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FACTORS IMPACTING THE PRICE OF THE GOLD: AN EMPIRICAL STUDY OF EGARCH MODEL

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ABSTRACT

Purpose- The gold as a fundamental asset has been displaying a high and sharp price volatility in international financial markets. The price dynamics of gold are believed to be influenced by non-linear dependencies with stock market indices, exchange rates, and commodity prices. Therefore, it is rational to examine the factors contributing to the non linear inferences. As a financial asset for the portfolio investment and hedging, gold prices display multilateral and dynamic data patterns this study aims to focus the analysis of price volatility which will contribute to the volatility structure, persistence, and correlated behaviors of gold prices.
Methodology- To display and analyze the persistence level of volatility in the financial markets, a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) specification is employed. GARCH class models are further applied to determine the relevance of the leverage effect of market news, the progress of spillover pattern, and the effects on the risk-premium.
Findings- Volatility in gold price has become an important feature of the financial markets in terms of volatility trading in adjusting the international portfolio investments. The correlated structure of the financial markets and the contagion effects of the news have displayed the asymmetric and complex but time-fragmented portfolio returns in terms of short and long term volatility formation and forecasting.
Conclusion- Since gold's safe haven status have played a major stake in the determination of the gold price, it is undeniable that the speculators' rising power, the artificial intelligence utilisation in robo-trading, global and regional geo-political tensions, the recent developments in the risk sentiment in investment portfolios have an increasing amount of influence on gold prices.

Keywords: Gold returns, US Dollar Index, exponential generalized autoregressive conditional heteroskedasticity, volatility persistence.
JEL Codes: C58, G12, C22, G17

1. INTRODUCTION

Throughout history, various societies, nations, empires, and states have aimed to accumulate gold due to cultural, economic, and financial motives. Gold is one of the major investment options due to its unique set of characteristics, including being an efficient convertible money as a store and source of value. Historically, it has been used to exchange/pay for resources and as a safe haven financial instrument in times of war or political turmoil.

In the 16th century, the discovery of South America led to the first flood of "new" gold supply into Spain and Europe as a result of the conquistadores dominating this huge gold supply. This accumulation of gold deposits led to an enormous fall in the price of gold at that time.

On the other hand, the availability of reachable gold supply caused significant factors on the price formation. Briefly, the Gold Standard is a monetary system in which a nation's currency is pegged to the value of gold. In the gold standard system, a given amount of paper money can be converted into a fixed amount of gold. The system is based upon the discretionary decisions of the monetary authorities who are not able to increase the amount of paper money in circulation without increasing the equivalent reserves of gold.

In historical perspectives, by the late 1800s until the 1930s, most countries in the world (led by the United States and the United Kingdom) applied an equilateral gold standard. However, the Great Depression in the 1930s caused some countries to abandon the Gold Standard, which brought about an increase in their monetary base and artificially reflated their markets. Physical supply availability is not the only significant factor in the valuation of gold to a higher level.

Gold has unique properties that distinguish it from copper and other metals in terms of corrosion. These properties make gold a prominent store of value, as it holds its value well over time. In 1971 (the end of the Bretton Woods System), the United States unilaterally terminated convertibility of the US dollar to gold, which was a pivotal policy action in terms of monetary imposition. As a result, the US dollar, as a fiat currency, dominated the global market and trade actions, leading to the free floating of major currencies such as the British Pound Sterling, Deutsche Mark, and Japanese Yen.

These global monetary policy actions strengthened gold's negative correlation to the US dollar and fortified gold as a financial instrument for storing value in portfolio investment dynamics, in line with increasing gold price volatility features. Recently, gold has been traded on seven major official and regulated markets, including the London OTC market, COMEX (New York), the three Shanghai Exchanges, TOCOM (Tokyo), MCX (India), Dubai, and Istanbul. In terms of turnover, the two major markets for gold are the London OTC market and New York (COMEX).

The impact of the gold price should be examined in the context of seven primary interrelated global factors:

(1) Its relative value compared to other major currencies.

(2) The expected and realized level of global inflation.

(3) Global interest rates.

(4) The vitality of consumer spending and income growth.

(5) Market-related risks such as concentration or portfolio disposition.

(6) Short-term investment flows.

(7) Supply-related factors.

Systemic market disruptions and price anomalies in line with tail risks have a clear influence on the price of gold, as financial crises lead corporate and individual investors to flight to high-quality assets in terms of investors portfolio decisions and liquidity preferences via considering the transformation and preserving the wealth.

Financial crises can have a negative impact on investors' net wealth through portfolio investments, which is often exacerbated by market momentum. However, gold is a liquid and significant financial underlying asset that can partially mitigate losses in portfolio net asset value due to diversification.

To display and analyze the persistence level of volatility in the financial markets, a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) specification is employed. GARCH class models are further applied to determine the relevance of the leverage effect of market news, the progress of spillover pattern, and the effects on the risk-premium.

The objective of this study is to examine and assess the dynamics of volatility estimation on the price of gold for the most common factors. Finally, several GARCH models are used to analyze dynamic modeling and forecasting of gold price volatility. These models, which take asymmetry and long-range dependence into account, allow for the examination of different characteristics of gold price dynamics.

We conducted a study that analyzed four hypotheses. The first hypothesis suggests that the daily return of the gold price is negatively correlated with the daily differences of the Japanese Yen vs US Dollar. The second hypothesis proposes that the daily return of the gold price is negatively correlated with the daily differences of the trade-weighted US Dollar Index, indicating an adverse relationship between the US-denominated gold price and the US Dollar.

The third hypothesis suggests that the daily return of the gold price is negatively correlated with the daily differences of the US 10 Year Treasury rates, indicating an indirect burden of US Dollar interest rate in regard to investors' expectations for future prospects of the global and the US market dynamics. Finally, the fourth hypothesis suggests that the daily return of the gold price is positively correlated with the daily differences of the US Dollar-denominated price of copper, silver, and crude oil.

Our study revealed the effects of the inverted asymmetry and long-range dependence in the conditional volatility process of the gold market. The empirical results showed different forecast error measures, indicating the superior out-of-sample performance for the EGARCH model. Our results provide guidance measures for corporate investors and portfolio managers to optimize and diversify their portfolio risks regarding the international financial asset dynamics.

The remaining sections of the study are as follows: Section 2 presents the literature review. Section 3 describes the nature of the data and methodology for GARCH models. Section 4 portrays the fundamental data findings with the empirical results, and finally, Section 5 concludes the paper.

2. LITERATURE REVIEW

This section aims to examine the literature related to gold prices as an investment asset and contextualize the papers in this study. The global financial crisis of 2007-2009 caused major and emerging markets to experience sharp and historical declines with a simultaneous spillover effect. As a result, the financial markets tend to co-move simultaneously, even though perfect market integration between international markets does not exist completely . Investors tend to readjust their portfolio compositions and relative weight structures away from equities into safer investments such as gold. Therefore, understanding the channels of shock transmission from one market to another is crucial for volatility forecasting in terms of safe haven focused portfolio management.

For instance, Goodman (1956) examined whether the officially set price of gold should be raised to increase international liquidity. Busschau (1949) considered a decrease in the value of all currencies relative to gold that originated from the degree of illiquidity in the international banking position arising from too low a relation of gold to paper money. Johnson (1950), on the other hand, proposed that the reasons for officially adjusting the price of gold were stemmed from issues around macroeconomic variables, such as trade imbalances and wages. Roger C. Van Tassel (1981) has shown that in the long run, the price of gold will go up in real terms. Empirical results have shown that the percentage increase in the gold price will be greater than the percentage fall in the dollar's value.

Hillier et al. (2006) discovered that precious metals, including gold, platinum, and silver, have hedging capabilities, particularly during periods of abnormal stock market fluctuations. They analyzed data from 1976 to 2004 and found that precious metals have low correlations with stock index returns. The authors suggest that commodity metals may provide diversification within broad investment portfolios. They conclude that financial portfolios containing precious metals perform significantly better than standard equity portfolios. The authors proposed two strategies to examine portfolio efficiency: a buy-and-hold strategy and a switching strategy with portfolio efficiency measured as the relative reward-to-risk ratio. Empirical results indicate that in a passive buy-and-hold strategy, the switching strategy for gold, silver, and platinum does not provide significant efficiency gains.

Capie et al. (2005) evaluated the extent to which gold has acted as an exchange rate hedge by analyzing weekly data for the gold price and sterling-dollar and yen-dollar exchange rates. They found a negative and inelastic relationship between gold and these exchange rates, but the strength of this relationship has shifted over time. While gold has served as a hedge against fluctuations in the foreign exchange value of the US dollar, it has only done so to a degree that seems highly dependent on unpredictable political attitudes and events. In brief, empirical results indicate that when the dollar is losing value, investors might exchange their dollars for gold, raising the price of gold on average

Mark Joy and his colleagues conducted a study on the correlation between dollar pairs and 16 currencies from 1986 to 2008. They used a dynamic model of conditional correlations in which all variables were treated symmetrically. Their findings suggest that gold has acted as a hedge against the US dollar for the past 23 years. Additionally, gold has increasingly acted as an effective hedge against currency risk associated with the US dollar. Similar findings of gold as a potentially useful hedge for currencies are reported in Reboredo and Rivera-Castro (2014), Yang and Hamori (2013), who also examined the safe haven properties of gold for currencies.

While an asset may be a hedge to provide protection under normal market conditions on average, the hedge characteristics may disappear in times of extreme market conditions. The protective feature of gold to investors in times of panic or extreme market stress is widely known.

Gold is predicted to lead both silver and platinum prices as it is seen here as more widely held and visible for investors. Its price changes are assumed to spillover onto the other precious metals.

It has been frequently debated that the US Dollar is one of the significant, but not the primary driver of the gold price. The basis for this argument is that gold is traded primarily in dollars. A weaker US Dollar (as measured by the dollar's trade-weighted exchange rate) makes gold cheaper for other nations to purchase and increases their demand. This then drives up the price of gold, explaining their observed negative relationship.

Tully & Luceyh (2007) and Sjaastad (2008) have both found that the US Dollar is a significant factor in explaining gold price changes. Tully & Luceyh used an APGARCH model to show that the trade-weighted value of the US Dollar is a dominant factor in gold price changes. Sjaastad's study used longer and more recent data from 1991 to 2004 to show that the US Dollar is the most dominant currency, followed by the Japanese Yen.

Byers & Peel (2001) have studied the existence of long-term memory in volatility as a driver of volatility in gold. They found that gold has a long memory, which implies that shocks to the variance are long-lived. This is also the case for other assets they examined. Beckmann & Czudaj (2013) have questioned the relationship between the price of gold and its ability to hedge against inflation by reviewing inflation figures from major economies such as the USA, the UK, the Euro Area, and Japan. Li & Diao (2013) have examined the dynamics of gold pricing in the New York Gold Exchange using a dataset for global macroeconomic indicators regarding financial market indices, quantities, and prices of energy products. Their study found a negative correlation between financial market indices and macroeconomic indicators, indicating that the level of gold reserve and prices of energy products to gold is positive.

3. DATA AND METHODOLOGY

Our study is based on the examination of the volatility structure between the daily return of the gold price and the daily differences of some specific commodities, metals, exchange rates, US Treasury 10 Year rates and stock exchange indices indicated below. The data consists of daily observations of gold price per ounce (Gold Fixing Price 3:00 P.M. London time in London Bullion Market, based in U.S. Dollars), Japanese Yen vs USD, CME Copper Futures price, West Texas Intermediate Crude Oil price per barrel, Silver price per troy ounce in LBMA London fixing, S&P 500 stock exchange index, Trade Weighted U.S. Dollar Index (Broad, Goods, Jan 1997=100), 10-Year US Treasury Constant Maturity Rate regarding the period between January 17, 2008 – April 30, 2019.

The data analysed in this paper were sourced from FRED Economic Data platform (https://research.stlouisfed.org/about.html) provided by Federal Reserve Bank of St. Louis and Quandl (www.quandl.com). Data synchronization is provided to eliminate any problem arising out of missing data.

Table 1 : Composition the data Analysed

Ret_GOLD (LBMA)	Daily return of Gold Fixing Price (3:00 P.M. London), London Bullion Market, U.S. Dollars per ounce
DJPYUSD	Daily difference of the Japanese Yen to One U.S. Dollar, Not Seasonally Adjusted,
DSP500	Daily difference of the Standard's&Poors 500 Stock Exchange Index, USA
DCOPPER	Daily difference of the Continuous Contract #1. Non-adjusted price based on spot-month continuous contract calculations.
DUSTREAS	Daily difference of the 10-Year Treasury Constant Maturity Rate Percent, Not Seasonally Adjusted
DDTWEXB	Daily difference of the Trade Weighted U.S. Dollar Index(DTWEXB): Broad, Goods Index Jan 1997=100, Not Seasonally Adjusted
DSILVER	Daily difference of the Silver Futures, Continuous Contract #1. Non-adjusted price based on spot-month continuous contract calculations.
DWTI	Daily difference of the West Texas Intermediate, Cushing, Oklahoma US Dollars per barrel

Return: [(Variablet –Variablet-1]/ Variablet-1, Difference D(Variable): [(Variablet –Variablet-1]

Many financial times series display periods of low volatility followed by periods of high volatility called as volatility clustering. Autoregressive conditional heteroskedasticity (ARCH) model was developed by Engle in 2001 and aims to model and forecast the variance of financial and economic time series over time. ARCH models have been generalized to become the generalized ARCH (GARCH models). These models have become common tools for analysing with time series heteroskedastic models where it is providing a volatility measure that can be used in portfolio selection, risk analysis and derivative pricing.

A GARCH (1,1) model is the most effective and common feature in financial time series data. However, all ARCH and GARCH models have been expanded over the previous two decades to factor in the direction of returns, not just the magnitude (Engle, 2001).

They include, for example, the IGARCH model which allows for volatility shocks to be permanent, the TARCH (threshold ARCH) and the EGARCH (exponential GARCH) which are asymmetric models which allow negative shocks to behave differently from positive shocks. It should be noted that EGARCH model solves the problem by its superior formation than the standard ARCH/GARCH models where symmetry is imposed on the conditional variance.

It is acknowledged that the coefficients of GARCH constant (α_0), ARCH (α_1) and GARCH (β_1) are significantly different from zero and are within the parametric restrictions. This implies greater impact of shocks (news) on market returns and presence of volatility clustering.

To classify the repercussions in general framework, in case of a large shock in a day leads to a large (conditional) variances the following day, indicating the impact of recent news on price changes. Again, the higher value of GARCH implies long memory of the model to the shocks.

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j h_{t-j} \qquad \textit{Eq.01}$$

where α_0 captures the long-run average volatility. The terms α and β are the ARCH and GARCH coefficients; q is the order of the moving average ARCH terms and p is the number of the autoregressive GARCH terms. Standard GARCH model does not allow to measure asymmetric behaviour of the volatility parameters. Being interested in classifying the outcomes how volatility responds to good and bad news, following Abhyankar (1998), it is fair to apply exponential GARCH (EGARCH) specification popularized by Nelson (1991). McKenzie emphasized that when data is non-normally distributed, the use of a squared power transformation "imposes a structure on the data which may potentially furnish sub-optimal modeling and forecasting performance relative to other power terms" McKenzie and Mitchell (1999).

Brooks et al. (2000, p. 378) puts forward that any positive power term value can be specified as "absolute changes in an asset's price will exhibit volatility clustering and the inclusion of a power term Hence, it is acting so as to the periods of relative tranquillity and volatility by magnifying the outliers". McKenzie and Mitchell (1999) points thatt volatility clustering is not just specific to the use of squared asset returns but are also a component of absolute returns. The use of a power term in these cases acts to emphasis the periods of tranquility and volatility by amplifying the outliers in the dataset.

A number of standard ARCH and GARCH models are nested within the asymmetric power GARCH model. The mean equation for each model where the model exhibits significant first order autocorrelation, an AR(1) specification is adopted.

In ARCH/GARCH framework, symmetry is imposed on the conditional variance implying that positive and negative shocks have the same impact on the current volatility. However it is well known that many financial time series are influenced by negative shocks more than positive shocks.

Plausible explanations for this phenomenon can be classified as [(Exponential GARCH (EGARCH)] where (1) leverage and (2) volatility feedback effects. Leverage effect points out that an increase in financial leverage level causes an increase in equity volatility level. Thus volatility rises more following a large price fall than following a price rise of the same magnitude. On the other hand, volatility feedback effect explains how an increase in volatility may result in negative returns.

Here is to capture the asymmetric response of financial variables, exponential GARCH (EGARCH) model proposed by Nelson (1991)

$$\log(h_t) = \omega + \sum_{j=1}^{q} \beta_j \log(h_{t-1}) + \sum_{i=1}^{p} \alpha \left| \frac{\varepsilon_{t-i}}{h_{t-i}} \right| + \sum_{k=1}^{r} \gamma_k \frac{\varepsilon_{t-k}}{h_{t-k}} \quad \text{Eq.02}$$

where ω, β, γ, and α are the model parameters.

EGARCH models the logarithm of conditional variance and an additional term is included in the model to account for asymmetries. Finally, statistically significant and negative asymmetry term implies the existence of a leverage effect and asymmetric response of prices.

In the context of stock markets, the EGARCH model is asymmetric since coefficient γ is usually found to be negative. EGARCH model incorporates the standard GARCH model in the sense that the model analyzes both the effect of past shocks and volatilities on the current variance. It is the superior advantage of the EGARCH model displaying good news and bad news to have a different influence on conditional variance. The EGARCH model also shows big news to have a greater effect on the variance than the standard GARCH model. In addition, the EGARCH model imposes no constraints on the parameters to ensure positivity of the conditional variance.

The EGARCH model is popular, among other reasons, because it can capture both asymmetry, namely the different effects on conditional volatility of positive and negative effects of equal magnitude, and leverage, which is the negative correlation between returns shocks and subsequent shocks to volatility.

The coefficients of ARCH term, γ dsiplays the spillover behavior of the markets in such a way that a significant negative value indicating that for a given decrease in volatility of the market would bring about a decrease in volatility of the other market. Leverage term is expected to be negative to convey that market reacts more to negative news than to positive (good) news. The lag truncation length (p and q) is determined using likelihood ratio (LR) tests.

4. FINDINGS AND DISCUSSION

The quantitative analysis and all the statistic tests, the estimation methods are performed by using the Eviews Software.

To study the properties of data, each time series is subjected to a check for stationarity. When we have a stationary system, effect of a shock will die out gradually. When we have a non-stationary system, effect of a shock is permanent.

Augmented Dickey-Fuller(ADF), Phillips–Perron test (PP), Kwiatkowski–Phillips–Schmidt–Shin (KPSS - to have stationarity as the null hypothesis) test were separately carried out for the daily return of the gold price and the daily difference of all other variable series. Table 2 reports the result of unit root tests.

Table 2: The Results of the Unit Root Test

									Critical Value		
	Ret_GOLD	DCOPPER	DSILVER	DDTWEXB	DJPYUSD	DSP500	DUSTREAS	DWTI	1%	5%	10%
ADF(c,t)*	-54.55954	-57.00596	-18.86116	-52.85771	-55.14583	-56.86210	-41.41797	-56.77176	-3.96116	-3.4113	-3.12751
PP(c,t)*	-54.59558	-56.95917	-60.23528	-52.87385	-55.21181	-57.40650	-55.82957	-56.79901	-3.96116	-3.4113	-3.12751
KPSS(c,t)*	0.06556	0.06088	0.05654	0.06419	0.13339	0.05426	0.02604	0.05696	0.21600	0.146	0.11900

*(c,t), c: Intercept, t: Trend

The unit root hypothesis (i.e., H_0: Series is non-stationary for DF, ADF, PP) and the KPSS (i.e H_0: Series is stationary) is rejected given the analysed sample data indicating all the variable series are stationary in 1%, 5%, 10% intervals of the test critical value.

The Mean Equation for the model as follows:

$$\begin{aligned} GOLD_t &= \beta_0 + \beta_1 \Delta COPPER_t + \beta_2 \Delta SILVER_t + \beta_3 \Delta DTWEXB_t + \beta_4 \Delta JPYUSD_t \\ &+ \beta_5 \Delta SP500_t + \beta_6 \Delta USTREAS_t + \beta_7 \Delta WTI_t + \varepsilon_t \end{aligned} \quad (3)$$

In order to check the existence of the heteroskedascitiy, we carried out ARCH test (the ARCH test regresses the squared residuals on lagged residuals and a constant) with number of 5, 10, 15 lags respectively. Eventually, the test result displays that the ARCH LM Test concerning 15 lags in the residuals is $N{*}R^2$ = 449.02. The residual values indicate that it can easily run ARCH model or GARCH model, because there is clustering volatility in the residual at the same time. There is ARCH effect, so it has all the validity to run ARCH or GARCH model.

The model based on EGARCH(1,1) model with daily returns of the gold price under the normal distribution has both the smallest AIC and largest log-likelihood value. Performing the EGARCH(1,1) model, the results are displayed obtained in the Table 3.

Table 3: EGARCH Model Results

Dependent Variable: RET_GOLD				
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)				
LOG(GARCH) = C(10) + C(11)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(12)*RESID(-1)/@SQRT(GARCH(-1))				
+ C(13)*LOG(GARCH(-1)) + C(14)*DUSTREAS + C(15)*DWTI + C(16)*DSILVER				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	7.26E-05	9.40E-05	0.772654	0.43970
DCOPPER	0.019529	0.002805	6.963393	0.00000
DSILVER	0.011258	0.000241	46.79891	0.00000
DDWTEXB	-0.005219	0.000377	-13.83597	0.00000
DJPYUSD	-0.003365	0.000211	-15.9832	0.00000
DSP500	-1.44E-05	6.80E-06	-2.116788	0.03430
DUSTREAS	-0.014121	0.002498	-5.653529	0.00000
DWTI	0.000219	9.17E-05	2.385479	0.01710
AR(1)	-0.197626	0.019193	-10.29674	0.00000
Variance Equation				
C(10)	-0.229077	0.025377	-9.026933	0.0000000
C(11)	0.152096	0.01087	13.992	0.0000000
C(12)	-0.015578	0.006982	-2.231077	0.0257000
C(13)	0.988241	0.002201	449.0356	0.0000000
DUSTREAS	-0.444098	0.134205	-3.309096	0.0009000
DWTI	-0.02583	0.005288	-4.885009	0.0000000
DSILVER	-0.02818	0.012253	-2.299887	0.0215000

After performing the EGARCH estimation, we checked the residuals for the existence of the ARCH effect and serial correlation respectively. Diagnostic tests were performed in order to establish the goodness of fit and appropriateness of the model.

First we examined if the standardized residuals and squared standardized residuals of the estimated model were free from serial correlation. The Ljung-Box LB(n) statistics for the standardized residuals proved that in most cases they are not statistically significant and the LB(n) statistics for standardized squared residuals indicate that the ARCH effect has disappeared. The Durbin Watson statistic (1.9988) and the ARCH LM test concerning 15 lags in the residuals ($N*R^2$= 13.69746) confirm the aforementioned results.

In this study, our intent is to display some fundamental intuitive approaches with the confirmation of quantitative estimation techniques of the parameters.

Regarding the estimation output for the EGARCH(1.1) model in Table 3, the persistence parameter C(13) is statistically significant and very large, implying that the variance moves slowly over time. Further, the asymmetry parameter C(12) is negative, implying that the variance goes up more after negative residuals (gold returns) than after positive residuals (returns). This implies that the volatility spill over mechanism is asymmetric.

In line with our first hypothesis , the return of the gold price is negatively correlated with daily difference of the Japanese Yen vs US Dollar. Gold is one of the favorite trading instruments in the precious metals asset class. Its appeal ranges from the intraday trader/speculator to investors involved in actual purchasing of the bullion. Well known for its status as a safe haven currency, some liken gold to the default currency for mankind. Paying attention to the fundamentals always helps, monitoring specific comments from central banks (Federal Reserve Bank of US, Bank of Japan) that could bring about some short-term noise in the markets. Since 2008, the short borrowing in Japanese Yen has contributed positively in composing US Dollar denominated investment portfolios and this has also displayed its own dynamics mirroring the gold prices. In Table 3, the negative relationship between gold price and Japanese Yen is statistically significant.

Regarding our second hypothesis, the estimation results display that the return of the gold price is negatively correlated with daily difference of the trade weighted US Dollar index. According to the findings, in Table 3, return of the gold prices (Ret_GOLD) is negatively related with the DWEXTB and the coefficient is statistically significant. It is a fact that proves the gold is a feedback hedge for the assets held denominated in US Dollars when the US dollar depreciates against other major currencies. Thus, regarding the periods of US Dollar were depreciating persistently as measured by the dollars trade weighted exchange rate makes gold cheaper for other nations to purchase and increases their demand. Eventually, this effect drives up the price of gold showing a negative relationship between US Dollar and gold price.

Considering the third hypothesis, it is observed that the return of the gold price is negatively correlated with daily difference of the US 10 Year Treasury rates. This relation is statistically significant in Table 3. Since the gold and US Treasury rates are both alternative investment factors in structuring the expected portfolio return while minimizing the portfolio volatility. Since the gold is a hedge against consumer expenditure inflationary pressures, the US 10 Year Rate has embedded the inflationary pressure premium in the level of market rates with a significant lags in line with monetary authorities forward looking policy. In boom times, when interest rates go up it stokes fears of inflation, which pushed the price of gold up. In recovery times, when interest rates go up it suggests the economy is improving, and investors dump gold for other assets like stocks. Regarding the variance equation results, daily differences US 10 Year Treasury rates decreases the daily return volatility of the gold price.

The coefficients of the daily differences of the price of copper, the silver and crude oil display a positive relation with the daily return of the gold price and are statistically significant according to the sample span, since the depreciation of US Dollar against the other major currencies in 2008 has triggered a concentrated tendency towards energy, commodities and precious metals. Hence, in composing the investment portfolios in US denominated assets, due to the growth boosting measures taken internationally by the monetary authorities, the gold prices had strong upward momentum which trailed the the price of copper, silver and crude oil in an orchestrated manner. However, the major trading and investment characteristics differ in the short and long term, the price dynamics has changes sharply.

Observed results shows that daily difference of the SP500 stock exchange index exhibits a negative impact on the daily return of the gold price. This concludes that in terms of the boom periods in an economy boosts the investors' choices (since the price of SP500 normally rises as a result of positively expected economic prospects) in favor of the stocks. Therefore, negative changes in the price of stocks are associated with negative financial news that the volatility is transferred from the other markets to the stock market. Since investment in stocks or the gold are alternatives each other in different proportions, in terms of investors' portfolio choices, profit seeking or loss minimizing motivation could lead to an increased volatility.

5. CONCLUSIONS

Volatility in gold price has become an important feature of the financial markets in terms of volatility trading in adjusting the international portfolio investments.

Gold has become an asset class in its own right. Hence, volatility structure in the return of the gold price has become a key measure for gauging in recent years. Briefly, it has become an important tool for hedging systemic risk and uncertainty. The value of such a hedging instrument of course is dependent upon its correlation and volatility structure with the other major underlying financial assets in the means of financial diversification. These diversification properties are enhanced further as they are shown to be leading indicators of the gold price return as a dependent variable.

Finally, in the relevant sample span, return of the gold demonstrates a significant non-linear characteristics. Since gold's safe haven status have played a major stake in the determination of the gold price, it is undeniable that the speculators' rising power, the artificial intelligence utilisation in robo-trading, global and regional geo-political tensions, the recent developments in the risk sentiment in investment portfolios have an increasing amount of influence on gold prices.

In portfolio construction, the major goal is to minimize the portfolio volatility in line with holding a positive alpha return to stabilize the portfolio net wealth. Hence, the gold has distinctive investment facilities by having hedge features against the global inflation and reflationary monetary dynamics. The correlated structure of the financial markets and the contagion effects of the news have displayed the asymmetric and complex but time-fragmented portfolio returns in terms of short and long term volatility formation and forecasting. It has potential to enhance the study of price volatility of the gold as a financial instrument in relation of the complex correlation structures by the high frequency gold data to verify the empirical results shared in this study.

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