and used by the (Bollerslev et al, 1988) investigated that the conditional variance of a variable depends just on the value of the lags square and the conditional co-variances among the variables just depends on the cross products of the value of lags of the variables. However, in the return of financial series we determine the conditional

variances and conditional co variances through diagonal BEKK model, because diagonal BEKK model give to us a satisfactory measure for the benchmark. Further, it does not endure from the limitation of the series data due to diagonal BEKK model., (Allen and McAleer, 2017). Diagonal BEKK-GARCH is below:

$$H_t = CC' + \sum_{i=1}^{q}\sum_{k=1}^{k} A'_{ki}\,\varepsilon_{t-1}\varepsilon'_{t-1}A'_{ki} + \sum_{i=1}^{p}\sum_{k=1}^{k} G'_{ki}\,H_{t-1}G_{ki}$$

In the above model, A_{ki}, G_{ki}, and C indicates the diagonal matrices for the optimal hedge of the six portfolios diversifications. This is important for those matrices of products of the $(\varepsilon_{t-1}\varepsilon'_{t-1})$ by the *A*. so, *A* is a diagonal and it is defined positive. It is provided $(T \times T)$ matrix. Additionally, OLS method has been used to estimate hedge for optimal return portfolios.

$$r_1 = a + r_p + br_2$$

Now R_p become;

$$r_p = r_1 - a - br_2$$

So, the VAR model is;

$$R_t = \sum_{i=1}^{k} A_i\,R_{t-1} + \varepsilon_t$$

In the model, where,

$$R_t = \begin{bmatrix} r_1 \\ r_2 \\ r_3 \end{bmatrix}, \varepsilon_t = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{bmatrix}$$

In the DBEKK model, where,

$$\boldsymbol{H_t} = \begin{bmatrix} \boldsymbol{h_{11,t}} \boldsymbol{h_{12,t}} \boldsymbol{h_{13,t}} \\ \boldsymbol{h_{21,t}} \boldsymbol{h_{22,t}} \boldsymbol{h_{23,t}} \\ \boldsymbol{h_{31,t}} \boldsymbol{h_{32,t}} \boldsymbol{h_{33,t}} \end{bmatrix}, \boldsymbol{C} = \begin{bmatrix} \boldsymbol{C_{11}} \boldsymbol{0} \boldsymbol{0} \\ \boldsymbol{C_{21}} \boldsymbol{C_{22}} \boldsymbol{0} \\ \boldsymbol{C_{31}} \boldsymbol{C_{32}} \boldsymbol{C_{33}} \end{bmatrix}$$

H_{11} represent the co-volatility while **H_{12}** represent the conditional volatility at time **t**, and **C** indicate the constant.

Furthermore, in this study, we use and select 2 week's sample out of the 1408 samples from the return series of the gold, bond yields, and stock. We are making six portfolios diversification from these three variables for to hedging through diagonal baba Engle Kraft Kroner DBEKK-GARCH model with Gauss distribution method. The return series of the three variables used in this study are:

R_{gt} = → Gold

R_{bt} = → Bond yield

R_{st} = → Stock

Where, **R_{gt}**, **R_{bt}**, and **R_{st}** are the returns on the gold, bond yield, and stock over the time **t** in the portfolios. Following are the general equations of optimal hedging ratios of the six portfolios of the above return series. i.e.

- ***Hedging ratio of the return series of gold, bond, and stock:***

$$\boldsymbol{r_i = a + br_j + \varepsilon_t} \ldots\ldots\ldots\ldots \boldsymbol{11}. (\boldsymbol{a})$$

Now return on portfolio becomes, i.e.

$$\boldsymbol{r_p = r_i - a - br_j + \varepsilon_t} \ldots\ldots\ldots\ldots\ldots\ldots (\boldsymbol{b})$$

Minimum variance strategy of r_{pt} of the portfolio is become:

$$V(r_p) = V(r_i - a - br_j) + \varepsilon_t \ldots\ldots(c)$$

Minimum variance strategy for the function of b:

$$f(b) = V(r_p) = V(r_i - br_j) + \varepsilon_t \ldots(d)$$

$$f(b) = \delta ii + b^2 \delta jj - 2b\delta ij + \varepsilon_t \ldots\ldots(e)$$

$$f'(b)\frac{df}{db} = 2b\delta jj - 2\delta ij + \varepsilon_t = 0 \ldots(f)$$

Now special function of the variance of r_{pt} is:

$$b^* = \frac{\delta ij}{\delta jj} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(g)$$

Now hedge equation is become:

$$rp_t = ri_t - b^* rj_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(h) \qquad i \neq j$$

In the above equations, r_i and r_j are the return series, a indicates constant, b is used for hedge in the equation **(a)**. σ_{ij} represents the co-volatility of r_{it} and r_{jt}, and the σ_{jj} represents the conditional volatility of r_{jt}. Moreover, in the equation **(h)**, r_{it} represents here as a variance of un-hedge and overall $r_{it} - b^* r_{jt}$ represents the variance of hedge, and the percentage reduction is the following:

$$\%\, Reduction = unhedge - hedge \times (100/hedge) \ldots\ldots\ldots(i)$$

CHAPTER NO: 4

RESULTS AND DISCUSSIONS

4.1 Introduction:

In this chapter, we will find the hypothesis from our data analysis on the basis of those tests and models which are discussed in the chapter 3. We included figures and tables of the estimated results which are found from the return series. We discussed, whether the series are normal distributed or not, series are stationary or not, is there autocorrelation exists in the return series or not? Is the autoregressive conditional heteroskedasticity ARCH effects present in the return series, if present we will apply MGARCH model. Interpretations are included on the basis of finding results of the return series of gold, bond yield, and stock. We also discussed and interpret of the six portfolios hedging through Diagonal BEKK model. This chapter is divided in various sections of the data analysis.

4.2 ***Stationarity Test:***

First, we check stationarity of the original data that the data is stationary at level or not? Following are the original data of the gold prices, bond yields, and the stock prices have been estimated through ADF test.

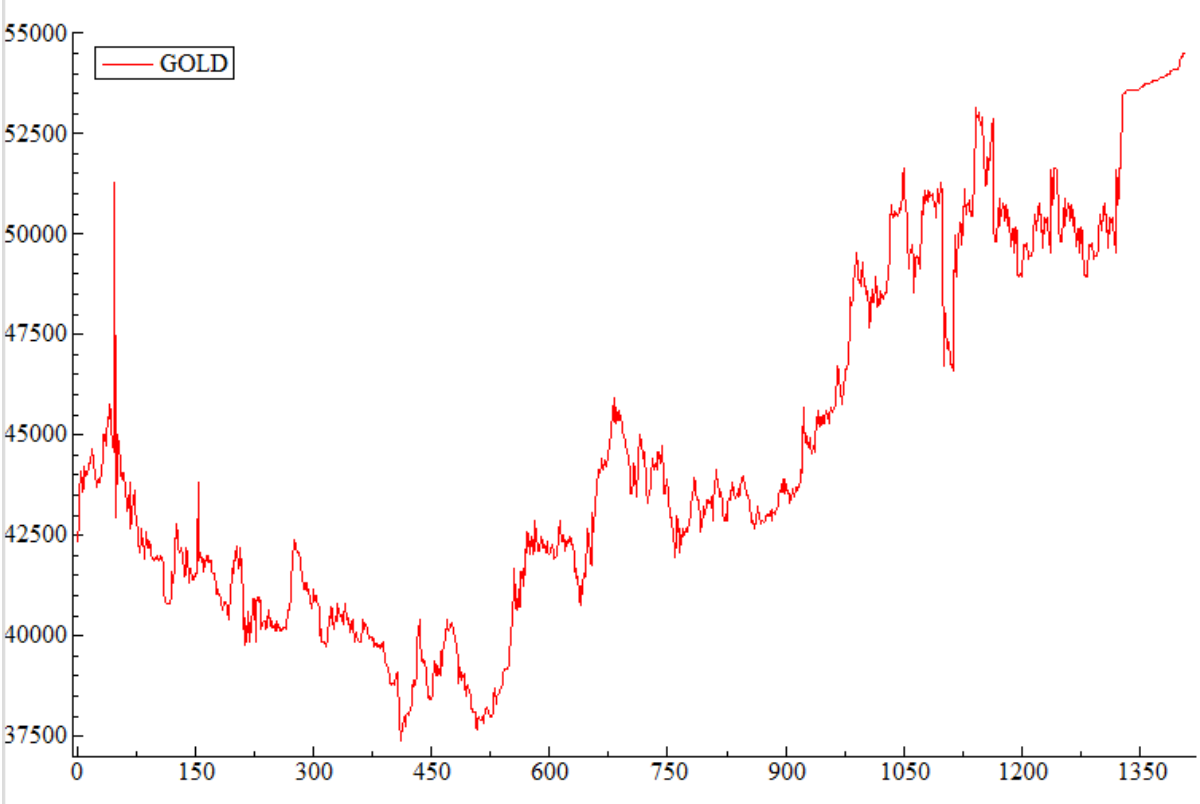
ADF (UNIT ROOT TEST) **Table 1**

S. No	Variables	ADF-Statistics values	Critical values at 1%	Critical values at 5%	Critical values at 10%
1	Gold	0.977467	-2.56572	-1.94093	-1.61663
2	Bond yield	-0.308998	-2.56572	-1.94093	-1.61663
3	Stock	0.739586	-2.56572	-1.94093	-1.61663

The augmented dickey fuller ADF test, the ***table 1*** result show that ADF statistics values of gold, bond yield, and stocks are **(0.977467)**, **(-0.308998)**, **(0.739586)**, and the critical values are **(-2.56572)** at **5%**, **(-1.94093)** at **1%**, and (**-1.61663**) at **10%** significance levels for all the three variables and we have taken absolute of these negative variables. So, the null hypothesis for all the three variables are not rejected because the ADF statistics values are less than critical values. Moreover, we can say that our data is non-stationary at level. Following are the actual graphs of the original time series data of the gold price, bond yield, and the stock prices. Whilst, in the ACF plots are showing the autocorrelation functions and PACF plots indicating the partial autocorrelation functions are exist in all the returns series, because the points are out of the bound thus there are presence of autoregressive process. ***See appendix***.

Actual series of Gold

(Figure 1)



The other figures ***(2, 3)*** of the actual series of bond yield and stock in the next page, and shows non-stationary to support ADF test results.

Actual series of bond yield

Figure 2

Actual series of stock

Figure 3

Interpretation:

In the figures ***(1, 2, 3)*** shows, there are the actual gold, bond yield, and stock series that our series are not indicating the mean reverting behaviors i.e. mean is changing over the time, and our series are instable. It shows that the gold series is not stationary at level. Furthermore, we are taking d-log for making return series for all the three variables, it is briefly discussed in chapter 3.

ADF (UNIT ROOT TEST) **Table 2**

S. No	Variables	ADF-Statistics values	Critical values at 1%	Critical values at 5%	Critical values at 10%
1	**Gold**	-25.8783	-2.56572	-1.94093	-1.61663
2	**Bond yield**	-28.5945	-2.56572	-1.94093	-1.61663
3	**Stock**	-20.4521	-2.56572	-1.94093	-1.61663

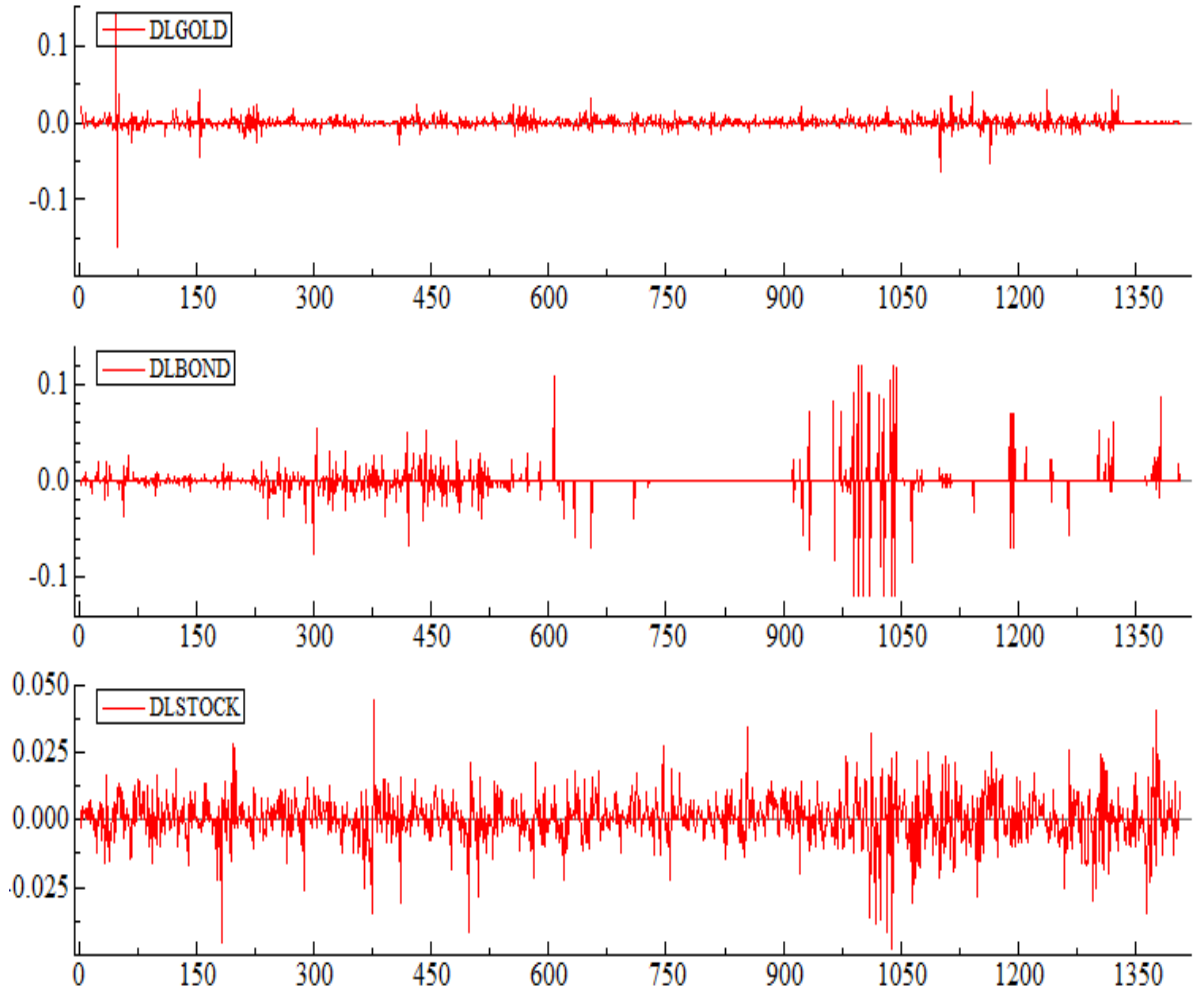
*Significance level at **1%, 5%, 10%**

Interpretation:

Table 2, results show, that the ADF statistics absolute values of the return series of gold, bond yield, and stock are (**-25.8783, -28.5945, -20.4521**). When we compare these values with the critical values, which are shown in table 2. We suggested that ADF absolute values are greater than the critical values. So, we reject the null hypothesis and can say that the return series are stationary. The figures of the return series of gold, bond yield, and stock are in the next page.

Actual return series of gold, bond yield, and stock

Figure 4



In the above ***figure 4*** shows, that return series are become stationary, because the up and down signs show us the volatility, here the mean is constant and equal to zero. It is indicating the mean reverting behaviors. The above figure also indicates, that there are autocorrelation problems in the return series. The large up and down lines with mean point in the ***figure 4*** reveals of small and large volatility in the all the return series of gold, bond yield, and stock.

4.3 *Normality Test:*

Secondly, we are determining that whether the return series is normally distributed or not. In this section includes, mean, skewness, kurtosis, JB test, and figures of the return series, i.e.

Descriptive Statistics of Return Series **Table 3**

Return Series	Mean	Standard Deviations	Skewness	Excess Kurtosis	Jarque Bera
Gold	0.0001	0.0089816	-1.3371**	117.44*	8.0845e+005*
Bond yield	0.0000	0.017155	-0.14515**	26.124*	39986.*
Stock	0.0003	0.0088316	-0.39728*	3.9449*	948.68*

*Significance levels at ***1%, **5%, ***10%**

Hypothesis for Excess Kurtosis:

H_0: Excess kurtosis is equal to zero, EK = 0

H_1: Excess kurtosis is not equal to zero, EK ≠ 0

Table 3 results show for in the case of gold return series, that mean is the average value which is very near to the zero and its mean that it has mean reverting behaviors. While, in the case of bond yield the mean is also near to zero, and in the case of stock, the mean is very near to zero and we can say that it has mean reverting behaviors in the all return series. Although, standard deviations of all the return series are almost near to the average. However, skewness of all the return series; in the case of gold the tail is toward negatively skewed, it is negatively but low skewed for the bond yield, while in the case of stock and it is also negatively low skewed. On the other hand, the all return series are not symmetric because the p-value is less than alpha value 0.005. Furthermore, Excess kurtosis and Jarque-bera have shown the results in the above

table 3 that excess kurtosis of all the return series are tends to the positive and the peakdness of gold return series is very high, so the return series is leptokurtic as well as for bond return, while in the case of stock the peak curve is lower but tends to positive and it is also leptokurtic. Similarly, JB values of all the return series are higher than zero. In the case of excess kurtosis, the null hypothesis of all the return series have been rejected because $k \neq 0$, the series are not normal as well as for JB. Finally, after done all the normality tests, all the results show that our return series are not normally distributed. Figures for non-normally distributed are in the ***Appendix page.***

4.4 ***Serial Correlation Test:***

In this section we are going to interpret the serial correlations of all the return series of the raw and squared series. Q-statistics results are shown in the following tables of the gold return, bond yield, and stock. i.e.

Q-Stat on raw data of gold return

Q (5)	75.3728	[0.0000000]**
Q (10)	78.3861	[0.0000000]**
Q (20)	92.6299	[0.0000000]**
Q (50)	114.234	[0.0000006]**

Q-Stat on squared data of gold return

Q (5)	320.734	[0.0000000]**
Q (10)	320.779	[0.0000000]**
Q (20)	321.384	[0.0000000]**
Q (50)	321.832	[0.0000000]**

(Table 4)

Q-Stat on raw data of bond yield return

Q (5)	142.554	[0.0000000]**
Q (10)	152.691	[0.0000000]**
Q (20)	226.369	[0.0000000]**
Q (50)	358.325	[0.0000000]**

Q-Stat on squared data of bond yield return

Q (5)	377.864	[0.0000000]**
Q (10)	526.581	[0.0000000]**
Q (20)	850.295	[0.0000000]**
Q (50)	1453.96	[0.0000000]**

(Table 5)

Q-Stat on raw data of stock return

Q (5)	22.6517	[0.0003934]**
Q (10)	29.8489	[0.0009068]**
Q (20)	58.8282	[0.0000108]*
Q (50)	84.4859	[0.0016560]**

Q-Stat on squared data of stock return

Q (5)	75.1102	[0.0000000]**
Q (10)	132.532	[0.0000000]**
Q (20)	202.387	[0.0000000]**
Q (50)	244.708	[0.0000000]**

(Table 6)

Table 4, 5, and ***6*** results are showing, that all the return series of gold, bond yield, and stock both the raw and squared data of the null hypotheses have been rejected in the case of all return series, because both the raw and squared series values are less than the **5%** alpha value and the serial correlations are exists in the both the raw and squared series. It's mean that all the series have depends on the previous lags from 5 lags to 50 lags.

4.5 ***Autoregressive Conditional Heteroskedasticity ARCH Test Interpretation:***

In this section, we interpret the results of all the return series on the basis of output of the Lagrange Multiplier LM arch test. i.e.

LM ARCH Test Results

Gold return series	
ARCH 1-2	F (2,1401) = 263.61 [0.0000]**
ARCH 1-5	F (5,1395) = 123.30 [0.0000]**
ARCH 1-10	F (10,1385) = 62.653 [0.0000]**
Bond yield return series	
ARCH 1-2	F (2,1401) = 100.79 [0.0000]**
ARCH 1-5	F (5,1395) = 60.500 [0.0000]**
ARCH 1-10	F (10,1385) = 33.313 [0.0000]**
Stock return series	
ARCH 1-2	F (2,1401) = 21.255 [0.0000]**
ARCH 1-5	F (5,1395) = 11.440 [0.0000]**
ARCH 1-10	F (10,1385) = 8.5953 [0.0000]**

(Table 7)

Interpretation:

Table 7 results of all the return series are showing us, that ARCH effects from ***(1-2, 1-5, 1-10)*** lags of all the return series are rejecting the null hypotheses in all the three cases. It's mean that all the series are subjected to autoregressive conditional heteroskedasticity ARCH effects, and we can see clearly that all the p-values are less than the **5%** critical values in all the cases of series returns. So, that's why we go to the alternative hypothesis. Although, the LM ARCH test results proved that ARCH effects exist here in all the return series, due to the presence of ARCH effects. Therefore, we will use the multivariate diagonal BEKK-GARCH type model for to estimation of the optimal hedge ratios for to fulfill our objectives in this study.

4.6 ***Optimal hedge ratios by using DBEKK-GARCH Model:***

In this section, we are estimating the six portfolios diversifications of gold, bond yield, and stock to find whether are the best hedging asset for the investors to invest in these assets Which are,

i. ***Gold against hedge bond yield***
ii. ***Gold against hedge stock***
iii. ***Bond yield against Gold***
iv. ***Bond yield against Stock***
v. ***Stock against Gold***
vi. ***Stock against Bond yield***

The optimal hedge ratios result of the six portfolios diversifications are in the next page, which are given a full information of the investment opportunities.

Optimal Hedge Ratios of six portfolios

Model							
DBEKK	**Optimal Hedge Ratios**						**% Reduction in Risk**
Portfolios	**b***	**c***	**d***	**e***	**f***	**g***	
Gold/Bond	-0.0049						-1.7441
Gold/Stock		-0.0065					**2.3846**
Bond/Gold			-0.0495				-52.905
Bond/Stock				0.2630			-23.877
Stock/Gold					-0.0132		**4.7868**
Stock/Bond						0.0634	-98.003

(Table 8)

Interpretation:

Table 8 results are showing the optimal hedge ratios of six portfolios, the estimation of optimal hedge ratios through diagonal BEKK model with Gauss/Normal distribution. The above model is perfect and fit, because there were no autocorrelations left both the Q-stat on residuals and as well as on squared residuals, also no ARCH effects left in all the returns series. **See appendix**. There are two best portfolios out of six portfolios which are the second and fifth one, but remains other are the worst portfolios. There is the great opportunity for the investment in these two portfolios, because there is a positive reduction in risk in the both portfolios ***(2, 5)***.

Therefore, the other four portfolios are associated with highly risks. So, these four portfolios are worthless and investors should not have to invest in these types of portfolios. The top of the two portfolios are indicating that the chance of losses is very low instead of the other four portfolios. Moreover, in this study we have determined that there is benefits, when we hedge gold against stock.

Whilst, there is excellent benefits when we hedge stock against gold of the fifth portfolio, but investment in the other portfolios have no benefits. We also estimated optimal hedge ratios for three portfolios of these return series, but there are also no benefits to invest in these portfolios. ***See Appendix***. Finally, on the basis of above results we decide that we can hedge gold against stock and can invest in these assets in case of Pakistan.

CHAPTER NO: 5

CONCLUSION

5.1 Introduction:

In this chapter, we summarized all the aims of this study, procedures or methods, results and discussions were used in this paper.

5.2 Summary:

Hedging means protection, that you protect yourself from losses. In the financial markets, investors want to save themselves from risk and losses whatever they invested, we can avoid risk and conserve from losses through hedging. The purpose of this paper is to hedging of gold-bond yield, gold-stock, bond yield-gold, bond yield-stock, stock-gold, and stock-bond. We computed six portfolios of these return series. First, we collected daily data from different websites, i.e. (yahoo finance, investing.com, and business recorder) from 1/1/2014 to 15/09/2015, the total observations were 1408 after synchronized the data.

Secondly, we used various tests to analyzed the data, until we used stationarity test by applied augmented dickey fuller ADF unit root test. In the results shown, that all the series were not stationary at level. Although, we have taken dlog of all the series, then our series have been stationary at first difference. We also used graphical representation for stationarity, in the results we saw and confirmed that series has been stationary at first difference and became return series. While we used skewness, excess kurtosis, jarque bera tests for the normality of the series. In the results of normality test shown us, that our returns series were not normally distributed.

According to the results shown of the serial correlation test used in the study, it confirmed that serial correlation was existed both Q-state on raw and squared data. We rejected the null on

based of the golden rules of alpha value. We used lagrange multiplier LM ARCH test for to existence of autoregressive conditional heteroskedasticity ARCH effects, the results confirmed that there was ARCH effects presented in returns series. Furthermore, due to the existence of the ARCH effects, therefore we used multivariate general autoregressive conditional heteroskedasticity MGARCH model.

Finally, optimal hedge ratios utilized by diagonal BEKK-GARCH model with Gauss method results have been shown that gold can be hedged against stock, on the other hand stock also can be hedged against gold and provides best opportunity of portfolio investment in case of Pakistan, but remained other portfolios were worthless and could not be hedged. Therefore, we run test for goodness of fit for DBEKK model, in the results were shown that there were no autocorrelations and ARCH effects remained left. Hence, we accepted two of the alternative hypotheses out of the six hypotheses, we also estimated three portfolios used optimal hedge ratios by diagonal BEKK-GARCH type model, so in the output confirmed that these kinds of portfolio were also worthless and risky.

5.3 Recommendation and Future research Gap:

Investors can invest in both the gold and stock against bond, but they can get more benefits if they invest in stocks. Hence, there is no benefits if investors may invest in the others four portfolios, it is more riskier and investors will lose all of their invested money instead by the other two portfolios diversifications which are gold and stock can be hedged. Therefore, researchers can further to study on optimal portfolio weights with adding these variables in their study in case of Pakistan financial markets for future research.

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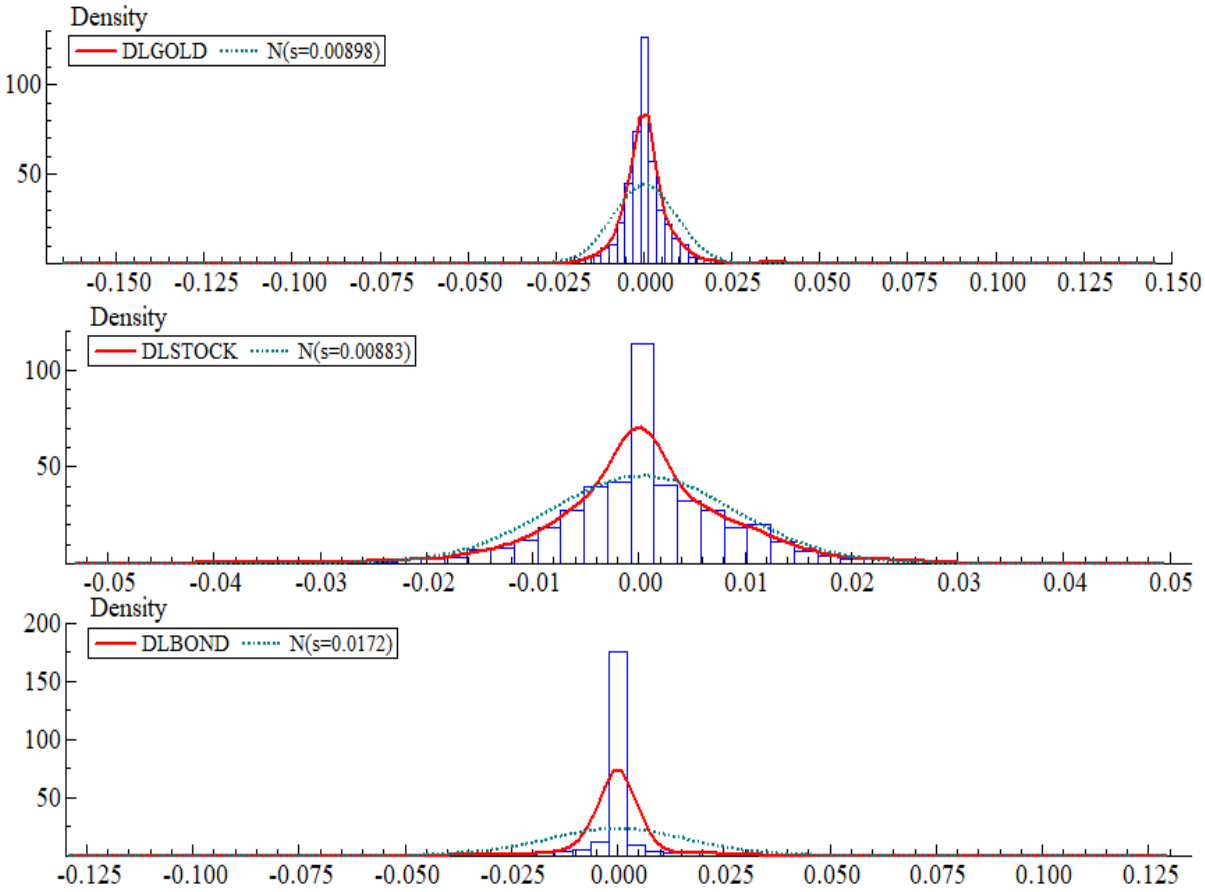
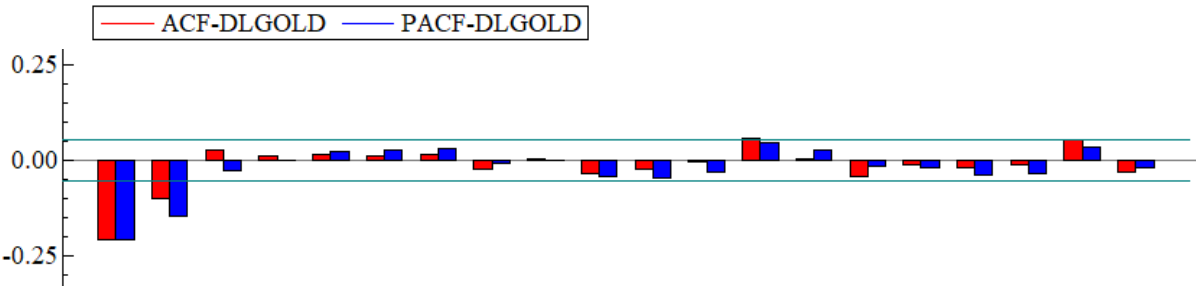
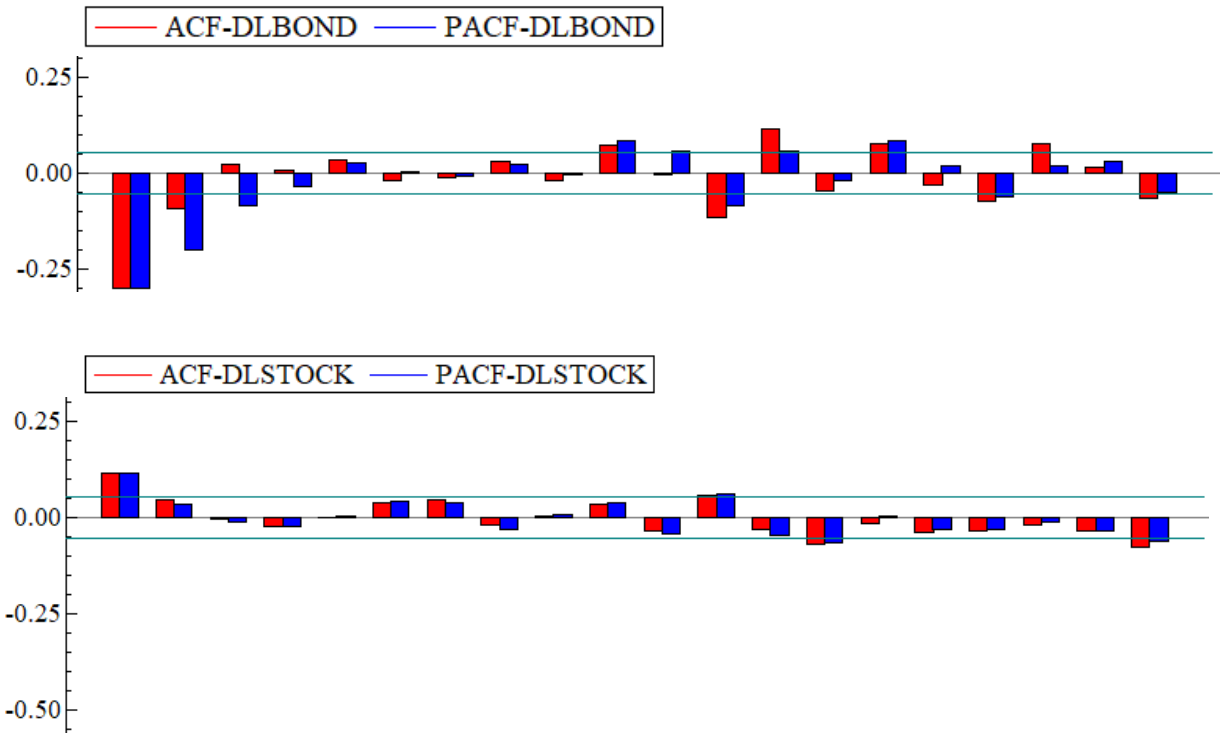
APPENDEX

Non-Normal Distribution figures of all the return series:



Autocorrelation Function and Partial Autocorrelation Function Plots of the gold return, bond, and stock:





Optimal hedge ratios of three portfolios of gold return, bond yield return, and stock return:

Model			
DBEKK	Optimal Hedge Ratios		% Reduction in Risk
Portfolios	b*	c*	
Gold; Bond/Stock	-0.00218	0.0002492	**-102.814**
Stock; Gold/Bond	-0.0199	0.072642	**-7.3081**
Bond; Gold/Stock	-0.03535	0.283436	**-26.4794**

No autocorrelations and ARCH effects have been left in all the returns series:

Gold Return Series

Q-Stat on standardized residuals

Q (5)	4.78365	[0.4428504]
Q (10)	10.1191	[0.4301055]
Q (20)	16.8953	[0.6597607]
Q (50)	56.1253	[0.2561557]

Q-Stat on squared standardized residuals

Q (5)	0.290577	[0.9978166]
Q (10)	0.422890	[0.9999970]
Q (20)	1.40287	[1.0000000]
Q (50)	3.54486	[1.0000000]

Bond yield Return Series

Q-Stat on standardized residuals

Q (5)	6.38112	[0.2708797]
Q (10)	13.4143	[0.2014224]
Q (20)	25.8896	[0.1694877]
Q (50)	60.8102	[0.1406787]

Q-Stat on squared standardized residuals

Q (5)	0.604588	[0.9877922]
Q (10)	0.934304	[0.9998741]
Q (20)	2.32163	[0.9999996]
Q (50)	43.5259	[0.7291358]

Stock Return Series

Q-Stat on standardized residuals

Q (5)	2.59222	[0.7625465]
Q (10)	5.40511	[0.8625275]
Q (20)	22.5071	[0.3136370]
Q (50)	50.2794	[0.4623221]

Q-Stat on squared standardized residuals

Q (5)	3.99937	[0.5495068]
Q (10)	18.7208	[0.0439556]
Q (20)	27.7793	[0.1147272]
Q (50)	46.5968	[0.6107385]