PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS

PIDE WORKING PAPERS
No. 118

Evaluation of Gold Investment as an Inflationary Hedge in Case of Pakistan

Sadaf Zafar
Attiya Yasmin Javid

January 2015

PIDE Working Papers
No. 118

Evaluation of Gold Investment as an Inflationary Hedge in Case of Pakistan

Sadaf Zafar
Pakistan Institute of Development Economics, Islamabad

and

Attiya Yasmin Javid
Pakistan Institute of Development Economics, Islamabad

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS
ISLAMABAD
2015

Pakistan Institute of Development Economics
Islamabad, Pakistan

E-mail: publications@pide.org.pk
Website: http://www.pide.org.pk
Fax: +92-51-9248065

Designed, composed, and finished at the Publications Division, PIDE.

C O N T E N T S

List of Tables

List of Tables

ABSTRACT

In countries like Pakistan, where the macroeconomic situation remains uncertain and inflationary expectations always linger to a high level, investors stay in search of such cost-effective or profitable investment opportunities that can be able to provide their capital an effective hedge against inflation. Therefore, the present study aims at empirically testing the status of gold as a potential hedge against inflation. The study whirls around analysing the nature of the relationship of expected and actual inflation with gold return and its cost of carrying i.e. the interest rate. By employing an autoregressive moving average (ARMA) with generalised autoregressive conditional heteroscedasticity (GARCH) models, the time varying relationship between the variables is studied. The data sample used in the study ranges from January, 2001 to December, 2013. The results support gold as an effective hedge against inflation in Pakistan; since, the returns on gold investment exceeds its cost of carrying with the view of changing expected inflation. Another important implication of the study is that gold can also perform a considerable role with the prospect of Islamic financing because it is proven to be more advantageous as compared to its alternative interest bearing investments.

Keywords: Inflation Hedge, Expected Inflation, Actual Inflation, Gold Return, Interest Rate, Pakistan

1. INTRODUCTION

Gold holds the greatest value among all the important metals and is always regarded as an inseparable part of any culture. Its importance is amplified by the fact that its value does not plummets even in economic crises and social unrest. Surprisingly, its prices have shown an upward trend during the war, stock market crashes and inflation where all other real and financial instruments failed to uphold their values. Owing to this fact, investors have started using it as a hedging instrument in crucial times which has raised its importance to a whole new level.

Gold has been used as a vehicle of monetary exchange for a longer period in human civilisation. Gold coins were circulated as currencies in many economies before the initiation of the paper money. In Seventeenth century, the first formal over the counter trading of gold started in London. By the Nineteen century, the metal became the backbone of the international exchange rate system, by the adoption of the 'Gold Standard' and later on by the Bretton Wood system by many European countries. This system abolished in 1973 but the influential role of the metal remained persistent in the international monetary system. Collapse of the Bretton Wood system allowed the gold prices to be determined freely by the market forces for the first time over the period of 250 years.

According to Ghosh, *et al*. (2002) demand for gold is mainly of two types; the "use demand" and the "asset demand". The former is said so because gold is used in the production of coins, jewelry, medals, dentistry items and other electrical as well as mechanical components. The latter is defined so because gold has been considered as a store of value since the prehistoric times**.** Generally, gold maintains the status of a stable and liquid asset around the world. The last decade has widely turned the importance of gold from a real asset to a financial asset. Gold, unlike other financial assets, does not pay any dividend or coupon yield; however, it is considered more advantageous because of the lack of the default risk.

Since 2007, the economic instability and financial volatility are the biggest threats faced by the financial markets worldwide. The value of many financial instruments such as equities, bonds, mortgage-backed securities have shown a steep decline. But even in such circumstances, gold alone recovered in quick fashion and ended-up making all time high prices. Therefore, the continuous gold price appreciation leads to an unprecedented surge in the gold investment. According to the World Gold Council Report (2013), the average global investment demand for gold was approximately 37 percent of its total average global demand during the last 5 years (2008-2013).[1] The demand for gold in Pakistan has also shown an upward trend. Pakistan's gold consumption was recorded more than 100 tonnes by year 2013, which ranks it as the world's 10th largest gold market.[2]

In developing countries like Pakistan, inflation uncertainty always remains a major concern for the investors. In order to protect the money from losing its value, the investors usually tend to invest their funds in the physical assets during the inflationary periods. The conventional wisdom behind this behaviour is that commodities are the effective hedge against the rise in the general price level, which reduces the return on financial assets such as bonds and stocks, etc. In Pakistan, precious metals, especially gold, are widely considered as a source of putting funds for the bad hours, even by the common people who have no knowledge about the economic or market situations.

Gold is widely believed as an inflation hedge because of the tendency to maintain its real value over the long term. In the ongoing global scenario, expectations regarding future inflations are considered to be the main driving force behind the increasing trend of the gold investment**.** It is suggested by many studies, such as Moree (1990), Ghosh, *et al.* (2002), Adrangi, *et al*. (2003), and Worthington and Pahlvani (2006) and Tkacz (2007) that an upward revision in expected inflation results in the gold price appreciation. With the prospect of rising inflation, many investors put their funds in gold either to hedge expected future inflation or to make speculative profits. Investors generally believe that gold prices are directly proportional to general price level. Hence, a rise in the expected inflation results in an upward demand pressure, which consequently shoots up the gold prices. This relationship is mentioned as the expected inflation effect hypothesis in this study.

Mostly the impact of inflation on the interest rate is overlooked while explaining the relationship between expected inflation and gold prices. But it is immensely important to consider the fact that the change in expected inflation will also result in the interest rate movement in the economy as suggested by Fisher (1896). Here, the interest rate can be observed as the opportunity cost as investors could utilise their funds in other alternative interest bearing investments instead of holding gold. It implies that any gain from the gold price appreciation during the inflationary period will be offset by the rise in the carrying cost of gold. So investors would find no incentive to buy gold. This consideration is stated as the carrying cost hypothesis in the current study.

[1]*Source*: The official website of the World Gold Council <www.gold.org>.

[2]*Source*: "Business Recorder" (April 2013); stated by Zubair Ahmed Malik, the President of Federation of Pakistan Chambers of Commerce and Industry (FPCCI).

The study is mainly intended to empirically test the above mentioned two hypotheses in order to analyse the status of gold as an inflation hedge. Broadly the study tries to find whether the gold investment hedges inflation in case of Pakistan or not. The present study tries to answer this question by empirically analysing the following two relationships: (1) the relationship of expected inflation with the interest rates and (2) the relationship of expected inflation with the gold returns. The study empirically tests the impact of the actual inflation on interest rate and gold return. The comparison of government treasury bonds with the gold investment is also considered, as both are theoretically considered as risk free assets.

Gold retains a strong cultural and traditional meaning since the ancient times. In Pakistan, it is one of the most important items of dowry, which is frequently used by women as ornaments. However, the last decade has shown a continuous increase in gold prices, which has boosted its importance more than just a traditional ornament. Considering the escalating inflationary pressures, Pakistani investors also got attracted towards gold bullions like many investors across the globe. Therefore, the inflation hedging property of gold is needed to be analysed in detail. It is a fact that gold is generally believed as an inflation hedge without considering the change in the carrying cost of gold over the inflationary periods. Hence, this study is aimed at empirically testing the status of gold as a hedging instrument against inflation in Pakistan, with the view of comparing the benefit of making gold investment by its opportunity cost.

There is a small literature existing on the investment prospects of gold and other financial assets in Pakistan as not much research is done in this particular field. Although, small empirical work has been staunched to check the inflation hedging property of gold in Pakistan, but this study is the first in my knowledge, intended to involve the relationship of expected inflation with the cost of carrying (interest rate) as well i.e. the carrying cost hypothesis. This study is also unique in a form that it analyses the time varying relationship between the variables using the autoregressive moving average (ARMA) with generalised autoregressive condition heteroskasticity (GARCH) models. As far as the general idea of the study is concerned, Blose (2010) for the first time investigated two hypotheses, termed as the expected inflation hypothesis and the carrying cost hypothesis to confirm the inflation hedging property of gold for the United States. Following him, this study seeks to empirically investigate the inflation hedging property of gold in Pakistan.

After the introductory section, the remaining study is organised as follows. The relevant literature on the study is reviewed in Section 2. Section 3 develops the conceptual framework and working hypothesis. The data sources, variables and methodology are discussed in Section 4. Section 5 is composed of the results discussion and Section 6 provides the conclusion and the implications of the study.

2. LITERATURE REVIEW

This section broadly draws attention to the studies done so far in the relevant field of the study. The literature review is basically divided into three parts. Section 2.1 covers the studies conducted to analyse the worth of gold as an investment. Section 2.2 puts light on the literature of different approaches adopted to model the gold prices. Section 2.3 provides an overview of the studies, empirically testing the Fisher effect. Review of the studies is set forth in chronological order from the previous studies to the current studies.

2.1. Gold as an Investment

Previous studies analysing the value of gold as an investment have pointed out a range of benefits that can be accrued by making gold investment. Some of these studies, such as Jaffee (1989), Smith (2002), Hiller, *et al.* (2006), and Baur and Lucay (2010) recommended the importance of gold in creating a risk diversified portfolio. Similarly, numerous studies such as Ghosh, *et al* (2002), Capie, *et al.* (2005), Beckman and Czudaj (2010) and Levin and Wright (2006) pointed out the benefit of gold as a hedge against inflation, currency risk, financial crises and political uncertainty. These studies are discussed below.

Jaffee (1989) conducted a study by creating four hypothetical portfolios of varying risks and returns. The results indicated that addition of gold in each portfolio increased the returns and reduced risk. Moreover, the increment of gold in each portfolio decreased the risk even more. Smith (2002) analysed the correlation between gold prices and the stock indices in Europe and Japan. The results suggested the existence of a small and negative correlation between gold returns and returns on stock price indices for most of the time. However, the two variables were not found to be cointegrated over the period, indicating the absence of a long run relationship. Capie, *et al.* (2005) investigated the role of gold as a hedge against US dollar. The study assessed the relationship of gold prices with sterling-dollar and yen-dollar exchange rates, during different political and economic events. The results suggested the presence of a negative relationship between US dollar gold price and exchange rate and the relationship is found to be essentially contemporaneous.

Ghosh, et *al*. (2002) conducted a study to analyse whether gold is able to hedge inflation in the United State or not. The results suggested gold as a hedge against inflation in the short run as well as in the long run. Hille, *et al.* (2006) also studied the role of gold investment in the financial markets. The results suggested gold to have a small negative correlation with an S&P 500 index. The findings also revealed that portfolios with gold performed significantly better than the portfolios without gold. Baur and Lucy (2010) defined a hedge as an asset that is uncorrelated or negatively correlated with other assets on average. While a safe haven is an asset that is uncorrelated with other assets in the times of market turmoil. To find whether gold is a safe haven or hedge for bonds and stocks, constant and time varying relation of U.S, U.K and German's stock and bond returns with gold returns was analysed. The results proved gold as a hedge and a safe haven for stocks in normal conditions and in market crises, respectively. While for bonds, gold failed to provide such results. An important finding of the study is that gold serves its safe haven property only for the short-runs.

Beckman and Czudaj (2010) conducted a study to analyse the inflation hedging property of gold for the four major economies i.e. US, UK, Europe and Japan. The findings revealed that gold is able to hedge inflation in the long run. This ability tended to be higher for US and UK as compared to Europe and Japan. However, the metal was found unable to hedge inflation in the short-run. Beckaman and Czudaj (2014) further attempted to analyse the safe haven property of gold for different regional and international markets. The findings of the study overall indicated gold as a safe haven, however, this property seemed market specific.

2.2. Modelling of Gold Price

Previous literature aimed at modeling the price of gold basically followed three approaches. Section 2.2.1, covers the first approach that models the variation in gold prices in terms of variation in the main macroeconomic variables such as exchange rate, interest rate and income level etc. Section 2.2.1, covers the second approach that spotlights the rationality or speculation of gold price movements. Finally, Section 2.2.2, covers the last approach that examines gold as an inflation hedge by focusing on the short and the long term relationship between gold and general price level. It is important to mention that the present study whirls around the last approach.

2.2.1. *Macroeconomic Variables and Gold Prices*

A number of studies are devoted to determine the driving forces behind the gold price movements. Some of these are discussed below.

Most of the existing studies, under this category focused on investigating the nature of the relationship between oil and gold prices. Most of these studies examined the link between oil and gold prices through the inflation channel. As oil prices rise, general price level rises due to increase in production cost and hence, gold prices also show appreciation. Such as, Abken (1980) argued that there exist a significant positive relationship between inflation rate and gold prices through the oil prices channel. However, Simakova (2010) studied the relationship between gold and oil prices through the common factors such as inflation, interest rates, industrial growth and stock prices of gold mining companies. The results revealed the existence of strong correlation between the two variables via these common factors.

Some studies have been also devoted to link the gold prices with the forex market as well. In most of the world's economies, gold prices are determined in dollar and as a result the US dollar exchange rate is widely believed to determine the gold prices. Such as, Koutsoyiannis (1983) found presence of a negative relationship between the gold prices and US dollar exchange rate. The study further pointed out that US dollar plays an important role in providing the international liquidity, since gold and oil prices are determined in US dollar. Kiohos and Sariannidis (2010) used the daily data to explore the effect of energy (crude oil) plus financial (equity, currency and bond) markets on gold prices for the first time. By employing GJR-GARCH model, results suggested that crude oil prices exert positive impact on the gold prices. However, stock return, US dollar/Yen exchange rate and T-bill rate negatively affect the gold market.

Batten, *et al*. (2010) attempted to investigate the monthly price volatility of four precious metals including gold. The findings suggested that monetary variables such as interest rate, inflation, money supply and growth rate are significantly important in explaining the gold price movements. Toraman, *et al.* (2011) analysed the relationship of some macroeconomic variables with the gold prices in the US. The results suggested gold prices to be negatively related with the US dollar. However, a positive correlation was found between gold and oil prices. Sidhu (2013) also conducted a study for India. The results indicated that gold prices are closely connected with US dollar, crude oil prices, inflation and repo rate.[3] Pule (2013) employed a multiple regression model to examine the relationship of South African macroeconomic variables and gold prices using daily data for the period November 2004 to October 2012. The results indicated that gold prices depend on real GDP and Rand/Dollar exchange rate.

2.2.2. *Rationality of Speculation of Gold Price Movement*

A little literature is devoted to this approach so far. Pindyck (1993) used the present value model to explain the pricing of four storable commodities, including gold. For storable commodities, the convenience yield accrued from holding inventories is regarded as the payoff stream. However, it was found that the present value model fails to explain the movements in gold prices.

2.2.3. *Inflation and Gold Prices*

The literature on the relationship between inflation and gold prices is vast and complex. Existing studies, examining this relationship, can be mainly divided into two groups. The long term relationship between gold prices and inflation is examined by one strand of literature while the impact of expected inflation on gold prices is focused in the other group. Some of these studies are discussed below:

---

[3] Repo rate is the rate at which the central bank of a country (Reserve Bank of India in case of India) lends money to commercial banks in the event of any shortfall of funds.

Moore (1990) examined the effect of inflation signals on the New York market prices of gold. The results indicated a positive correlation between two variables and further suggested that investors who made the strategy of buying gold when the inflation signal flashed up and selling on down signals, and then investing in common stocks or U.S Treasury bonds would have earned an average annual rate of return much higher rather than if they would have invested in any of these assets for the whole period. Mahdavi and Zhou (1997) also conducted a study to analyse the effect of commodity prices and gold prices on inflation. The results implied some evidence of cointegration between commodity prices and inflation, while gold prices were found insignificant in predicting inflation. Worthington and Pahlavani (2006) pointed the importance of substantial changes associated with the transition of gold while examining the relationship between gold prices and inflation. By using the monthly prices of gold and inflation in the United State, the study provided strong evidence of a cointegrating relationship between the variables in both post war-period and since the early 1970s. These findings supported the view that gold investment can serve as an inflationary hedge.

Blose (2005, 2010) for the first time, examined the effect of changes in expected inflation on gold prices and interest rate. The results indicated that expected inflation affects interest rates, but does not affect gold prices. It implied that the cost of holding gold exceeds it benefit in the inflationary period. Hence, speculation strategies designed on the basis of expected inflation seemed successful in the bond market but not in the gold markets. Ranson and Wainwright (2005) pointed gold as a better indicator of unanticipated inflation than oil. This study also suggested the investors to keep their capital in the form of gold indicating it as a strong inflation hedge.

Levin and Wright (2006) further conducted a study and results suggested that US price level and gold price have one to one positive relationship in the long run. However, short-run changes in the inflation rate, inflation volatility, credit risk, and the US-dollar trade weighted exchange rate and the gold rate result in short-term deviations from the long-term relationship between the two variables. Tkacz (2007) argued that useful information about future inflation can be anticipated by monitoring the price movements of gold being treated as a financial asset. The results suggested that information about future inflation is depicted by gold prices, especially in the countries having a formal inflation target. It implied that the formulation of inflation expectations might have been improved by the introduction of inflation targets.

According to a report published by *Oxford Economics* in 2011, "The impact of inflation and deflation on the case for gold", inflation is the basic reason behind the gold price movement in the long run. But in the short run, other forces such as financial stress, political risk, real interest rate, central bank activity and US dollar exchange rate are also deemed responsible for price movements. According to the World Gold Council's Report (2011), gold's performance as an inflation hedge varies according to the economic scenarios. The study revealed that some assets (equity, bond, cash and houses) outperform gold in the periods of moderate inflation. While gold proved itself as a strong hedge in the case of high inflation and deflation as well. The report further stated that the lack of correlation with other financial assets is also a distinct feature of gold i.e. very helpful in creating an efficient investment portfolio.

Tufail and Batool (2013) conducted a study to analyse the inflation hedging property of gold, as compared to other financial assets such as real estate, stock-exchange securities and foreign currency holdings over the period 1960-2010 for Pakistan. The results of the Johanson cointegration analysis suggested gold as a potential determinant of inflation. The results further revealed that gold is able to provide hedge only against the unexpected inflation. However, real estate was found to be a suitable hedge against expected inflation. Shahbaz, *et al*. (2013) further employed ARDL technique for examining the long run relationship and innovative accounting approach (IAA) to examine the direction of causality between the gold prices and inflation. The study used the data of Pakistan over the period 1997-2006 and proved gold as an effective hedge to deal with inflation both in the long and short-run.

2.3. The Fisher Effect

The Fisher effect is considered as an imperative theoretical concept in finance and economics. It is basically the relationship between nominal and real interest rate, that was firstly introduced by Irving Fisher, in his book *Appreciation and Interest* (1896). In his later work, *Theory of Interest* (1930), nominal interest rate changes equally with a permanent change in inflation while the real interest rate remains unaffected by this change. The Fisher effect asserts that the real interest rate remains unaffected by the monetary policy and hence, by the expected inflation. It is important to mention that Fisher (1930) found a significant correlation coefficient between the past inflation and nominal interest rate for the United States and United Kingdom. Later on, with the Kenysian revolution, the Fisher effect was widely rejected. However, in 1970, the rose in inflation and interest rate gave a fresh wind to this theoretical concept. An extensive literature is devoted to this concept across the globe and mixed results have been found. The survey of literature would indicate that empirical tests of Fisher effect hypothesis are inconclusive

Mishken (1992) was the first to analyse the long-run Fisher effect using the cointegration test. The common trend evidence for a long-run relationship was found before October 1979. However, no evidence for the short-term Fisher effect was found. Mishken and Simon (1995) further investigated the Fisher effect hypothesis for Australia. The results clearly suggested that the Fisher effect holds only for the long-run. The study further revealed that the short-run changes in interest rate reflect changes in monetary policy, while the long-run level indicates the inflationary expectation.

Berument (1999) assessed the effect of expected inflation risk and inflation risk on interest rates, in the United Kingdom, within the fisher hypothesis framework. The study proposed that both the expected inflation and the conditional variance of inflation, positively affect the three-month treasury-bill rates. Berument, *et al.* (2005) further extended the study to test the validity of the Fisher hypothesis for the G7 countries and 45 developing economies. The results indicated that the relationship holds in its weak form[4] in all G7 countries, but in only 23 developing countries. The study provided few tentative explanations of the fact that Fisher effect is not occurring in a number of developing countries. First, the interest rates are not at all free to adjust. Second, even if the interest rates are free to adjust, there is only a partial response to the changes in inflation (especially, in the countries where money markets are not efficient). Finally, interest rate activities are considered a "sin" for religious reasons in some countries.

Hasan (1999) attempted to test the validity of the Fisher Effect for Pakistan, using the quarterly data over the period 1957Q1-1991Q2. Both adaptive and rational expectations were used in the study to model the expected inflation. The results suggested a long-run relationship between the nominal interest rate and expected inflation. However, it was also argued that the nominal interest rate does not fully cover or accurately anticipate inflation and therefore, the real interest rate falls. The findings further implied that as interest rate does not fully anticipate the inflation, the bank deposits deteriorate over time and investors seeks the alternative investment opportunities. Rehman, *et al.* (2004) also conducted the same kind of study for Pakistan and the results assured the acceptance of the Fisher effect hypothesis in its weak form.

Shahbaz (2010) proceeded the empirical testing of the Fisher hypothesis using the autoregressive distributed lag-bound testing approach. The results of the study indicated the presence of a weak form of the Fisher effect in Kuwait, Saudi Arabia, India and Pakistan. However, the hypothesis was found invalid for Bangladesh and Sri Lanka. Fatima and Sahibzada (2012) also conducted a study for Pakistan, by applying Johanson-Cointegration technique. The study used the data over the period 1980-2010. The results of the study suggested the presence of the long-run as well as the short-run relationship between the expected inflation and interest rate within the Fisher hypothesis framework.

The review of literature clearly shows that not many studies are devoted to analyse the effect of inflation on gold prices and interest rate in the common framework so far. Same is the case for Pakistan. Most of the studies done in this

[4]A positive but less than one value of the estimated coefficient implies the Fisher hypothesis in its partial/weak form.

field only consider the relationship between inflation and gold prices aimed at analysing gold as an inflation hedge. For instance, Tufail and Batool (2013) and Shahbaz, *et al*. (2013) simply analysed the relationship of gold prices with the rise in the general price level to prove the inflation hedging property of gold by using the cointegration technique. This study attempts to fill this gap in case of Pakistan in order to analyse the inflation hedging property of gold investment.

3. THEORETICAL FRAMEWORK AND WORKING HYPOTHESES

The theoretical relationship between the variables of the primary interest in detail and the hypotheses development is presented in this section.

3.1. The Expected Inflation Effect Hypothesis

This hypothesis suggests that expected inflation and gold prices have a positive relationship between them. Due to the expectation about the future rises in prices, individuals will choose to reallocate their assets holding by exchanging cash for gold, driving up the gold prices in this process. Thus, the expected inflation effect hypothesis has the following implications as suggested by Bose (2010). The gold spot prices depend upon the expected inflation and If investors have insight and knowledge about the future inflation, they can hedge inflation or even make speculative profits by making gold investments.

3.2. The Carrying Cost Hypothesis

The above mentioned hypothesis ignores the fact that expected inflation also affects the interest rate in an economy. The investment in gold must be financed either by diverting money from other investments or by borrowing. Accordingly, whatever the case may be, the interest rate, i.e. the cost of carrying gold would influence the gold investment decision. The theoretical literature suggests a positive association between the expected inflation and interest rate. Therefore, this essential implication is also taken into consideration in the carrying cost hypothesis. Blose (2005, 2010) suggests that the carrying cost hypothesis has two implications. These implications can be demonstrated by the following conceptual framework.

Any investment decision primarily depends on the risk and return anticipated before making the investment. Similar is the case with the gold holding, the expected return on gold would manipulate the behaviour of the investors. The capital asset pricing model (CAPM) by Sharpe (1964) and Lintner (1965), proposes that the expected return of any assets should be equal to its cost of capital.

According to the capital asset pricing model (CAPM),

$$\textit{Expected Return on Gold} = \textit{Risk Free Rate} + \beta(\textit{Risk Premium})$$

Where, market beta (β) is the measure of the systematic risk or volatility of an asset or a portfolio in comparison to the market as a whole. The risk premium is the compensation for making an investment by foregoing others. It is basically the difference between the expected market return and the risk free rate. Lawrence (2003), Blose (1996) and McCowm and Zimmerman (2006) suggest that gold has a market beta of zero or even slightly negative. If it is initially assumed that market beta of gold is zero, then gold should bring a capital gain equal to the risk free rate as suggested by the capital asset pricing model. In other words, the benefit of the gold investment should be equal to its opportunity cost.

Expected Return on Gold = Risk Free Rate

In such case, the upward revision in expected inflation will bring the upward movement in the risk free rate, so will in the expected appreciation of the gold. This implies no difference between the benefit and cost of holding gold, even after the change in expectations. Thus, investors will find no incentive to put their funds in the gold stocks. Since, the investment in gold does not bring any dividend the return on gold is purely its price appreciation over the period. Here, instead of gold, investors could also put the funds in any other risk free investment. Thus, the risk free rate can be regarded as the opportunity cost of holding.

Gold Price Appreciation = Opportunity Cost of Holding Gold
= Risk Free Rate … … … … … (i)

Consider a hypothetical case, in which inflationary expectations increase from zero to a positive number, say ‘E’. It means individuals would believe that all the commodity prices will increase by the same factor ‘E’, so will the prices of gold. In order to shun the losses in the value of money, believing in gold as an inflation hedge, the upward demand pressure will result in gold price appreciation.

Now, if E = The Rate of Expected Inflation.
G_0 = The spot price of gold at time zero.
G_1 = The expected future spot price of gold when expected inflation is 0.
G_1^E = The expected future spot price of gold when expected inflation is E.
R = The nominal and real rate of return when expected inflation is 0.
R^E = The nominal rate of return when expected inflation is E.

Initially, consider the situation in which the expected inflation rate is zero. Let P_1 be the expected profit at time t=1 from holding gold. This speculative profit, if any, would be equal to the gold price appreciation minus the opportunity cost.

$$P_1 = G_1 - G_o - G_oR \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(ii)}$$

Where, G_oR is the opportunity cost of holding gold. The carrying cost is basically the cost incurred due to an investment position. This may include a financial cost, such as the interest rate on the tied up funds and/or the economic cost, such as the opportunity cost of foregoing the alternative investments. In case of perfect and frictionless gold markets, the difference between the current and the future price would be simply its opportunity cost. One of the cost of carry arbitrage arguments implies that in frictionless markets, the difference between the current and future price of a commodity will be exactly equal to the cost of carry [Kolb (1944); Chance (2001); and Blose (2005)]. This can be stated as follows:

$$G_1 - G_o = G_oR \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(iii)}$$

By rearranging the above equation;

$$G_1 = G_o(1 + R) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(iv)}$$

Now, if the expectation about the future inflation rate increases from zero to ‘E’, the expected future spot price of gold would be:

$$G_1^E = G_1 + G_1E \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(v)}$$

In this case expected speculative profit would be:

$$P_1^E = G_1^E - G_o - G_oR^E \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(vi)}$$

By using Equations (iv) and (v), Equation (vi) can be written as follows:

$$P_1^E = G_o(1 + R)(1 + E) - G_o(1 + R^E) \quad \ldots \quad \ldots \quad \ldots \quad \text{(vii)}$$

By using the Fisher equation, it can be seen that how the nominal interest rate would behave after an upward revision in expected inflation. Fisher equation is basically an identity that links the nominal interest rate, (expected) inflation and the real interest rate. Mankiw (2012) states *“According to the Fisher equation, a 1 percent increase in the rate of inflation in turn causes a 1 percent increase in the nominal interest rate. The one-for-one relationship between the inflation rate and the nominal interest rate is called the Fisher effect”.* Thus, the Fisher equation can be stated as follows.

$$(1 + R^E) = (1 + R)(1 + E) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(viii)}$$

By substituting Equation (viii) into (vii);

$$P_1^E = G_o(1 + R^E) - G_o(1 + R^E) = 0 \quad \ldots \quad \ldots \quad \ldots \quad \text{(ix)}$$

Hence, investors would not be able to earn any sort of speculative profit in such case.

The implications of the carrying cost hypothesis can be stated as follows:

(1) Gold spot prices are not determined by the expectations regarding the future inflation.
(2) Investors who have insight about the future inflation will not be able to hedge inflation by making gold investments.

The above mentioned case is based on some hypothetical assumptions. If any or all the assumptions of the capital asset pricing model, frictionless gold market or zero market beta do not hold, the gold price appreciation may differ from the risk free rate. Thus, following two situations may arise.

(i) If the gold price appreciation exceeds the risk free rate, then only in such case individuals would be better off by investing in gold.

$$G_1^E - G_o > G_o R^E$$

(ii) If risk free rate gets an increase more than the gold price appreciation, then investors would switch their demands towards interest bearing investments. So, the price of gold seems to be unaffected even after the upward revision of expected inflation.

$$G_1^E - G_o < G_o R^E$$

It means an empirical investigation is clearly needed to see which one of the above three situations is actually prevailing in Pakistan.

4. DATA AND METHODOLOGY

This section discusses the data, variables, sample period and methodological framework of the study.

4.1. Data

The study is conducted for Pakistan using the monthly data over the period January, 2001 to December, 2013. The data sample consists of 156 observations. The data on gold prices are taken in rupees per 10 grams from the *SBP Statistical Bulletin and Business Recorder*. The data on the government yield rates and CPI is extracted from the *International Financial Statistics* (IFS) and *SBP Annual Reports*.

4.1.1. *Variables Construction*

Gold Return: The return on gold investment can be defined as the gold price appreciation over the period. It is calculated by taking the first log difference of the gold prices.

$$RG_t = \ln\left(\frac{G_t}{G_{t-1}}\right) = lnG_t - lnG_{t-1}$$

Interest Rate: The study uses the yield of different treasury debts (that matures in 3 months, 6 months, 3 years and 10 years) as the proxy for the interest rate.

Actual Inflation: The actual inflation rates over the sample period are calculated by taking the first log difference of the consumer price index (CPI).

$$I_t = \ln\left(\frac{CPI_t}{CPI_{t-1}}\right) = ln\, CPI_t - ln\, CPI_{t-1}$$

The CPI series used 2010 as the base year.

Expected Inflation: Expected inflation is calculated by taking the first log difference of the expected consumer price index (ECPI).

$$EI_t = \ln\left(\frac{ECPI_t}{ECPI_{t-1}}\right) = ln\, ECPI_t - ln\, ECPI_{t-1}$$

The filter proposed by Hodrick and Presscot (1980, 1997), referred to as the HP filter, is employed to get the expected CPI from the series of historical actual CPI rate. This technique is discussed in detail in Appendix A.

4.2. Econometric Model

In order to study the time varying relationships between the variables, Autoregressive Moving Average (ARMA) with generalised autoregressive conditional heteroscedasticity (GARCH) models are used. This section will discuss these models in detail.

4.2.1. ARMA (m, n) with GARCH (p, q) Model

With the growing financial markets across the globe, the investors have no longer remained concerned only with the expected returns of the assets. Riskiness or uncertainty of a particular investment has also become an important concept. With time, the need for econometric models that are capable of dealing with the variance or volatility of the series has arisen. Volatility is basically a measure of the intensity of unpredictable changes in the financial returns series. Typically, autoregressive conditional heteroscediasticity (ARCH) family of models is terms as being hetereoscedastic[5] (i.e. the time varying variances). Engle (1982) introduced these ARCH models, giving weight to the current as well as historical information in modeling the volatility of the returns. Engle's model suggested that the variance of the residuals at the current time period depends on the squared error terms of the past periods. Later on, Bollerslev (1980) and Taylor (1986) proposed the GARCH models by allowing the conditional variance to be dependent on their own previous lags as well.

[5]Classical linear regression models (CLRM) assumes the variances of the error terms to be constant (homoskedastic). But ARCH/GARCH models violate these assumptions, stating that the disturbance of the financial data exhibits time varying variances (heteroskediastic).

GARCH models are considered far better than the ARCH specification because the former is more parsimonious and avoids over fitting. These GARCH models are estimated by employing the maximum likelihood method.

Generally, financial returns are believed to be dependent on their own historical information in addition to other factors. In order to analyse the effect of the return's own previous information, the autoregressive-moving average (ARMA) model can be employed. ARMA models are considered an important class of time series model and are usually associated with Box and Jenkins (1970). These models suggest that the current values of returns along with other factors depend on the previous values of the returns and the white noise disturbance terms.

In general an ARMA (m, n) GARCH (p, q) model is presented as follows:

$$R_t = \alpha + \beta X_t + \sum_{i=1}^{m} \partial_i R_{t-1} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \quad (a)$$
$$\varepsilon_t \sim iid\ (0, h_t)$$
$$h_t = \gamma + \sum_{i=1}^{p} \delta_i \varepsilon_{t-1}^2 + \sum_{j=1}^{q} \theta_j h_{t-1}$$

In the conditional mean equation, Returns R_t is presented as the linear function of the explanatory variable X_t, which may be a linear combination of exogenous as well as endogenous variables. The first summation term represents the autoregressive process, indicating that the current value of the return is determined by its own past values. The second summation term represents the moving average process, indicating that the current value of the returns series is determined by the current as well as the past disturbance terms. The error term ε_t is normally and independently distributed with mean zero and conditional variance h_t. The first summation term in the conditional variance equation represents the ARCH term of order *p* and the second summation term represents the GARCH term of order *q*. The sum of the parameters of ARCH and GARCH terms represents the persistence of shocks to the volatility.

4.3. Model Specification

This section describes the methodology used to analyse the effect of change in expected and actual inflation on the returns and volatility of the Treasury bonds as well as of the gold returns as suggested by Blose (2005, 2010).

4.3.1. The Impact of Expected Inflation on the Bond Yield

The effect of the expected inflation on the bond yield (the Fisher Effect Hypothesis) is examined by the following ARMA (m,n) with GARCH (p, q) specification model.

$$BY_t = \alpha + \beta EI_t + \sum_{i=1}^{m} \partial_i BY_{\mathbf{t-1}} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \quad (i)$$

$$\varepsilon_t \sim iid\ (0, h_t)$$
$$h_t = \gamma + \sum_{i=1}^{p} \delta_i\, \varepsilon_{t-1}^2 + \sum_{j=1}^{q} \theta_j h_{t-1}$$

Here, BY is the change in bond yield from the previous period and EI represents the expected change in the CPI from the previous period i.e. the expected inflation. ε_t is the disturbance term. In order to analyse the impact of the previous information in the bond market, autoregressive moving average, i.e. ARMA (m, n) structure is also introduced. The first summation term in the Equation (i) shows the AR (m) process and the second summation shows the MA (n) process. In the conditional variance equation, the first summation implies the ARCH (p) lags and the second summation term implies the GARCH (q) process.

If β in model (i) is positive and significantly different from zero, then it indicates that expected inflation affects bond yield (i.e. the cost of carrying gold) positively. According to the Fisher effect hypothesis this β should be equal to 1. However, if it is less than 1, then it implies the presence of partial or weak Fisher effect.

4.3.2. The Impact of Actual Inflation on the Bond Yield

To study the effect of actual inflation on the bond yields for different maturity periods, the following ARMA (m, n) with GARCH (p, q) specification is employed.

$$BY_t = \alpha + \beta I_t + \sigma I_{t-1} + \sum_{i=1}^{m} \partial_i\, BY_{\boldsymbol{t-1}} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \qquad (\boldsymbol{ii})$$
$$\boldsymbol{\varepsilon_t} \sim iid\ (0, h_t)$$
$$h_t = \gamma + \sum_{i=1}^{p} \delta_i\, \varepsilon_{t-1}^2 + \sum_{j=1}^{q} \theta_j h_{t-1}$$

Here, *BY* represents the change in the bond yield from the previous period, I_t is the inflation prevailing in the current time period and I_{t-1} is the previous period inflation. The inflation rate prevailing in the previous period is expected to influence the behavior of the individuals as well as of the policy-makers, in the current time period. Therefore, it is reasonable to include the lagged inflation term also in the model.

4.3.3. The Impact of Expected Inflation on the Gold Returns

In order to analyse the effect of the expected Inflation on the gold return, the following ARMA (m, n) with GARCH (p, q) specification model is employed.

$$Rg = \alpha + \beta EI_t + \sum_{i=1}^{m} \partial_i\, Rg_{t-1} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \qquad (iii)$$
$$\boldsymbol{\varepsilon_t} \sim iid\ (0, h_t)$$
$$h_t = \gamma + \sum_{i=1}^{p} \delta_i\, \varepsilon_{t-1}^2 + \sum_{j=1}^{q} \theta_j h_{t-1}$$

Here, *Rg* is the percentage change in the gold prices from the previous period, i.e. the returns on the gold investment. EI is the expected inflation. The historical information related to the gold prices is also expected to influence the current values; therefore ARMA (m, n) structure is also introduced in the model. The first summation term in the model (i) shows the AR (m) process and the second summation shows the MA (n) process. In the conditional variance equation, the first summation implies the ARCH (p) lags and the second summation term implies the GARCH (q) process.

Provided that the expected inflation affects the cost of carrying gold, the acceptance criteria for the hypotheses of the study is presented in Table 4.1. The expected inflation effect hypothesis will be accepted, only if, the expected inflation has a positive and significant relationship with the gold returns.

Table 4.1

Acceptance Criteria for the Hypotheses

Hypothesis	Acceptance Criteria
1. Expected Inflation Effect Hypothesis	In model (iii) if β is positive and significantly different from zero, then the second hypothesis can be rejected in favour of the first one.
2. Carrying Cost Effect Hypothesis	In model (iii) if β is not significantly different from zero, then the first hypothesis can be rejected in favour of the second one.

4.3.4. The Impact of Actual Inflation on the Gold Return

The effect of the actual inflation on the gold returns is analysed by employing the following ARMA (m, n) with GARCH (p, q) specification model.

$$Rg = \alpha + \beta_1 I_t + + \beta_2 I_{t-1} + \sum_{i=1}^{m} \partial_i \, Rg_{\boldsymbol{t-1}} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \quad (iv)$$

$$\varepsilon_t \sim iid\ (\,0, h_t\,)$$

$$h_t = \gamma + \sum_{i=1}^{p} \delta_i \, \varepsilon_{t-1}^2 + \sum_{j=1}^{q} \theta_j h_{t-1}$$

Here, R_g represents the returns on the gold investment, I_t is the inflation prevailing in the current time period and I_{t-1} is the previous period inflation.

5. EMPIRICAL RESULTS AND DISCUSSION

After presenting summary statistics and initial diagnostic tests result in Section 5.1, the empirical results presented of the Fisher Effect Hypothesis and the analysis of the inflation hedging property of the gold are presented in Sections 5.2 and 5.3.

5.1. Time Series and Initial Diagnostic Analysis of the Variables

This section comprises of four sub-sections. The summary statistics and unit root analysis of the variables are presented in Sections 5.1.1 and 5.1.2 respectively. The results of the pre-estimation diagnostic and visual analysis of the variable are presented in Sections 5.1.3 and 5.1.4.

5.1.1. *Summary Statistics*

The summary statistics of the data is presented in Table 5.2. The mean values for the series of inflation, expected inflation, gold returns and bond yields for the different maturity period (for three months '3m', six months '6m', three years '3y' and for ten years '10y') are almost zero, indicating the mean reversion behaviour.

The gold returns are positively skewed, showing the above average returns is more than the below average return. However, the series for bond yields for different maturity periods are negatively skewed. The value of excess kurtosis of the gold returns series is positive, indicating the leptokurtosis. Leptokurtosis is basically the distribution having clustering of data around the mean with high peaks and heavy tail. The bond yields for all the maturity periods are found to be leptokurtic.

The Jarque-Barra statistics for the gold returns series indicates the rejection of null hypothesis of normality. The bond yields for all the maturity periods also confirm the non-normality of the series. Therefore, it can be stated that the gold return and bond yields for all the maturity periods are leptokurtic, skewed and hence non-normal.

5.1.2. *Unit Root Test*

The time series analysis begins with the tests for stationarity of the data. To achieve valid results, using the ARMA GARCH models, stationarity (i.e. the fluctuation of data around a common mean throughout the series) of the series is pre-requisite. Augmented Dickey-Fuller (ADF) unit root test is used to check the stationarity of the variable and results are shown in Table 5.1.

Initially, CPI is found to be non-stationary at level. After taking the first log difference of CPI, the series of inflation 'I' is found to have no unit root. The trend component of the inflation series, i.e. the Expected inflation 'E' is also found to reject the null of non-stationarity. The series for the gold prices 'G' is initially found to be non-stationary at level. But after taking the first log difference of the prices, the returns series 'R_G' is found to be stationary. The Treasury bond yields for different maturity periods (3 months, 6 months, 3 years and 10 years) are found to have no unit root at the level. Moreover, the returns on bond yields i.e. the first difference yield rate series are also found to have no unit root.

Table 5.1

Descriptive Analysis of the Variables

	I= DLCPI	EI=DLECPI	G	Rg=DLG	R3m=D3m	R6m=D6m	R3y=D3y	R10y=D10y
Mean	0.007	0.007	21602	0.013	−3.9477e-005	−6.329e-005	−2.4535e-005	−6.8671e-005
S.D	0.008	0.003	16274	0.038	0.004	0.005	0.003	0.003
Skewness	0.437	−0.599	0.698	0.038	−0.457	−0.562	−0.834	−2.136
Excess Kurtosis	0.214	−0.752	−1.036	0.8042	2.066	3.752	1.802	7.956
JB test	5.171	12.75	19.664	4.477	32.754	99.087	38.949	526.73
	(0.075)+	(0.001)	(0.000)	(0.091)	(0.000)	(0.000)	(0.000)	(0.000)
ADF Statistics	−2.524	−3.335	1.780	−5.364	−4.470	−5.005	+−4.068	−4.264

Note: I= DLCPI = Actual Inflation
EI=DLECPI = Expected Inflation
G= Gold prices
Rg=DLG = Return on Gold
R3m=D3m = Return on the 3 months treasury bills
R6m=D6m= Return on the 6 months treasury bills
R3y= D3y = Return on the 3 years treasury bonds
R10y=D1y= Return on the 10 years treasury bonds

Null Hypothesis for Jarque Berra test : Series is normal
Null Hypothesis for ADF test: Non-Stationary / There is no unit root.
Critical Values for ADF test: –3.473096 at 1% level
–2.880211 at 5% level
–2.576805 at 10% level.
Parenthesis; (__) contains P-value.

Table 5.2

Initial Diagnostic Analysis of the Variables

	I= DLCPI	EI=DLECPI	G	Rg=DLG	R3m=D3m	R6m=D6m	R3y=D3y	R10y=D10y
Q-stat(5)	26.598***	705.904 ***	744.844 ***	8.450**	58.105***	25.180***	149.113***	96.204***
	(0.000)	(0.000)	(0.000)	(0.033)	(0.000)	(0.000)	(0.000)	(0.000)
Q-stat(10)	34.091***	1288.11***	1402.24***	11.368	66.678***	31.751***	160.402***	98.744***
	(0.000)	(0.000)	(0.000)	(0.329)	(0.000)	(0.000)	(0.000)	(0.000)
Q^2-stat (5)	85.565***	731.225***	736.593***	13.518**	43.914***	18.2413***	25.154***	34.111 ***
	(0.000)	(0.000)	(0.000)	(0.018)	(0.000)	(0.003)	(0.000)	(0.000)
Q^{2-}stat(10)	95.678***	1362.29***	1368.15***	14.651	45.278***	20.949**	41.838***	37.909***
	(0.000)	(0.000)	(0.000)	(0.146)	(0.000)	(0.021)	(0.000)	(0.000)
LM-ARCH	20.871***	1.0943e+008***	8686.7***	4.565**	11.678 ***	3.674**	11.280***	24.121***
test stat (2)	(0.000)	(0.000)	(0.000)	(0.012)	(0.000)	(0.028)	(0.00)***	(0.000)
LM-ARCH	11.961***	1.9342e+008***	3510.4***	2.092	5.450***	2.889**	4.444***	10.526***
test stat (5)	(0.000)	(0.000)	(0.000)	(0.069)	(0.000)	(0.016)	(0.001)***	(0.000)

Note: *** Shows 1 percent significance level Pranthesis, (__) contains P-value. Null hypothesis for Box-Pierce test : No Autocorrelation

** Shows 5 percent significance level Null hypothesis for LM ARCH test : No Arch Effect

* Shows 10 percent significance level

Table 5.1

Table 5.2

5.1.3. *Pre-Estimation Diagnostic Analysis*

In order to capture the presence of ARCH effect, Lagrange Multiplier (LM) ARCH test with the null hypothesis of "No ARCH Effect" is applied. Table 5.2 shows that actual and expected inflation series are found to have an ARCH effect till 5th lag. The gold price series depicts the presence of ARCH effect till the 5th lag. Furthermore, the gold returns series shows an ARCH effect at least till 2nd lag. The different bond yields for all the maturity periods are also found to have an ARCH effect at 2nd and 5th lag. It implies that all of the variables are found to have an ARCH effect, at least up till the 5th lag.

The Box-Pierce test is also applied for the detection of the autocorrelation. The null hypothesis for the Box-Pierce test is the absence of autocorrelation. The Q-stats for the actual and expected inflation series implies the rejection of the null of "No Auto-Correlation", till the 10th lag. The gold prices are also subject to the autocorrelation. Moreover, the gold returns series is found to have the serial-correlation till the 5th lag, while the bond yield for different bond maturity periods show the serial-correlation at least till the 10th lag.

The presence of the volatility is also confirmed by the Q^{2}-stats (i.e. the Q-stat for the squared return series). The Q^{2}-stats confirms the volatility of all the variable series at least till the 5th lag. Therefore, ARMA with GARCH models seem perfect to explain the time varying behaviour of the variables.

5.1.4. *Visual Inspection of the Gold Returns and Bond Yields*

It is important to carry out the visual inspection of any financial time series, before employing the GARCH type modeling. Figure 5.1 (a) clearly shows that the returns on gold is not constant throughout the series, which depicts the volatility of the gold returns. The interlacing of the high and low volatility indicates the autocorrelation of the volatility. These two combined effects are known as the autoregressive conditional heteroscedasticity. Volatility clustering can be observed in the returns series; since, the large changes in prices are following the large changes and small are following the small ones.

The series of bond yields for different maturity periods also indicates the presence of heteroscedasticity (Figure 5.1 (b) - Figure 5.1 (f)). However, it is important to notice that the yields for short-term treasury bills are found to be more volatile, as compared to the long-term treasury bonds. As the spikes and volatility's ups and downs are more for the short term bonds.

In order to get a tentative idea about the MA and AR lags, in the condition mean equation, autocorrelation function (ACF) and partial autocorrelation function (PACF) can be used. The autocorrelation function, measures the linear dependence of the observations of a variable at two points in time (i.e. the autocorrelation). On the other hand, the partial autocorrelation function, measures the autocorrelation between the two observations of a variable, at different points in time by controlling the observations at intermediate lags. At lag 1, ACF and PACF are same because there is no intermediate lag to eliminate [Brooks (2008)].

An autocorrelation function can be useful in distinguishing between an AR or MA process. However, a partial autocorrelation function is particularly important for making a distinguished between the AR (m) or ARMA (m, n) process. The former has a geometrically declining ACF, but a PACF that cuts off to zero after m lags, while the later have both the ACF and PACF geometrically declining. The ACF and PACF for gold returns and bond yields for different maturity periods are shown in Figures 5.2 (a) – 5.2 (f).

Each figure has a 5 percent (two sided) rejection band represented by two lines. The figures clearly indicate the significant lags of AR and MA in each case. Here, it is essential to mention that ACF/ PACF is not always easy to read and understand, that is why one should not fully rely on these graphs and should just get a tentative idea about the ARMA lags. Hence, Various ARMA models can be estimated in each case and the most appropriate one can be chosen on the basis of the post estimation residual analysis. To get the valid results, first an ARMA model should be estimated, and then the Box–Pierce statistics for the standardised residuals should be analysed to check whether any autocorrelation is left to be captured or not.

The most suitable order of GARCH specification, in the conditional variance equation, can also be chosen on the basis of the post estimation residual tests. Bollerslev (1992) empirically found GARCH (1, 1) as an ample choice for GARCH modeling. However, if GARCH (1, 1) remains insignificant in removing the ARCH effect completely, further lags can also be included. The post estimation Lagrange multiplier (LM) ARCH statistics can be analysed to check the validity of each model.

Fig. 5.1. Visual Inspection of the Returns on Gold and Bonds

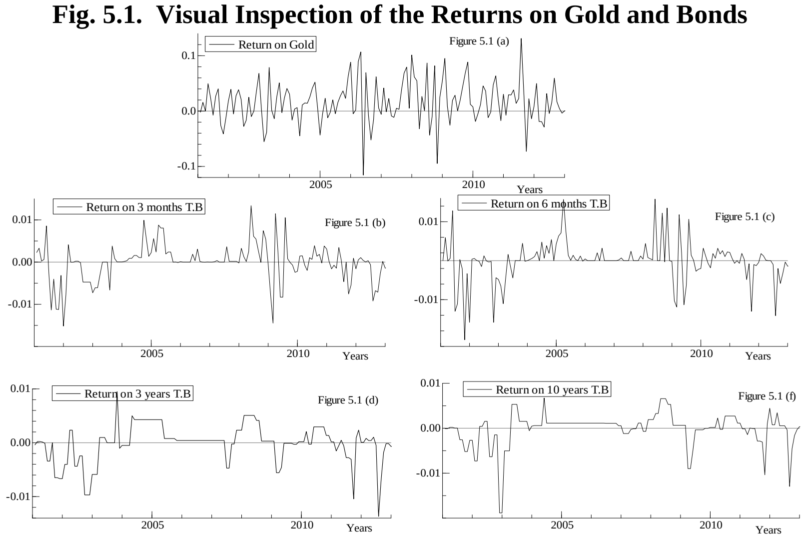
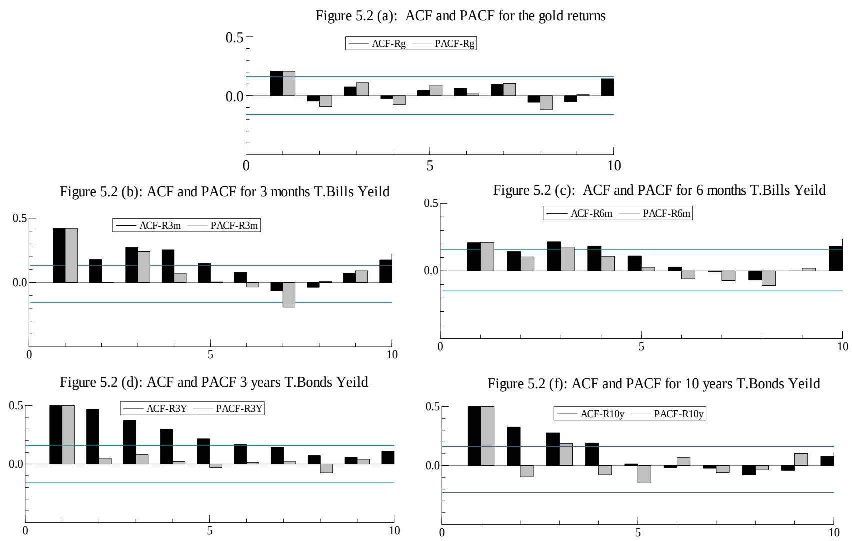


Fig. 5.2. ACF and PACF for Gold Return and Treasury Bond Yields



5.2. The Impact of Expected Inflation on the Bond Yield

In order to analyse the effect of expected inflation on the bond yield for different maturity periods, the most suitable and significant order for ARMA and GARCH specifications is selected in each model. Furthermore, the results are confirmed by the post estimation residual analysis as well.

The results reported in Table 5.2, show that expected inflation is found to have a positive and significant impact on the bond yields for all the maturity periods. However, the magnitude of this impact is more for the short term treasury bills as compared to the long term treasury bonds. This signifies that expected inflation is likely to have more influence on the bond yields for the current periods and for the near future. The results clearly indicate the empirical evidence of the validity of the Fisher Effect hypothesis in its weak form.

For three month treasury bills, ARMA (1, 0)-GARCH (1, 1) lags are found adequate to bring linear dependence and capture the ARCH effect. The Q-stats on residuals and residual squares assures the absence of any serial correlation. The LM-ARCH test also confirms that no ARCH effect is left to be captured (Table 5.4).

Similarly, for six months Treasury Bills, ARMA (1,1) with GARCH (1,1), for three year T.B, ARMA (1,2) with GARCH (1,3) and for 10 years T.B, ARMA (1,0) with GARCH (1,1) lags are found accurate and significant to capture the ARCH effect. The residual analysis presented in Table 5.3.1 also validates the results; since, no auto-correlation and ARCH effect is left to be captured by employing these specifications.

Table 5.3

The Effect of Expected Inflation on Different Bond Yields

3 Months Treasury Bills				6 Months Treasury Bills			
Mean Equation		Variance Equation		Mean Equation		Variance Equation	
α	–0.004**	γ	5.03e-06***	α	–0.004	γ	2.43e-06***
	(0.0243)		(0.005)		(0.120)		(0.000)
β	0.599***	δ_1	0.225**	β	0.662*	δ_1	0.139***
	(0.0347)		(0.0191)		(0.072)		(0.003)
∂_1	0.744***	θ_1	0.539***	∂_1	0.785***	θ_1	0.742***
	(0.000)		(0.0001)		(0.000)		(0.000)
λ_1	–0.469**	Log likelihood		λ_1	–0.541**	Log likelihood =616.061	
	(0.0134)	=623.900			(0.021)		
3 Years Treasury Bonds				10 Years Treasury Bonds			
Mean Equation		Variance Equation		Mean Equation		Variance Equation	
α	–0.002**	γ	1.14e-06***	α	–0.002***	γ	–5.84e-09
	(0.036)		(0.000)		(0.002)		(0.633)
β	0.339**	δ_1	0.577***	β	0.522***	δ_1	0.723***
	(0.040)		(0.000)		(0.000)		(0.000)
∂_1	0.803***	θ_3	0.520***	∂_1	0.675***	θ_1	0.723***
	(0.000)		(0.000)		(0.000)		(0.000)
λ_2	–0.180***	Log likelihood				Log likelihood =703.360	
	(0.000)	=706.695					

Note: Parentheses, (__) contains the Probability-Values.
***Indicates 1 percent significance level.
**Indicates 5 percent significance level.
*Indicates 10 percent significance level.

Table 5.3.1

Post Estimation Residuals Analysis

	3 Months Treasury Bills ARMA (1,1) GARCH (1,1)	6 Months Treasury Bills ARMA (1,1) GARCH (1,1)	3 Years Treasury Bonds ARMA (1,2) GARCH (1,3)	10 Years Treasury Bonds ARMA (1,0) GARCH (1,1)
Q-stat (5)	1.421	1.511	0.636	6.017
	(0.701)	(0.680)	(0.727)	(0.198)
Q-stat (10)	10.055	14.896	1.882	10.218
	(0.261)	(0.161)	(0.966)	(0.333)
Q^2-stat(5)	0.623	0.417	2.973	1.818
	(0.968)	(0.937)	(0.226)	(0.769)
Q^{2-} stat(10)	3.856	6.231	8.235	4.033
	(0.870)	(0.621)	(0.312)	(0.909)
LM-ARCH Test	0.0182	0.0128	0.002	-0.041
Stat (2)	(0.825)	(0.875)	(0.977)	(0.635)
LM-ARCH Test	0.010	0.003	–0.096	–0.068
Stat (5)	(0.896)	(0.702)	(0.246)	(0.430)

Note: Parentheses, (__) contains the Probability-Values.

The null Hypothesis of the Q-stat (n) i.e. the Ljung-Box statistics for up to n^{th} order autocorrelation on the residual series: No Serial Correlation.

The null hypothesis of the Q^2-stat i.e. the Q-stat on the squared residuals: No Serial Correlation.

The null hypothesis of the LM (n) i.e. the Lagrange multiplier test for ARCH effect up to n^{th} order: No ARCH effect.

5.2.1. The Impact of Actual Inflation on the Bond Yield

This analysis provided mixed results, for different bond yields, as shown in Table 5.4. In the conditional mean equation, actual inflation in the current time period is found to have an insignificant impact on the yields for short-term treasury bills. However, previous period inflation is found to have a positive and significant relationship with these bond yields. The 3-years Treasury bond yield is also found to have an insignificant relationship with the actual inflation, while the lagged inflation term is found positive and significant in explaining its behaviour. For 10 years treasury bonds yield, current as well as lagged inflation term are found insignificant. The results in this section also validate the presence of Fisher effect in its weak form. These results are consistent with the study of Hassan (1999), Rehman, *et al.* (2004) and Shahbaz (2010); since, these studies

The results presented in Table 5.4.1 shows that for 3 months Treasury bills yield, ARMA (0,1) with GARCH (1,1) , for 6 months T.B, ARMA (1,1) with GARCH (1,1), for 3 years T.B, ARMA (0,1) with GARCH (1,2) and for 10 years T.B, ARMA (1,) GARCH (1,2) lags are found significant and adequate to capture the autocorrelation and ARCH effect in this analysis.

Table 5.4

The Effect of Actual Inflation on Different Bond Yields

3 Months Treasury Bills				6 Months Treasury Bills			
Mean Equation		Variance Equation		Mean Equation		Variance Equation	
α	–0.005	γ	3,14e-06***	α	–0.009	γ	7.42e-07**
	(0.354)		(0.001)		(0.303)		(0.0549)
β	0.034	δ_1	0.281***	β	0.0390	δ_1	0.239***
	(0.426)		(0.008)		(0.351)		(0.000)
σ	0.097***	θ_1	0.512***	σ	0.166***	θ_1	0.762***
	(0.001)		(0.000)		(0.000)		(0.000)
λ_1	0.375***			∂_1	0.867***		
	(0.000)		Log likelihood		(0.000)		Log likelihood = 620.275
			=651.988	λ_1	–0.725***		
					(0.000)		
3 Years Treasury Bonds				10 Years Treasury Bonds			
Mean Equation		Variance Equation		Mean Equation		Variance Equation	
α	–0.001	γ	6.15e-06***	α	0.001***	γ	7.14e-09***
	(0.682)		(0.000)		(0.000)		(0.001)
β	0.014	δ_1	0.1980*	β	0.002	δ_1	0.184***
	(0.700)		(0.060)		(0.813)		(0.000)
σ	0.072*	θ_2	–0.033**	σ	0.007	θ_2	–0.552***
	(0.068)		(0.010)		(0.240)		(0.000)
λ_1	0.470***		Log likelihood =	∂_1	0.687***		Log likelihood =708.834
	(0.000)		692.616		(0.000)		

Note: Parentheses, (__) contains the Probability-Values.
*** Indicates 1 percent significance level.
** Indicates 5 percent significance level.
* Indicates 10 percent significance level.

The post estimation residual analysis also confirms the validity of the models (Table 5.4.1). The insignificance of the Q-stat on residuals and residuals square confirm the absence of any autocorrelation. The LM-ARCH test stats are also found insignificant, showing that no further ARCH effect is left to be captured.

Table 5.4.1

Post Estimation Residuals Analysis

	3 Months treasury Bills ARMA(0,1) GARCH(1,1)	6 Months Treasury Bills ARMA(1,1) GARCH(1,1)	3 Years Treasury Bonds ARMA (0,1) GARCH (1,2)	10 Years Treasury Bonds ARMA(1,0) GARCH(1,2)
Q-stat(5)	6.109	1.382	1.582	2.487
	(0.191)	(0.710)	(0.191)	(0.647)
Q-stat(10)	10.96	14.08	6.335	5.196
	(0.278)	(0.680)	(0.278)	(0.817)
Q^2-stat(5)	0.532	1.582	1.829	1.637
	(0.970)	(0.663)	(0.767)	(0.802)
Q^{2-}stat(10)	3.117	9.764	9.190	4.173
	(0.959)	(0.282)	(0.420)	(0.900)
LM-ARCH	0.014	0.089	-0.023	-0.008
Test Stat (2)	(0.863)	(0.295)	(0.781)	(0.921)
LM-ARCH	0.046	–0.033	-0.041	-0.076
Test Stat (5)	(0.590)	(0.691)	(0.618)	(0.379)

Note: Parentheses, (__) contains the Probability-Values.

The null Hypothesis of the Q-stat (n) i.e. the Ljung-Box statistics for up to n^{th} order autocorrelation on the residual series: No Serial Correlation.

The null hypothesis of the Q^{2-}stat i.e. the Q-stat on the squared residuals: No Serial Correlation.

The null hypothesis of the LM (n) i.e. the Lagrange multiplier test for ARCH effect up to n^{th} order: No ARCH effect.

5.3. The Impact of Expected Inflation on the Gold Returns

The result presented in Table 5.5 shows that the expected inflation is found to have a positive and significant impact on the gold returns. The MA (1) term is also found to be significant in explaining the behaviour of the gold returns.

Table 5.5

The Effect of Expected Inflation on the Gold Return

	Mean Equation		Variance Equation
α	–0.0163***	Γ	0.001***
	(0.001)		(0.004)
β	1.802***	δ_1	0.297***
	(0.001)		(0.004)
λ_1	–0.730***	θ_1	0.709***
	(0.000)		(0.000)
Log-likelihood = 289.611			

Note: Parentheses, (__) contains the Probability-Values.

***Indicates 1 percent significance level.

**Indicates 5 percent significance level.

*Indicates 10 percent significance level.

Table 5.5.1

Post Estimation Residual Analysis

Q-stat(5)	1.746
	(0.780)
Q-stat(10)	13.505
	(0.141)
Q^{2-}stat (5)	2.718
	(0.606)
Q^{2-}stat (10)	7.065
	(0.630)
LM-ARCH test stat (2)	–0.013
	(0.874)
LM-ARCH test stat (5)	–0.034
	(0.688)

Note: Parentheses, (__) contains the Probability-Values.

The null Hypothesis of the Q-stat (n) i.e. the Ljung-Box statistics for up to n^{th} order autocorrelation on the residual series: No Serial Correlation.

The null hypothesis of the Q^{2-}stat i.e. the Q-stat on the squared residuals: No Serial Correlation.

The null hypothesis of the LM (n) i.e. the Lagrange multiplier test for ARCH effect up to n^{th} order: No ARCH effect

In the condition variance equation, GARCH (1,1) specification is found significant and adequate to capture the ARCH effect. The post estimation residual analysis presented in Table 5.5.1 also validates the results. The insignificance of the Q-stats on residual and Residual Square assures the absence of the autocorrelation. The LM ARCH test stats further confirm the absence of any ARCH effect left to be captured.

5.3.1. *The Impact of Actual Inflation on the Gold Returns*

The effect of the actual inflation on the gold returns is analysed by employing the following ARMA (m, n) with GARCH (p, q) specification model. The results presented in Table 5.6, show that the current inflation has a positive and significant impact on the gold returns. However, the previous period inflation is found to have an insignificant impact on the gold returns. In the conditional mean equation, AR (1) term is found significant in explaining the behavior of the gold returns.

Table 5.6

The Effect of Actual Inflation on the Gold Return

Mean Equation		Variance Equation	
α	–0.008*	γ	7.94e-05*
	(0.065)		(0.063)
β	1.359***	δ_1	0.248***
	(0.002)		(0.000)
σ	–0.390	θ_1	0.771***
	(0.390)		(0.000)
∂_1	–0.4726***	Log-likelihood =	221.302
	(0.000)		

Note: Parentheses, (__) contains the Probability-Values.
*** indicates 1 percent significance level
** indicates 5 percent significance level
* indicates 10 percent significance level.

In the conditional variance equation, GARCH (1,1) specification is found significant to capture the ARCH effect. The residual analysis presented in table 5.6.1, also confirms the validity of the model. The insignificance of Q-stats on residual and residual Square assures the absence of any autocorrelation. The ARCH test stats are also insignificant implying that no ARCH effect is left to be captured.

Table 5.6.1

Post Estimation Residual Analysis

Q-stat(5)	1.974
	(0.683)
Q-stat(10)	7.205
	(0.743)
Q^{2-}stat (5)	–0.091
	(0.243)
Q^{2-}stat (10)	0.108
	(0.269)
LM-ARCH test stat (2)	0.059
	(0.414)
LM-ARCH test stat (5)	–0.070
	(0.622)

Note: Parentheses, (__) contains the Probability-Values.
The null Hypothesis of the Q-stat (n) i.e. the Ljung-Box statistics for up to n^{th} order autocorrelation on the residual series: No Serial Correlation.
The null hypothesis of the Q^{2-}stat i.e. the Q-stat on the squared residuals: No Serial Correlation.
The null hypothesis of the LM (n) i.e. the Lagrange multiplier test for ARCH effect up to n^{th} order: No ARCH effect.

The results presented in this section indicate that the expected inflation has a positive and significant impact in explaining the behaviour of the gold returns. The magnitude of this effect is greater than the effect of expected inflation on the bond yield, which in turn implies the acceptance of the expected inflation effect hypothesis

6. CONCLUSION AND IMPLICATIONS

The literature mostly revealed the inflation hedging property of gold, devoid of making a comparison with its cost of holding. The present study, mainly focuses on examining the inflation hedging property of gold for Pakistan by empirically testing, whether the benefit of gold investment is greater than its cost of carrying or not. This analysis is carried out by testing the two hypotheses that propose the relationship of expected inflation with the gold prices. First is the expected inflation effect hypothesis, which argues that the rise in the expected inflation would result in an immediate rise in the gold prices. Second is the carrying cost hypothesis, which proposes that the rise in the expected inflation would cause the interest rate to rise, which in turn raises the cost of holding gold. Thus, the investors would find an incentive to choose the interest bearing investments and hence, the gold prices remain unchanged. The positive association between the expected inflation and interest rate is termed as the Fisher effect hypothesis in the literature.

The study is conducted using the monthly data over the period January, 2001 to December, 2013. In order to get the time varying effects of expected and actual inflation on the returns and volatility of the gold prices and bond yields, autoregressive moving average (ARMA) with generalised autoregressive conditional heteroscedasticity (GARCH) specification models has been employed. The Treasury bond yields for different maturity periods have shown a positive association with the expected inflation. However, the coefficient of the effect is less than 1, implying the acceptance of the Fisher effect in weak form. This finding, in turn, suggests that there exists a positive and significant relationship between the expected inflation and the cost of carrying gold. The bond yields for all the maturity periods are also found to have a direct relationship with the previous period inflation rate, except for the 10 years T-bonds. However, the current period inflation is found insignificant in explaining the behaviour of the treasury bonds.

The gold returns are also found to have a positive relationship with the expected inflation. Moreover, the magnitude of this effect is greater than the effect of expected inflation on the bond yields (for different maturity periods). It implies that benefit of making gold investment exceeds its cost of carrying. Hence, the result of the study suggests the acceptance of the expected inflation effect hypothesis. Furthermore, the gold returns are found to have a positive relationship with the actual inflation as well. The significance of different

ARMA lag implies the importance of historical information of gold returns and bond yields in determining the current returns and yields.

These empirical findings lead to the following implications:

- Interest rate is proven unable to completely hedge the expected as well as actual inflation; therefore investors tend to seek other alternative investments in order to protect their capital from losses during inflationary periods.
- Gold can be regarded as a potential hedge against expected as well as actual inflation in case of Pakistan, since; the gold returns is confirmed to exceed its cost of carrying.
- Gold is proven to be more profitable investment as compared to its alternative risk free investment i.e. the government treasury bonds.
- In Islamic countries like Pakistan, where a specific religious class considers interest involving transactions a sin, gold can be treated as a perfect substitute for other inflation hedging instruments.
- Future research can be conducted to analyse the safe haven property of gold against its alternative investments (i.e. stocks or bonds etc.) in Pakistan.

APPENDIX A

Hodrick Presscot Filter and Expected Inflation

The Hodrick Presscot or HP filter is considered as a very useful tool in economic time series analysis. It is basically used to separate the long-term trend in a series from its short-term fluctuations. It is important to mention that this technique is used for purely historical analysis only. The HP filter has remained a standard technique to remove the trend part of any series, mostly in the literature of the business cycle. Such as used by Brandner and Neusser (1992), Cooley and Hansen (2006) and Kydland and Prescott (1990) in their studies. Moreover, Bhardwaj, *et al*. (2001) and Razzak (1997) has also applied this technique to decompose historical inflation into expected and unexpected parts.

The conceptual framework given by Hodrick and Presscot (1980), proposes the decomposition of any given time series 'y' into a trend (or growth) component 'τ' and a cyclical component 'c'.

$$y_t = \tau_t + c_t \qquad\qquad t = 1,2, \ldots, T$$

The HP filter separates the trend component of a given series by solving the following constraint:

$$min_{\tau_t} \sum_t^{\tau} \{(y_t - \tau_t)^2 + \lambda\,((\tau_{t+1} - \tau_t) - (\tau_t - \tau_t))^2\}$$

Where, the deviation from the trend '$y_t - \tau_t$' is the cyclical component 'c_t' of the series. λ is a positive smoothing parameter that penalises the change in the trend component. The higher the value of λ , the larger is the penalty. One of the important features of HP filter is that it provides an optimal solution, only if the deviation from the trend component 'c' and the second difference of the trend component are independent and normally distributed. Hodrick and Presscot (1980) as well as King and Rebelo (1997) calculated λ as the ratio of the two variances i.e $\frac{\sigma_{c_t}}{\sigma_{\Delta^2 \tau_t}}$. Hodrick and Presscot (1980) initially proposed the value of λ as 1600 for quarterly data. Later on, Ravn and Uhlig (2002) suggest that λ should be adjusted according to the 4th power of the frequency change. Such that λ for annual data should be $1600/4^{4} =$ 6.25 and for monthly data it should be 1600.3^4 = 129,600.

By analysing the long-term trend of any series, the expectations about the future values can be made. Therefore, in this study, the trend component of the inflation series is treated as the expected inflation. As actual inflation is generally considered as the sum of the expected and unexpected inflation. Hence, it is reasonable to consider the trend part of the inflation series as the expected one. Hence, the HP filter technique is applied to separate the expected inflation, by using the value of as 129,600 for the monthly data, as suggested by Ranv and Uhlig (2002).

REFERENCES

Abken, P. A. (1980) The Economics of Gold Price Movements. *FBR Richmind Economic Review* 66:2, 3–13.

Adrangi, B. Chatrah, A., and Raffiee, K. (2003) Economic Activity. Inflation, and Hedging: The Case of Gold and Silver Investments. *The Journal of Wealth Management* 6:2, 60–77.

Batten, J. A., C. Ciner, and B. M. Lucey (2010) The Macroeconomic Determinants of Volatility in Precious Metals Markets. *Recourses Policy* 35, 65–71.

Baur, D. G. and B. M. Lucey (2010) Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold. *The Financial Review* 45, 217–229.

Baur, D. G. and T. McDermott (2010) Is Gold a Safe Haven? International Evidence. *Journal of Banking and Finance*34, 472–490.

Berument, H. (1999) The Impact of Inflation Uncertainty of Interest Rates in the UK. *Scottish Journal of Political Economy* 46:2.

Berument, H., N. B. Ceylan, and H. Olgun (2007) Inflation Uncertainty and Interes Rates: Is the Fisher Relation Universal? *Applied Economics* 39, 53– 68.

Beckmann, J. and R. Czudaj (2012) Gold as an Inflation Hedge in the Time-Varying Coefficient Framework. *RUHR Economic Papers.*

Beckmann, J. and R. Czudaj (2014) Does Gold act as a Safe Haven for Stocks? A Smooth Transition Analysis. *European Economics and Finance Society.*

Blose, L. E. (2005) How Changes in Expected Inflation Affect Gold Prices. *Seidman College of Business.*

Blose, L. E. (2010) Gold Prices, Cost of Carry, and Expected Inflation. *Journal of Economics and Business* 62, 35–47.

Bollerslev, T. (1986) Generalised Autoregressive Conditional Heteroscedasticity. *Journal of Econometrics* 31:3, 307–327.

Brandner, K. and K. Nuesser (1992) Buisness Cycles in the UK: Facts and Fictions. *Economics* 59, 383–401.

Brooks, C. (2008) *Introductory Econometrics for Finance*. (Second Edition). Cambridge University Press.

Capie, F., T. C. Mills, and G. Wood (2004) Gold as a Hedge Against the US Dollar. (World Gold Council, Research Study, No. 30).

Chance, D. M. (2001) *An Introduction to Derivatives and Risk Management*. Harcout College Publishers, Fort Worth, Texas.

Cooly, T. and G. Hansen (1989) The Inflation Tax in Real Business Cycle Mode. *American Economic Review* 79, 773–748.

Engle, R. F. (1892) Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrics* 50:4, 987–1007.

Fama, E. F. (1975) Short Term Interest Rates as Predictors of Inflation. *American Economic Review* 65, 269–282.

Fatima, N. and S. A. Sahibzada (2012) Empirical Evidence of Fisher Effect in Pakistan. *World Applied Sciences Journal* 18:6, 770–773.

Fisher, I. (1986) Appreciation and Interest. *American Economic Association* 11:4.

Fisher, I. (1930) *The Theory of Interest*. New York: MacMillan.

Ghosh, D., E. J. Levin, P. Macmillan and R. E. Wright (2002) Gold as an Inflation Hedge. *Studies in Economics and Finance* 22:1, 1–25.

Hamid, H. (1999) Fisher Effect in Pakistan. *The Pakistan Development Review* 38: 2, 153–166.

Hiller, D., D. Paul, and F. Robert (2006) Do Precious Metals Shine? An Investment Perspective. *Financial Analysts Journal* 62:2.

Hodrick, R. J. and E. C. Prescott (1997) Postwar U.S. Buisness Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking* 29:1, 1–16.

Jaffe, J. F. (1989) Gold and Gold Stocks as Investments for Institutional Portfolios. *Financial Analysts Journal* 49:2, 53–59.

King, R. G. and S. T. Rebelo (1997) Resuscitating Real Business Cycles. Center for Economic Research (RCER).

Kioshos, A. and N. Sariannidis (2010) Determinants of the Asymmetric Gold Market. *Investment Management and Financial Innovations* 7:4.

Kold, R. W. (1994) *Understanding Future Markets*. (4th Edition).

Koutsoyiannis, A. (1983) A Short-run Pricing Model for Speculative Asset, Tested with Data from Gold Bullion Market. *Applied Economics* 15, 563–581.

Kydland, F. and E. Presscot (1990) The Econometrics of General Equilibrium Approach to General Equilibrium Approach to Buisness Cycles. *Scandinavian Journal of Economics* 93, 161–178.

Lawrance, C. (2003) Why is Gold Different from other Assets. An Empirical Investigation. World Gold Council.

Levin, E. J. and R. E. Wright (2006) Short-Run and Long-Run Determinants of the Price of Gold. (The World Gold Council Research Paper, No. 32).

Mahdavi, S. and S. Zhou (1997) Gold and Commodity Prices as Leading Indicators of Inflation: Test of Long Run Relationship and Predictive Performance. *Journal of Business and Economics* 49, 475– 489.

Mankiw, N. G. (2010) *Macroeconomics.* (7th edition). Worth Publishers, New York.

McCown, J. R. and J. R. Zimmerman (2006) Is Gold a Zero-Beta Asset? Analysis of the Investment Potential of Precious Metals. Oklahoma City University.

Mishkin, F. S. (1992) Is the Fisher Effect for Real? A Reexamination of the Relationship between Inflation and Interest Rates. *Journal of Monetary Economics* 30, 195–215.

Mishkin, F. S. and J. Simon (1995) An Empirical Examination of the Fisher Effect in Australia. (NBER Working Paper, No. 5080).

Moore, G. H. (1990) Gold Prices and a Leading Index of Inflation. M.E. Sharpe, Inc. *Challenge* 33, 52–56.

Pindyck, R. S. (1993) The Present Value Model of Rational Commodity Pricing. Massachusetts Institute of Technology Cambridge.

Pule, B. P. (2013) Evaluation of Gold as an Investment Asset: The South African Context. University of the Witwatersran.

Ranson, D. and H. C.Wainwright, (2005) Why Gold, not Oil, is the Superior Predictor of Inflation. (World Gold Council Report).

Ravn, M. and H. Uhlig (2001) On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations. *The Review of Economics and Statistics* 84: 2, 371–375.

Razzak, W. (1997) The Inflation-Output Trafde-off: Is the Philips Curve Symmetric? A Policy Lesson from New Zealand. Reserve Bank of New Zealand.

Rehman, H. R., S. Khan, and I. Ahmad (2004) Does Fisher Effect Exist in Pakistan? A Cointegration Analysis. *Pakistan Economic and Social Review* 12:1&2, 21–37.

Simakova, J. (2010) Analysis of the Relationship between Oil and Gold Prices. Silesian University in Opava.

Sidhu, D. (2013) A Study on Impact of Select Factors on the Price of Gold. *IOSR Journal of Business and Management (IOSR-JBM)* 8, 84–93.

Shahbaz, M., M. I. Tahir, and I. Ali (2013) Is Gold Investment a Hedge against Inflation in Pakistan? A Cointegtaion and Causality Analysis in the Presence of Structural Breaks. (MPRA Paper, No. 47924).

Shabbir, A. (2010) The long-Run Fisher Effect in Developing Economies. *Studies in Economics and Finance* 27:4, 268 – 275.

Sherman, E. J. (1982) New Gold Model Explains Variations. *Commodity Journal* 17, 16–20.

Smith, G. (2002) London Gold Prices and Stock Price Indices in Europe and Japan. World Gold Council.

Tkacz, G. (2007) Gold Prices and Inflation. (Bank of Canada Working Paper 2007–35).

Tufail, S. and S. Batool (2013) An Analysis of the Relationship between Inflation and Gold Prices: Evidence from Pakistan. *The Lahore Journal of Economics* 18:2, 1–35.

Toraman, C., C. Bassarir, and M. F. Bayramoglu (2011) Determination of Factors affecting the Price of Gold: A Study of MGARCH Model. *Business and Economics Research Journal* 2: 4, 37–50.

Worthington, A. C. and M. Pahlavani (2006) Gold Investment as an Inflation Hedge: Cointegration Evidence with Allowance for Endogenous Structural Breaks. University of Wollogong.