CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

As an instrument for private investment, gold has generally been viewed as a hedge against currency inflation or devaluation and as an object of "safe-haven" investment. Although some analysts periodically doubt the importance of gold in this regard, the prominence given to the gold market in the financial press, where daily price movements are generally reported prominently, suggests that gold remains an asset the price and investment performance of which is widely monitored. Moreover, despite the fact that gold's historical significance as a monetary anchor has faded away, it retains its importance as an official reserve asset, with some 40 percent of the world's monetary reserves still held in the form of gold. The market for gold consists of (1) a physical gold market, in which gold bullion or coin is transferred between market agents, and (2) a paper gold market, which involves trading in claims to physical stocks rather than in the stocks themselves. Physical gold is principally traded in the form of bullion, but official and imitation gold coins, medallions, and jewellery (especially that of low fabrication quality but of high gold content) are also actively traded. Gold bullion is assumed to refer to gold that has been formed into bars, either in crude form (80 percent fine) as treated at the mine site or as defined by weight and greater fineness and authenticated by the stamp of a recognized refinery. Weights range from 1 kilogram (32.151 troy
ounces) to 400 ounces. When refined, gold bars generally consist of parts of gold ranging between 995 and 999 per thousand (i.e., between 99.5 and 99.9 percent fine).

Like most commodities, the price of gold is driven by supply and demand including demand for speculation. However unlike most other commodities, saving and disposal plays a larger role in affecting its price than its consumption. Most of the gold ever mined still exists in accessible form, such as bullion and mass-produced jewellery, with little value over its fine weight and is thus potentially able to come back onto the gold market for the right price. It is generally accepted that the price of gold is closely related to interest rates. As interest rates rise the general tendency of the gold price, which earns no interest, is to fall, and as interest rates dip, to rise. As a result, gold price can be closely correlated to central banks via the monetary policy decisions related to interest rates made by them.

Abken (1980) explains the economics that underlies the movements in the price of gold. The spot prices of all storable commodities including gold are particularly influenced by the anticipation of future spot prices. In the case of gold, the relative insignificance of flow supply and demand compared to stock, the relative insensitivity of flow supply and demand with respect to spot price movements and changes in the gold price especially sensitive to changes in its anticipated future spot price, the episodic run-ups and run-downs in the price of gold associated with periods of economic and social turmoil, have all fascinated the frequently bewildered observers of gold market. At such times, analysts often conclude that mob psychology overwhelms the market as market participants lose sight of so called market fundamentals. However the theory and empirical evaluation of gold price movements presented here demonstrate that ad hoc appeals to mob psychology are
unnecessary to explain the behaviour of gold price. The paper states that economic theory appears sufficient to account for gold price movement in recent years.

**Fama and French (1988)** explain in their study that inventory responses spread the effects of demand and supply shocks between current and expected spot prices. The theory of storage predicts that when inventory is high, large inventory responses to shocks imply roughly equal changes in current and expected spot prices. Thus changes in spot prices are largely permanent; they show up one for one in forward prices. When inventory is low, smaller inventory responses mean that current shocks cause larger changes in the spot prices than in forward prices. During the sample study period, the variation of spot and forward prices for metals has a strong business–cycle component. There are sharp rises and falls in the prices of all metals around the business cycle peaks of 1973-74 and 1979-1980.

**Sam Hewitt (1996)** studied about the behaviour of gold during historic US deflationary periods. The study, divided into three parts are: (i) the gold price behaviour during 19th century deflations, (ii) deflation from the civil war to World War I and (iii) the Great Depression of the 1930s. During the panics of 1837, 1857 and 1873, the combination of deteriorating credit quality of bank note issues and the lack of FDIC insurance provided an institutional framework which favored gold over paper currency during the stresses of deflation.

**Sjaastad and Scacciallani (1996)** investigated the gold and foreign exchange markets for the period 1982-1990. They found that although the price of gold is usually denominated in US dollars, real appreciations or depreciations of the European currencies have profound effects on the price of
gold in all other currencies and the US dollar has only a small influence on the
gold price. They also found that the floating exchange rates contributed
substantially to the instability of the gold price during the period. Fluctuations
in the real exchange rates amongst the major currencies accounted for almost
half of the variance in the price of gold.

Mahdavi and Zhou (1997) compared the performance of gold and
commodity prices as leading indicators of the inflation rate and explored the
possibility of improving the inflation rate forecast by specifying error correction
models. They used quarterly price data for gold from the period 1970 to 1994.
They found no evidence for a co-integrating relationship between the CPI and
the London price of gold over the testing period. However, their study suggests
that commodity prices might be a better leading indicator for CPI since they are
co-integrated with the CPI. According to Mahdavi and Zhou, the relatively poor
out-of-sample forecasts of the price of gold is consistent with the view that
short-term movements in the price of gold are too volatile and market specific
to forecast relatively gradual and small changes in the general price level in a
satisfactory manner.

Aggarwal, Inclan and Leal (1999) examined the kind of events
that caused shifts in the volatility of emerging stock markets, using an iterated
cumulative sum squares (ICSS) algorithm to identify the points of
shocks/sudden changes in the variance of returns in each market and the
duration for which the shift lasts. They identified that the October 1987 crash
was the only global event during the period 1985-1995 that caused a significant
jump in the volatility of several emerging stock markets. They examined ten of
the largest emerging markets in Asia and Latin America. Their findings showed
that the high volatility in emerging markets is marked by several shifts; the
large changes in volatility seem to be related to important country-specific
political, social and economic events. The number of change in variance varies from country to country and they also depend on the frequency of the data. More change points are found with daily returns than with weekly or monthly returns.

Garry (2002) studied the exposure of stock prices of Australian gold mining firms to changes in gold prices and the valuation effects of gold price exposure. The study shows that gold mining firms have significant gold price exposure and the price of the average gold mining stock moves 0.76% for each 1.00% change in Australian –dollar denominated gold prices. The study evidences a strong association between the gold premium, firm size and volatility of gold prices as predicted by the option model. No relationship exists between the gold premium and other identified option characteristics—resources/reserve ratio, number of operational mines, hedging levels and the levels of gold prices. Further the paper also explains that the premium is in part explained by the misuse of the discounted cash flow techniques.

Al-Eisa, Al-Nsour, and Hammoudeh (2003) provided an institutional analysis of the financial valuations for the individual Gulf Cooperation Council (GCC) markets (Oman, Kuwait, Bahrain, Saudi Arabia and UAE). They examined whether any long-term relationship exists among these markets, using co-integration techniques and investigating the transmission of changes and volatility in oil prices, as represented by the NYMEX oil futures prices, to the Inter-linkages between Equity, Currency, Precious Metals and Oil Markets: an Emphasis on Emerging Markets individual GCC stock markets, using the vector error correction models and the GARCH models. They analysed daily data for the GCC stock indices and the oil prices that cover the period 15/02/1994 to 25/12/2001. They found that the five GCC markets are strongly co-integrated, which means that they have many long term
relationships and that they co-moved over time. Oil price volatility spill overs are significant in all the GCC markets; this volatility moves in the same direction with the oil volatility at NYMEX, meaning that if the oil prices become more volatile in NYMEX, the share prices in GCC markets feel this volatility.

Agren (2006) studied volatility spill overs from oil prices to stock markets within an asymmetric BEKK model, using weekly data on the aggregate stock markets of Japan, Norway, Sweden, the UK and the USA. He found strong evidence of volatility spill overs for all stock markets with the exception of the Swedish one, where only weak evidence was found. News impacts showed that, although statistically significant, the volatility spill overs are quantitatively small. The stock market’s own shocks, which are related to other factors of uncertainty than the oil price, are more prominent than oil shocks.

Fernández (2004) examined the presence of structural breaks in volatility using two alternative approaches, the iterative cumulative sum of squares (ICSS) algorithm and wavelet analysis, looking at the effect of the outbreak of the Asian crisis and the terrorist attacks on September 11, 2001, on emerging Asian and Latin American markets. She also analysed North American and European stock markets. Her results showed that the numbers of shifts detected by the two Inter-linkages between Equity, Currency, Precious Metals and Oil Markets: an Emphasis on Emerging Markets methods were substantially reduced when filtering out the data for conditional heteroskedasticity and serial correlation. In particular, for the filtered stock data, the ICSS algorithm did not find any volatility shifts over 1997-2002, whereas the wavelet analysis found evidence of volatility breakpoints at some given scales of the data and only for 1997-1998.
Ranson and Wainwright (2005) suggest that commodities are the best hedge against inflation and especially gold and other precious metals perform the best. They examined periods of high inflation in Great Britain and USA, and discovered that the price of gold has gone up 4 years successively before a period of high inflation. The increase in the gold price has been 2 to 3 times as large as the inflation following the increase and it has effectively provided a hedge for inflation. Ranson and Wainwright also studied how an investment in gold could immunize a bond portfolio from inflation. They found that including 18% gold in a bond portfolio immunizes the portfolio from a rise in inflation. However, when inflation rate goes down, the inclusion of gold in bond portfolio could harm the portfolio with its harmful leverage.

Levin and Wright (2006), observe that the amount of gold supplied from extraction in any period is positively related to the gold price in an earlier period. This is because there may be a substantial time lag before mines react to a price change. The quantity of gold supplied from extraction is also negatively related to the amount of extracted gold that is diverted to repay central banks for the gold leased in the previous period incremented by a physical interest rate in those cases where the central bank opts for interest to be repaid in gold. In return for the gold lease rate, central banks forgo the convenience yield. Convenience yield is the benefit of holding gold for a period of time. Central banks adjust their lending to the point where the return they receive from lending is equal to the convenience yield forgone with an added default risk premium. Levin and Wright (2006) state that a fall in the physical interest rate, a rise in default risk or a rise in convenience yield caused by political or financial turmoil would reduce the quantity of gold leased to the industry from central banks during that period. Also, the repayment of gold leased in the previous period impacts on the current period supply. The total supply of gold in any given period fluctuates in response to the current gold
price, gold lease rate, convenience yield and default risk premium and also the previous period quantity of leased gold to be repaid at the previous physical interest rate.

**Batten and Lucey (2006)** analysed the volatility structure of gold, trading as a futures contract on the Chicago Board of Trade using intraday (high frequency) Interlinkages between Equity, Currency, Precious Metals and Oil Markets with an Emphasis on Emerging Markets data from January 1999 to December 2005. They used GARCH modeling and the Garman Klass estimator. They found significant variations across the trading days consistent with microstructure theory, although volatility was only slightly positive correlated with volume when measured by tick-count.

**Fernández and Lucey (2006)** analysed the implications for portfolio management of accounting for conditional hetero-skedasticity and structural breaks in long-term volatility. They based their analysis on PGARCH models fitted to the return series. They used weekly data of the Dow Jones Country Titans CBT municipal bond, spot and futures prices of commodities for the period 1992-2005. They also applied their procedure to artificial data generated from distribution functions. They concluded that neglecting GARCH effects and volatility shifts may lead to overestimating financial risk at different time horizons.

**Hiller, Draper and Faff (2006)** investigated the role of precious metals in financial markets by analysing daily data for gold, platinum and silver from 1976 to 2004. They included the S&P 500 Index as a proxy for stock market returns from the US investors’ perspective. They found that all three precious metals have low correlations with stock index returns, which suggests that these metals may provide diversification within broad investment
portfolios. They found that normally financial portfolios that contain precious metals perform significantly better than standard equity portfolios. They also found that precious metals exhibit some hedging capability during periods of abnormal market volatility.

Tully and Lucey (2006) investigated the macroeconomic influences on gold using the asymmetric power GARCH model (APGARCH). They examined cash and futures prices of gold and significant economic variables over the period 1983-2003, paying special attention to two periods, around 1987, and 2001 the year of the equity market crash. Their results suggest that the APGARCH model provides the most adequate description for the data, with the inclusion of a GARCH term, free power terms and unrestricted leverage effect terms. They also found that the gold cash and futures data over a long period confirmed the US dollar is the main macroeconomic variable which influences gold.

As is possible to appreciate in the literature review carried out so far, most of the studies have been conducted analysing precious metals markets on their own (Taylor, 1998; Mills, 2003; Aggarwal and Lucey, 2005). Few studies have paid attention to the Inter-linkages that could exist between stock markets and precious metals markets (Hiller, Draper and Faff 2006), and no study has analysed the interactions between stock markets, precious metals market and oil markets. The next part of this literature review will be outlining relevant research taking into account oil markets.

Spargoli and Zagaglia (2007) studied the linkages between prices of oil futures traded on the New York Mercantile Exchange and the Intercontinental Exchange of London. They estimated a structural BEKK-GARCH model on daily data from the 26th of April 1998 to the 26th of April
2007 on prices of futures. The main conclusion from their analysis is that in normal periods, NYMEX and ICE futures are used by investors for hedging purposes. However, in turbulent periods when there are peaks in the structural conditional variance of both markets, the structural correlation between them is positive and hedging is no longer feasible.

The analysis of the literature shows that oil shocks and stock markets have received much attention with regard to the study of their individual and related behaviour, but there is a clear and astonishing lack of evidence regarding the interaction of these markets with precious metal markets. Therefore, the objective of this thesis is to analyse volatility taking into account the ICSS algorithm to detect jumps in volatility using a GARCH (1,1) and a EGARCH (1,1) approach; the intention is to identify sudden changes in variance which will be used to correct the GARCH model. Therefore, it will provide an opportunity to do a comparison between the results without taking into account the jumps and also, what happens after the model is corrected by adding jumps and possible structural breaks; this correction will allow us to demonstrate the existence of a possible bias in the methodology when the data set is not subject to breakpoints adjustments. The same analysis will be done employing an EGARCH model in order to compare the results.

**Batten, Ciner and Lucey (2008)** investigated the impact of macroeconomic factors (inflation, monetary aggregates, industrial production, US dollar exchange rates, stock index returns and consumer confidence indices) that affect price returns of precious metals markets (gold, silver, palladium and platinum). They found limited evidence to establish that the same macroeconomic factors jointly influence volatility processes of the precious metals price series, although there are some Inter-linkages between Equity, Currency, Precious Metals and Oil Markets: an Emphasis on Emerging Markets
evidence of volatility feedback between the precious metals series. This finding lends weight to the view that these individual commodities are too distinct to be considered a single asset class or to be represented by a single index. Most of the research that has been done until now has been mainly focusing on the analysis of the gold market. A main area of interest has been the role of this precious metal as a hedge against inflation. Some studies have also analysed the variables that could be affecting the behaviour of gold prices, but little has been done with regard to the other precious metals (silver, platinum and palladium) as is clearly reflected in the literature review presented. Fortunately, it seems that the trend is changing and that researchers are starting to pay more attention to the other precious metals markets and their behaviour, as they are becoming aware of the importance of these markets in terms of portfolio risk management. But there is still a clear lack of research analysing the reaction of precious metals markets to the different financial crises that had impacted the financial markets in the past. There is also little evidence on the analysis of the relationships between precious metals markets and equity markets, energy markets, major macroeconomic variables, etc. These studies are of key importance as they could provide important information to investors in order to help them diversify their portfolio and to design their hedging strategies.

Rohnn Sanderson (2011) in his study uses the techniques of spectral analysis and Hurst Exponent to measure the level of long run dependence in the price data of gold. The gold price has two components, deterministic and random. The deterministic component is smaller in case of gold price and suggests that the industry structure has little effect on the price of gold and the external events (randomness) have the largest impact on the changing price over time. From the analysis, researchers show that external factors such as business cycle events will have larger effect on price changes than that of intra-industry competition.
Bapna, Vinod, Navindra and Harmender (2012) studied the casual effects of micro economic variables on gold prices using unit root test, regression and granger causality test which will further specify the probability of change in the variables studied. The study shows that the exchange rate, fiscal deficit, forex reserve and inflation rate are independently affecting gold prices at large but growth rate, GDP, BSE Sensex, and NIFTY are having a very low impact on gold prices. The inflation and interest rate affect the gold price and vice versa.

Radhika and Shachi (2012) analysed the correlation between gold price and stock market returns across six countries. The study was based on the data related to six renowned stock exchanges, investigated the Granger causality in the Vector Error Correction Model for the period 2002 to 2011. This study provides the evidence of feedback causality between the variables and thus concludes whether one variable can be used to predict the other or not.

Sayyed Mahdi Ziaei (2012) employs the GMM model to investigate the effect of gold price on equity, bond and domestic credit in the ASEAN+3 countries. The findings show a significant negative relationship between gold price and equity. Gold can act as a hedge against equity due to its significant effects on equity, but this result proves that gold price cannot be considered as a safe haven in the case of ASEAN +3. The effect of gold price on both bond and equity is significant, however compared to empirical studies for European countries and US, the effect is much less. The outcome of this study is important since the gold price is expected to have a higher role in equity value variation in the East Asia region, because ASEAN +3 (especially China, Japan, Korea, Singapore and Malaysia) have large gold stocks; besides precautionary demand, application for jewellery is much higher than in western countries. The results also indicate a positive relationship between bond value
and equity value during crisis periods. In the analysis, the lag value of all three main financial variables (bonds, equity and domestic credit) has significant effect on their dependent variable. Even though these countries have been resisting incoming financial crisis waves, the dummy variable coefficient demonstrates that the 2008 credit crunch had significant, negative effects on bonds, equity and domestic credit.

Bhunia and Mukhuti (2013) examined the impact of domestic gold price on stock price indices in India for the period from January 1991 to August 2012 using unit root test and granger causality test. The study was conducted using the secondary data taken from World Gold Council database and BSE and NSE database. The correlation statistics indicated that the BSE and NSE indices are positively associated with domestic gold price in the study period. Granger causality test illustrated no causality and bidirectional causality subsists between gold price and stock price indices under the study.

Lingjie Ma and Patterson (2013) investigated the relationship between the price of gold and relevant factors from 1968 to 2012. The gold prices determined by the market forces during the period, show an upward trend since 2001. The authors identified and investigated seven underlying factors for gold price movement: 1) unemployment rate 2) GDP growth rate 3) expected inflation rate 4) US dollar index 5) Dow Jones industrial average return 6) 3 months US Treasury bill yield, and 7) oil price. The impact of these factors on gold price when gold price is at different levels, was investigated using quintile-regression. Hence it provide a natural tool to evaluate the overpricing issue, as the recent gold prices are at historical heights and remain at the right tail of the distribution. Using the data from 1968 to 2008, a joint effect of seven factors in a linear multi factor model was derived and then used the derived estimate to forecast the price of gold for each month from January 2009 to March 2012. In
this study it was found that by quantile regression, the price of gold is not over valued (although the OLS implies that gold is overpriced for the period January 2009 – March 2012). The study also forecasts that the gold price will fall if the US economy returns to its long run economic average, and that the price will remain the same if the economic trend continues in US.

**Lucey and O’Connor (2013)** assessed whether two classes of bubbles occur in the spot price of gold, rational speculative and periodically bursting bubbles using gold’s lease rates for the first time in the literature as a measure of its fundamental value. The study used unit root and co-integration tests to look for rational speculative bubbles and Markov Switching Augmented Dickey–Fuller tests for periodically bursting bubbles.

**Partap Singh (2013)** studied the trends in gold prices and its demand, volatility in gold prices and causes of the mounting prices of gold in the Indian economy. This paper also analyses the comparative trends and patters between India and China. The paper recommends that gold is an effective investment avenue for the investors.

**Dilip Kumar (2014)** investigated the first and second order movement transmission between gold and Indian industrial sectors with an application of portfolio design and hedging effectiveness using generalized VAR-ADDC-BVGARCH model. The study indicates that there is significant return spill over from gold to Indian industrial sectors and no significant evidence of volatility spill over from gold to Indian industrial sectors. For each stock-gold pair, the dynamic conditional correlations vary substantially between positive and negative values over time and the negative values are observed during the periods of crisis and recession especially during dot-com bubble burst (2000-2001), sub-prime crisis (2008-2009), and European debt crisis
(2011-2012). This indicates wide scope of portfolio diversification during the periods of crisis and recession. The study also suggests that the hedge ratio and optimal portfolio weights have investment risk in Indian industrial sectors, and that this can be managed with relatively low costs by taking short position in the gold futures markets. The study shows that stock-gold portfolio provides better diversification benefits than the stock portfolios.

2.1.1 Gold as an investment

Hillier, Draper, and Faff (2006) survey the literature on the role of gold and other precious metals in financial markets. They categorize studies into five different approaches. The first approach studies the investment and diversification properties of precious metals when combined with stock market investments in financial portfolios. The second approach concentrates on the role of gold as a potential hedging variable in inter-temporal asset-pricing models. The third approach studies the properties of the return distribution and the possibilities for earning excess returns in gold and silver markets, i.e. the efficiency of these markets. The fourth approach studies the relationships of gold (and silver) to macroeconomic variables and government policy. The final approach concentrates on the particular features and characteristics of gold (and silver) production and market processes. We will look at some of these roles briefly in the following:

By itself, gold is quite a risky asset but its returns are generally independent of those on other assets. This makes gold a good diversifier for portfolios. Chua et al. (1990) and Jaffe (1998) examined the benefits of diversifying investment portfolios with gold stocks and generally observed a diversifying effect for gold. Chua et al. found, that the beta of gold bullion remained virtually indistinguishable from zero through 1970’s and 1980’s, and
gold was a meaningful investment for diversification for both long-run and short-run. By using data from 1971 to 1987, Jaffe constructed 4 portfolios mirroring allocations of typical large institutional portfolios each being different in risk and return. He found that adding 5% gold into all of these portfolios reduced the risk and increased the return of these portfolios and with 10% gold, the benefits increased even more. With more recent data, Hillier et al. (2006) examined the diversification benefits of gold in the US and international markets. They used data for the period 1976-2004 for S&P 500 and EAFE, and found that gold was especially a useful diversifier in periods with high volatility and poor performance. When comparing buy-and-hold strategy against switching strategy with gold they found that the former was superior and over the last 25 years, holding 9.5% gold in portfolio was the optimal allocation. Capie et al. (2004) examined one aspect of the second role of gold, gold as a hedge against US dollar. Using data from 1971 to 2002, they applied a variety of statistical techniques to explore the relationships between gold and the exchange rates of various currencies against the US dollar, with particular attention paid to the hedging properties of gold in episodes of economic or political turmoil. The US dollar gold price was found to move in opposition to the US dollar, and the movement was essentially contemporaneous. For each exchange rate considered, a typical weekly movement against the dollar generated a movement in the gold price of just under-one dollar. Gold is also believed to be an effective hedge against inflation. With data from 1976 to 2005, Levin and Wright (2006) found that the US price level and the price of gold moved together in a statistically significant long-run relationship supporting the view that a one percent increase in the general US price level leads to a one percent increase in the price of gold. However, they found that there are short-run deviations from the long-run relationship between the price of gold caused by short-run changes in the US inflation rate, inflation volatility, credit risk, the US dollar trade-weighted
exchange rate and the gold lease rate. This is consistent with findings from Ghosh et al. (2002), Gorton and Rouwenhorst (2006), Kolluri (1981) and Ranson and Wainwright (2005).