NUST JOURNAL OF SOCIAL SCIENCES AND HUMANITIES
Vol. 6 No. 2 (July-December 2020) pp. 78-96

Analysis of Gold as a Potential Inflation Hedge in Case of Pakistan

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Abstract

In developing countries such as 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 provide their capital an effective hedge against inflation. The present study empirically tests the status of gold as a potential hedge against inflation in Pakistan by analyzing the relationship of the expected and actual inflation with gold return and its cost of carrying, i.e., the interest rate. The autoregressive moving average (ARMA) with generalized autoregressive conditional heteroscedasticity (GARCH) models is applied to examine the time varying relationship between the variables from January 2001 to December 2015. 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.

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

JEL Classification: C32, E31, E44

1. INTRODUCTION

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

In the ongoing global scenario, expectations regarding future inflations are considered as the driving force behind the increasing trend of the gold

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investment. With the prospect of rising inflation, many investors put 99their 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 that consequently shoots up the gold prices. This relationship is called the expected inflation effect hypothesis. The impact of inflation on the interest rate is overlooked while explaining the relationship between the 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). The main motivation to undertake this study is to address this neglected issue of opportunity cost of gold investment. Here, the interest rate can be observed as the opportunity cost as investors could utilize their funds in 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. Therefore, investors would find no incentive to buy gold. This consideration is stated as the carrying cost hypothesis in the current study. This necessitates to compare benefits of hedging by investment in gold in with cost of holding gold is inflationary periods

The study is mainly intended to empirically test the two above mentioned hypotheses to analyze the status of gold as an inflation hedge. Broadly, this study tries to find whether the gold investment hedges inflation in case of Pakistan or not by investigating the increase in expected inflation increase gold investment. An increase in expected inflation will force investors to buy gold, either to hedge against the expected decline in the value of money or to speculate due to the associated rise of the gold price. This generates a purchasing pressure that yields to an immediately rising price of gold in time of the upward revision in inflation expectations. Thus, changes in expected inflation will cause changes in the price of gold and investors with knowledge regarding future inflation have the ability to gain excess revenues by purchasing and selling gold in spot and futures markets in anticipation of prospective market adjustments. Therefore, the gold price acts as a leading indicator of the level of inflation and hence, gold could be used to hedge against future inflation. This causality pattern has been questioned by Blose (2010) who argues that the costs of carrying gold are also affected through changes in interest rates by expected inflation. If those costs offset revenues from speculation, the price of gold is not affected by changing inflation expectations.

There is scarce existing literature on the investment prospects of gold and other financial assets in Pakistan and very few of these studies are done to check the inflation hedging property of gold in Pakistan [Tufail and Batool (2013) and Shahbaz, *et al.* (2014)] applying cointegration technique for analysis. However, the carrying cost of gold is not considered by any study. The current study extends these studies in two dimensions by employing ARMA with GARCH to assess the time varying behaviour of inflation, gold prices, and interest-bearing securities. Also, this study departs from existing literature by examining the relationship of expected inflation with the cost of carrying (interest rate) as well. The gold acts effective hedge against inflation if returns from investment in gold exceed cost of carrying gold.

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

2. LITERATURE REVIEW

Previous studies analyzing the value of gold as an investment have pointed out a range of benefits that can be accrued by making gold investment. Jaffee (1989), Hiller *et al.* (2006), and Baur and Lucay (2010) empirically analyzed the performance of gold and recommended its addition while creating a risk diversified portfolio. Furthermore, Ghosh, *et al.* (2002) find inflation hedging property of gold and the results suggest gold as a hedge against inflation in the short run as well as in the long run. Beckman and Czudaj (2010) also confirm the inflation hedging property of gold for the four major economies, i.e., US, UK, Europe, Japan. The findings reveal that gold is able to hedge inflation in the long run. Beckaman and Czudaj (2015) further attempt to analyze the safe haven property of gold for different regional and international markets. The findings of the study overall indicate gold as a safe haven; however, this property is seemed market specific.

The literature on the relationship between inflation and gold prices is vast and 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. Moore (1990) examined the effect of inflation signals on the New York market prices of gold. The results indicate positive correlation between two variables and further suggest that investors who followed 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 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) and Worthington and Pahlavani (2006) point out the importance of substantial changes associated with the transition of gold while examining the relationship between gold prices and inflation and opposed the view that gold investment can serve as an inflationary hedge.

Blose (2005, 2010) is the first to examine 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 implies that the cost of holding gold exceeds its benefit in the inflationary period. Hence, speculation strategies designed based on expected inflation seemed successful in the bond market but not in the gold markets. Ranson and Wainwright (2005) further pointed out gold as a better indicator of unanticipated inflation than oil.

Levin and Wright (2006) and Tkacz (2007) argue 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 with a formal inflation target. It implied that the formulation of inflation expectations might have been improved by the introduction of inflation targets. Moreover, Tufail and Batool (2013) and Shahba, *et al.* (2013) analyze the inflation hedging property of gold compared to other financial assets such as real estate, stock exchange securities, and foreign currency holdings for Pakistan and proved the inflation hedging property of gold. These studies do not take into account the opportunities cost of gold investment in case of Pakistan. However, Ghazaili, *et al.*, (2018) show that gold is not a good hedge against inflation in Malaysia. It is also not an excellent store of value over a relatively short period of time as it is unable to retain its sustainable purchasing power. Lucy and Udin (2018) find gold is both a short, and long-term hedge against realized inflation for a number of developed economies. Dynamic analysis confirms that these hedging properties are not limited to a single historical cohort. Gold co-moves with unexpected inflation across all countries examined. The gold futures and gold stocks both act as hedges against inflation.

The review of literature clearly shows that the effect of inflation on gold prices and interest rate in the common framework is not investigated seriously yet. This study attempts to fill the said gap in case of Pakistan by analyzing the inflation hedging property of gold investment by considering the cost effectiveness of gold.

3. METHODOLOGY AND DATA

The theoretical framework is based on expected inflation effect hypothesis and the carrying cost hypothesis. The expected inflation effect 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. Therefore, 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 [Blose (2010)].

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. Blose (2005, 2010) suggests that the carrying cost hypothesis has two implications explained as follow.

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

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

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, the difference between the expected market return and the risk-free rate. Lawrence (2003), Blose (2005) 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.

$$Expected\ Return\ on\ Gold = Risk\ Free\ Rate$$

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. Therefore, 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.

$$Gold\ Price\ Appreciation = Opportunity\ Cost\ of\ Holding\ Gold$$
$$= Risk\ Free\ Rate \qquad \dots (1)$$

Consider a hypothetical case, in which inflationary expectations increase from zero to a positive number, say '*E*'. It means 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 is the rate of expected inflation, G_o is the spot price of gold at time zero, G_1 is expected future spot price of gold when expected inflation is zero, G_1^E, R is the nominal and real rate of return when expected inflation is zero, R^E is 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.

$$P_1 = G_1 - G_o - G_oR \qquad \dots (2)$$

where, G_oR is the opportunity cost of holding gold that 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. 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 [Chance (2001); Blose (2005)] stated as follows:

$$G_1 - G_o = G_oR$$

By rearranging the above equation;

$$G_1 = G_o(1 + R) \qquad \dots (3)$$

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

$$G_1^E = G_1 + G_1 E \quad \text{... (4)}$$

In this case expected speculative profit would be:

$$P_1^E = G_1^E - G_o - G_o R^E \quad \text{... (5)}$$

By using equation (3) and (4), equation (5) can be written as follows:

$$P_1^E = G_o(1 + R)(1 + E) - G_o(1 + R^E) \quad \text{... (6)}$$

By using the Fisher equation an identity linking the nominal interest rate, (expected) inflation and the real interest rate are stated as follow

$$(1 + R^E) = (1 + R)(1 + E) \quad \text{... (7)}$$

By substituting equation (7) into (6);

$$P_1^E = G_o(1 + R^E) - G_o(1 + R^E) = 0 \quad \text{... (8)}$$

Hence, investors would not be able to earn any kind of speculative profit in such case. The implications of the carrying cost hypothesis can be stated as: Gold spot prices are not determined by the expectations regarding the future inflation. 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 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 appear

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

$$G_1^E - G_o > G_o R^E \quad \text{… (9)}$$

2 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.

$$G_1^E - G_o < G_o R^E \quad \text{… (10)}$$

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

The financial time series depends on its own historical information in addition to other factors. Therefore, the autoregressive-moving average (ARMA) model is suitable to specify conditional mean equation [Box and Jenkins (1970)]. The financial time series has the characteristics of auto-regressiveness and heteroskedasticity therefore autoregressive conditional heteroscediasticity (ARCH) family of models introduced by Engle (1982) are suitable for modeling the volatility of these series. Among these models, the GARCH model proposed by Bollerslev (1986) is considered a far better specification because it is more parsimonious and avoids over fitting. Therefore, to study the time varying relationships between the gold prices, inflation, expected inflation, and interest rate ARMA with GARCH model is used.

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) model as suggested by Blose (2005, 2010).

$$BY_t = \alpha + \beta EI_t + \sum_{i=1}^{m} \partial_i BY_{\boldsymbol{t-1}} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \qquad \ldots (11)$$

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

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 analyze the impact of the previous information in the bond market, autoregressive moving average, i.e., ARMA (m, n) structure is also introduced. In the conditional variance equation has ARCH (p) and GARCH (q) process. If β in model (11) 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.

To examine the effect of actual inflation on the bond yields for different maturity periods, the following model is employed[†].

$$BY_t = \alpha + \beta I_t + \sigma I_{t-1} + \sum_{i=1}^{m} \partial_i BY_{\boldsymbol{t-1}} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \qquad \ldots (12)$$

[†]The conditional variance equation of GARCH (p, q) remains same for models (4.2), (4.3) and (4.4) as given in model (4.1).

where, it 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 affect the behaviour 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.

In order to analyze the effect of the expected Inflation on the gold returns, the following model is employed.

$$Rg = \alpha + \beta EI_t + \sum_{i=1}^{m} \partial_i Rg_{t-1} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \quad \ldots (13)$$

where, *Rg* is the percentage change in the gold prices from the previous period, i.e., the returns on the gold investment and Rg_{t-1} are previous period gold returns. The other variables remain the same as in the above model. Provided that the expected inflation affects the cost of carrying gold, the expected inflation effect hypothesis will be accepted, only if, the expected inflation has a positive and significant relationship with the gold returns. The effect of the actual inflation on the gold returns is analyzed by employing the following model.

$$Rg = \alpha + \beta_1 I_t + +\beta_2 I_{t-1} + \sum_{i=1}^{m} \partial_i Rg_{t-1} + \sum_{j=1}^{n} \lambda_j \varepsilon_{t-1} + \varepsilon_t \quad \ldots (14)$$

Where all the variables remain the same as described above

Data.

The present study is conducted for Pakistan using the monthly data over the period January 2001 to December 2015. 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 are extracted from the International financial statistics (IFS) and SBP annual reports.

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. This 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. The actual inflation rates over the sample period are calculated by taking the first log difference of the consumer price index (CPI) used 2010 as the base year. Expected inflation is calculated by taking the first log difference of the (ECPI) where expected consumer price index is obtained by applying Hodrick–Prescott (HP) filter [Hodrick and Presscot (1997)] to get the expected CPI from the series of historical actual CPI rate. The Hodrick–Prescott filter remove the cyclical component of a time series from raw data. This filtered trend inflation is used to obtain a smoothed-curve representation of a time series of inflation, one that is more sensitive to long-term than to short-term fluctuations.

4. EMPIRICAL RESULTS AND DISCUSSION

The analysis begins with summary statics of the data and diagnostic test. Then the model:11 to 14 are estimated to test the hypotheses given in Equations (9) and (10).

The summary statistics of the data is presented in Table 1. The mean values for the series of inflation, expected inflation, gold prices, and returns and treasury bond rates for the different maturity period (for three months (3m), six months (6m), three years (3y) and for ten years (10y). The gold prices are positively skewed, showing the above average returns is more than the below average return. However, the series for bond prices for different maturity periods are negatively skewed. The value of excess kurtosis of the gold prices and bond prices series is positive indicating leptokurtosis. Augmented Dickey-Fuller (ADF) unit root test is used to check the stationarity of the variable. The inflation, expected inflation, gold prices, and Treasury bond yields for different maturity periods have unit root at the level. After taking the first log difference of all the series become stationary. The results of first difference of series are shown in last row of Table 1.

Table 1. Descriptive Analysis of the Variables

	I	EI	G	B 3m	TB 6m	TB 3y	TB 10y
Mean	8.47	8.60	21602	8.32	8.52	3.28	3.32
SD	5.12	4.10	16274	9.61	10.5	3.17	2.75
Skewness	1.15	0.19	0.698	-0.39	-0.41	-0.59	-0.38
Excess Kurtisis	4.57	1.80	1.036	0.51	0.48	0.71	0.96
JB Test	58.5 (0.075	11.86 (0.001)	19.664 (0.000)	32.754 (0.000)	99.087 (0.000)	38.949 (0.000)	526.73 (0.000)
ADF Stat	-2.524	-3.335	1.780	-4.470	-5.005	+-4.068	-4.264

Note: I=Actual Inflation, EI=Expected Inflation, G= Gold prices, Rg= Return on Gold, TB3m= 3 months' treasury bills rate, TB6m=6 months' treasury bills rate, TB3y=3 years' treasury bonds rate, TB10y= 10 years' treasury bonds rate.

Null Hypothesis for Jarque Berra test: Series is normal; parenthesis contains p-value. Null Hypothesis for ADF test: Non-Stationary / There is unit root at level but log first difference (returns) has no unit root. Critical Values for ADF test: -3.473096 at 1% level, -2.880 at 5% level and -2.576 at 10% level.

The results of pre-estimation diagnostics are presented in Table 2. To capture the presence of ARCH effect, Lagrange Multiplier (LM) ARCH test is applied. The results reported in Table 2 show that all variables are found to have an ARCH effect at least up till the 5^{th} lag. The Box-Pierce test is also applied for the detection of the autocorrelation. The Q-stats for the actual and expected inflation and bond yield for different bond maturity periods show the autocorrelation at least till the 10^{th} lag. The gold returns series has the autocorrelation till the 5^{th} lag. The Q^{2-}stats confirms the volatility of all the variable series at least till the 5^{th} lag. Therefore, ARMA with GARCH models seem suitable to explain the time varying behaviour of the variables.

To get valid results, first an ARMA model is estimated, Q statistics for the standardized residuals are analyzed to check whether any autocorrelation is left to be captured or not. The most suitable order of GARCH specification, in the conditional variance equation is also chosen on the basis of the post estimation residual Q2 tests. Bollerslev *et al.* (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 final selection ARMA-GARCH specification is based on AIC criteria. The post estimation Lagrange multiplier (LM) ARCH statistics is analyzed to check the validity of each model.

Table 2. Initial Diagnostic Analysis of the Variables

	I	EI	G	Rg	RTB 3m	RTB 6m	RTB 3y	RTB 10y
Q-stat(5)	26.59*** (0.00)	705.9 *** (0.00)	744.8 *** (0.00)	8.45** (0.03)	58.11*** (0.00)	25.18*** (0.00)	149.11*** (0.00)	96.20*** (0.00)
Q-stat(10)	34.09*** (0.00)	1288.1*** (0.00)	1402.24*** (0.00)	11.37 (0.32)	66.68*** (0.00)	31.75*** (0.00)	160.40*** (0.00)	98.74*** (0.00)
Q^2-stat (5)	85.57*** (0.00)	731.23*** (0.00)	736.59*** (0.00)	13.52** (0.01)	43.91*** (0.00)	18.24*** (0.00)	25.15*** (0.00)	34.1 *** (0.00)
Q^{2-}stat(10)	95.68*** (0.00)	13.29*** (0.00)	1368.15*** (0.00)	14.65 (0.15)	45.28*** (0.00)	20.95** (0.02)	41.838*** (0.00)	37.91*** (0.00)
LM-ARCH (2)	20.87*** (0.00)	1.09e+008*** (0.00)	8686.7*** (0.00)	4.57** (0.01)	11.68 *** (0.00)	3.67** (0.03)	11.280*** (0.00)***	24.12*** (0.00)
LM-A RCH (5)	11.96*** (0.00)	1.93e+008*** (0.00)	3510.4*** (0.00)	2.09 (0.07)	5.45*** (0.00)	2.89** (0.02)	4.444*** (0.00)***	10.52*** (0.00)

Note: The parentheses contain the probability-values. The ***, ** and * indicate 1%, 5% and 10% significance level. Null hypothesis for Box-Pierce test: No Autocorrelation; Null hypothesis for LM ARCH test: No ARCH Effect.

In order to analyze 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. The results presented in Table 3 show that for 3 months' treasury bills yield, ARMA (0,1) with GARCH (1,1); for 6 months' treasury bills yield, ARMA (1,1) with GARCH (1,1); for 3 years' treasury bonds yield, ARMA (0,1) with GARCH (1,1) and for 10 years' treasury bills yield, ARMA (1,0) GARCH (1,1) lags are found significant and adequate to capture the autocorrelation and ARCH effect in this analysis. These results suggest 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.

Table 3. Effect of Expected Inflation on Different Bond Yields

	TTB 3m	RTB 6m	RTB 3y	RTB 10y
Conditional Variance Equation				
Constant	0.004** (0.024)	0.004 (0.120)	0.002** (0.036)	0.002*** (0.002)
Expected Inflation	0.599*** (0.035)	0.662* (0.072)	0.339** (0.040)	0.522*** (0.000)
AR(1)	0.744*** (0.000)	0.785*** (0.000)	0.803*** (0.000)	0.675*** (0.000)
MA(1)	-0.469*** (0.013)	0.541** -(0.021)	-0.108*** (0.000)	
Conditional Variance Equation				
Constant	5.03e-06*** (0.005)	2.43e-06*** (0.000)	1.14e-06*** (0.000)	5.84e-09 (0.633)
ARCH(1)	0.225** (0.019)	0.139*** (0.003)	0.577*** (0.000)	0.723*** (0.000)
GARCH(1)	0.539*** (0.0001)	0.724*** (0.021)	0.520*** (0.000)	0.322*** (0.000)
Log-likelihood	623.90	616.061	706.695	703.360

Note: The results presented in Table 3 show that for 3 months' treasury bills yield, ARMA (1,1) with GARCH (1,1); for 6 months' treasury bills yield, ARMA (1,1) with GARCH (1,1); for 3 years' treasury bonds yield, ARMA (1,1) with GARCH (1,1) and for 10 years' treasury bills yield, ARMA (1,0) GARCH (1,1) lags are found significant and adequate to capture the autocorrelation and ARCH effect in this analysis. The parentheses contain the probability-values. The ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

This analysis provided mixed results for different bond yields, as shown by results reported in Table 4. In the conditional mean equation, actual inflation in the current time-period has an insignificant impact on the yields for short-term treasury bills. However, previous period inflation has a positive and significant relationship with these bond yields. The 3-year Treasury bond yield also has an insignificant relationship with the actual inflation, while the previous inflation is positive and significant in explaining its behaviour. For 10 years' treasury bonds yield, current as well as previous inflation are found insignificant. These results also validate the presence of Fisher effect in its weak form. Shahbaz (2010), Fatima and Sahibzada (2012) findings also support the presence of the Fisher Effect in its weak form in Pakistan using the cointegration technique.

Table 4. Effect of Actual Inflation on Different Bond Yields

	TTB 3m	RTB 6m	RTB 3y	RTB 10y
Conditional Variance Equation				
Constant	-0.005 (0.354)	-0.009 (0.303)	-0.001 (0.682)	0.001*** (0.000)
Actual inflation	0.034 (0.426)	0.039 (0.351)	0.014 (0.700)	0.002 (0.813)
Actual inflation(-1)	0.097*** (0.001)	0.166*** (0.000)	0.072* (0.068)	0.007 (0.240)
AR(1)		0.725*** (0.000)		0.687*** (0.000)
MA(1)	0.375*** (0.000)	0.876*** (0.000)	0.470*** (0.000)	
Conditional Variance Equation				
Constant	3.14e-06*** (0.001)	7.42e-07** (0.055)	6.15e-06*** (0.000)	7.14e-09*** (0.001)
ARCH(1)	0.281*** (0.000)	0.239*** (0.003)	0.981* (0.060)	0.184*** (0.000)
GARCH(1)	0.512*** (0.000)	0.762*** (0.000)	0.003*** (0.000)	0.552*** (0.000)
Log-likelihood	0.512*** (0.000)	0.762*** (0.000)	0.033*** (0.000)	0.752*** (0.000)
Log likelihood	651.988	620.275	692.616	708.834

Note: The results presented in Table 4.4 show that for 3 months' treasury bills yield, ARMA (0,1) with GARCH (1,1); for 6 months' treasury bills yield, ARMA (1,1) with GARCH (1,1); for 3 years' treasury bonds yield, ARMA (0,1) with GARCH (1,1) and for 10 years' treasury bills yield, ARMA (1,0) GARCH (1,1) lags are found significant and adequate to capture the autocorrelation and ARCH effect in this analysis. The parentheses contain the probability-values. The ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

The results presented in Table 5 column 2 show that the expected inflation has 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. In the condition variance equation, GARCH (1,1) specification is found significant and adequate to capture the ARCH effect.

The effect of the actual inflation on the gold returns are reported in column 3 of Table 5 indicate 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 behaviour of the gold returns.

Table 5. Effect of Expected and Actual Inflation on the Gold Return

	Gold Returns	Gold Returns
Conditional Mean Equation		
Constant	0.0163*** (0.001)	0.008* (0.065)
Expected Inflation	1.802*** (0.001)	
Actual inflation		1.359*** (0.002)
Actual inflation(-1)		-0.390 (0.390)
AR(1)		0.473*** (0.000)
MA(1)	0.730*** (0.000)	
Conditional Variance Equation		
Constant	0.001*** (0.004)	7.94e-05* (0.063)
ARCH(1)	0.297*** (0.004)	0.248*** (0.000)
GARCH(1)	0.709*** (0.000)	0.771*** (0.000)
Log-likelihood	289.611	221.302

Note: The results presented in Table 5 show that for gold returns with Expected inflation ARMA (0,1) with GARCH (1,1); for gold returns with Actual inflation ARMA (1,0) with GARCH (1,1) are found significant and adequate to capture the autocorrelation and ARCH effect in this analysis. The parentheses contain the probability-values. The ***, ** and * indicate 1%, 5% and 10% significance level, respectively

To sum up, in all four models the conditional variance equation, GARCH (1,1) specification is found significant to capture the ARCH effect. The residuals analysis also confirms the validity of the model. The insignificance of Q-stats on residuals and residuals square assures the absence of any autocorrelation. The ARCH test stats are also insignificant implying that no ARCH effect is left to be captured.

The Treasury bond yields for different maturity periods show 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 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. Therefore, these results lead to the conclusion that interest rate is less able to completely hedge the expected as well as actual inflation; therefore, gold can be considered as alternative investments in order to protect their capital from losses during inflationary periods.

5. CONCLUSION AND IMPLICATIONS

The literature reveals that the inflation hedging study property of gold is devoid of making a comparison with its cost of holding. The present 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. The study is conducted using the monthly data from the period January 2001 to December 2015. 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, ARMA with GARCH (1,1) model is employed. The Treasury bond yields for different maturity periods show 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.

The implication emerge from empirical findings is that interest rate is unable to completely hedge the expected as well as actual inflation; therefore, gold can be considered as an alternative investment to protect 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 return exceed its cost of carrying. Gold is shown to be more profitable investment as compared to its alternative risk-free investment, i.e., the government treasury bonds.

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