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IS GOLD A GOOD HEDGE AGAINST INFLATION? EMPIRICAL EVIDENCE IN MALAYSIA

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This paper studies the role of gold quoted in domestic currency as an inflation hedge in Malaysia from July 2001 to November 2011. Using the Malaysian monthly domestic gold and consumer price index (CPI), we examine the relationship between gold return and inflation in Malaysia via correlation coefficients and linear regression model. This paper finds no significant relationship between gold return and inflation, gold return and expected inflation and gold return with unexpected inflation, which led to the conclusion that domestic 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.

Keywords: gold, inflation, hedge, Malaysia

INTRODUCTION

There has been a spate of news on rising gold prices in the Malaysian media recently. News on surging gold prices often attracts people's attention on the commodity as a profitable investment. After the burst of the dot-com bubble, many investors have started to invest in gold as a hedge against potential inflation risk. Although inflation has been historically low in Malaysia, investors have every reason to worry that flat wages and low interest rates would cause an extensive creation of bank deposit leading to inflation in the future. Inflation is likely to reduce purchasing power and real interest rates, and diminish the value of savings. In view of such a scenario, it is, thus, not surprising that the demand for gold is rising, including the demand for unlicensed gold trading schemes[1]. On the other hand, limited supply of the metal has also helped to accelerate the increase in the price of gold.

Despite its rapid increase in price, a cause of concern is whether gold is a good hedge against inflation risks. Researchers have often argued that gold is indeed a good inflation hedge over the long term (Ghosh et al., 2004; McCown and Zimmerman, 2006; Narayan, Narayan and Zheng, 2010; Worthington and

Pahlavani, 2007) but researchers are still uncertain if the metal can maintain its value in the short-term. While there is a wide array of studies on the effectiveness of gold as a hedge against inflation in developed countries, no study has investigated the role of gold as a hedge against inflation in Malaysia. Furthermore most related studies only used a maximum of two proxies to investigate the anticipated inflation. There are no studies that had used multiple proxies of expected inflation, indicating that the empirical evidence on the gold-inflation relationship is still in its infancy. Past studies also combined bull and bear markets in their analyses (Blose, 2005; 2010; Jaffe, 1989; Larsen and McQueen, 1995) that could result in an inconsistent conclusion for the relationship.

This paper places its critical lens on Malaysia in light of the interest shown by Malaysian policymakers and investors on gold. For the record, Malaysia became the 12th country to issue its own gold bullion known as Kijang Emas produced by the Royal Mint of Malaysia in 17 July 2001. Kijang Emas has a gold purity of 999.9 millesimal fineness and the coins come in denominations of RM200, RM100 and RM50, which are nominal face values, and weighs 1 troy ounce, ½ troy ounces and ¼ troy ounces, respectively. The Royal Mint also issued the gold dinar in 2003 and Kelantan gold dinar in 2008. With on-going inflation, the strength of gold price presents a strong motivation to empirically test the ability of this precious metal as a hedge against inflation.

LITERATURE REVIEW

The economic and financial literatures have yielded a large number of in-depth studies relating to the critical functions of gold in economy, which can be separated into four main categories. The first category is studies on the impact of macroeconomic news on gold price such as Ariovich (1983), Cai, Cheung and Wong (2001), Christie-David, Chaudhry and Koch (2000), Dooley, Isard and Taylor (1995), Fortune (1987), Kutan and Aksoy (2004), Lucey, Tully and Poti (2006); Sherman (1982; 1983), Sjaastad and Scacciavillani (1996) and Wang and Lee (2011). The second category of research relates to investigation on the potential role of gold as a diversifier, hedge and safe haven from losses in financial markets (Baur and Lucey, 2010; Baur and McDermott, 2010; Ciner, Gurdgiev and Lucey, 2013; Mansor, 2012; Pullen, Benson and Faff, 2011). Another category of studies have been on the benefit of gold in portfolios (Barisheff, 2006; Blose, 1996; Chua, Sick and Woodward, 1990; Ciner, 2001; Conover et al., 2007; Faff and Chan, 1998; Hillier, Draper and Faff, 2006; Hoang, 2011; Jaffe, 1989; Lucey, Tully and Poty, 2006; McDonald and Solnick, 1977; Michaud, Michaud and Pulvermacher, 2006; Ratner and Klein, 2008; Sherman, 1982; 1986; Smith, 2002; Tufano, 1998; Vandeloise and Wael, 1990; Wozniak, 2008). Finally the inflation hedge of gold has also received scholarly attention and can be further sub-divided into three sub-categories:

1. Research on the long-run relationship between gold return and ex-post inflation (Adrangi, Chatrath and Raffiee, 2003; Baillie, 1989; Ghosh et al., 2004; Hoang, 2012; Lawrence, 2003; Mahdavi and Zhou, 1997; McCown and Zimmerman, 2006; Narayan, Narayan and Zheng, 2010; Pecchenino, 1992; Wang, Lee and Thi, 2011; Worthington and Pahlavani, 2007).
2. Research on the short-run relationship between gold return and ex-post inflation rate (Ghosh et al., 2004; Hoang, 2012; Laurent, 1994; Taylor, 1998; Wang, Lee and Thi, 2011).
3. Research on the relationship between gold return and expected inflation (Bhardwaj, Hamilton and Ameriks, 2011; Blose, 2005; 2010; Christie-David, Chaudhry and Koch, 2000; Chua and Woodward, 1982; Froot, 1995; Jaffe, 1989; Larsen and McQueen, 1995; Sherman, 1983).

The large volume of studies on gold as an inflation hedge has mainly been spurred by the steady rise in its price since the last decade. Generally, many academics and practitioners have argued that gold is an inflation hedge using ex-post inflation data from United States and United Kingdom such as Lipschitz and Otani (1977), Feldstein (1983), Koutsoyiannis (1983), Jaffe (1989), Pecchenino (1992), Laurent (1994), Taylor (1998), Ghosh et al. (2004), Ranson (2005), Levin and Wright (2006), Barisheff (2006), McCown and Zimmerman (2006), Michaud et al. (2006), Conover et al. (2007), Worthington and Pahlavani (2007), Dempster and Artigas (2010), Jastram and Leyland (2009), and Narayan, Narayan and Zheng (2010). In contrast, Brown and Howe (1987), Baillie (1989), and Tully and Lucey (2007) found that gold is unable to hedge against inflation in the said countries.

While there are substantial empirical evidences regarding the relationship between gold return and ex-post inflation, the relationship between gold return and expected inflation, particularly in an emerging market is still vague. The first theoretical basis for the relationship between ex-ante inflation and asset return was postulated by Fisher as far back as 1930. He claimed that the expected nominal asset return comprises expected return and expected inflation rate. In other words, when expected inflation rises, asset return will rise. Much later, Fama and Schwert (1977) tested the hedging effectiveness of treasury bills, government bonds, residential real estate, corporate bonds, labour income and common stocks against expected and unexpected inflations. They opined that private residential estates were the only form of investment that provided a complete hedge against expected and unexpected inflations.

Chua and Woodward (1982) investigated gold as a hedge against inflation in Canada, Germany, Japan, Switzerland, the United States and United Kingdom. They found that gold had not offered consistent protection against inflation to individuals since the inflation characteristics of the major industrialised countries differ considerably. With the exception of United States, gold is neither a complete nor partial hedge against domestic inflation. Using autoregressive model to estimate expected inflation rates, gold appears to be a perfect hedge against both expected and unexpected inflations in the United States but not in the other five countries.

Sherman (1983) estimated annual gold prices against unexpected inflation and found a significant positive relationship. Christie-David, Chaudhry and Koch (2000) investigated the effect of macroeconomics news releases on gold, establishing the fact that Consumer Price Index (CPI) has a significant effect on gold futures. Gold futures reaction to unexpected changes in CPI is significant in the 15-min time period following the announcement.

In contrast, some researchers have found contradictory results such as Froot (1995), Blose (2005), Blose (2010) and Bhardwaj, Hamilton and Ameriks (2011). Froot (1995) points out that gold is a weak hedge in the United States. Blose (2005), on the other hand, claims that there is a strong and significantly positive relationship between unexpected inflation rate and interest rate. Nevertheless, inflation rates and unexpected inflation rates cannot explain the return of gold. In another study by Blose (2010), expected inflation was seen to have no impact on gold prices, supporting the carrying cost hypothesis, where higher expected inflation will cause higher interest rate (known as the Fisher effect).

The study by Bhardwaj, Hamilton and Ameriks (2011) showed that returns of gold are insignificant with expected inflation and unexpected inflation. For investors with long-term goals, although return for gold is positively correlated with inflation, it is, nevertheless, statistically insignificant. Bhardwaj, Hamilton and Ameriks (2011) also draw our attention to the existence of gold standard in the United States that causes the correlation between gold returns and inflation to be complicated. USD is pegged to a fixed quantity of gold and hence inflation in United States is effectively defined as the change in the value of gold relative to a broad-based basket of goods. The gold standard also imposes restrictions on monetary policy that might have influenced the relationship between inflation and other asset-return dynamics.

Several studies found mixed evidences, for example, Jaffe (1989), and Larsen and McQueen (1995). Jaffe (1989) estimated gold returns on contemporaneous anticipated inflation using yield of one month Treasury bill and surprisingly found that the relationship is negative. On the other hand, empirical results for return on gold and unanticipated inflation show a significant positive relation. Jaffe (1989), subsequently, concluded that a short time interval within a 17-year period is the reason why gold is not a good hedge against inflation. Jastram (1977) found that gold does not effectively hedge yearly commodity price increase because it does not match commodity prices in their cyclical swings. Nevertheless, over the long-run, gold maintains its purchasing power due to the retrieval phenomenon, that is, gold prices do not chase after commodities. In Larsen and McQueen's view (1995), the relationship between gold and unexpected inflation is weak based on their findings that the coefficient of unexpected inflation is significant and positive while *F*-statistic remains insignificant.

The findings postulated in previous studies have shown that effective hedge of gold against inflation and expected inflation is inconsistent and contradictory, suggesting that further studies are needed to shed more light on the issue. Moreover, many of the studies have caveats in terms of the limited (one or two only) proxies investigated for expected inflation.

In addition to Chua and Woodward (1982), Cai, Cheung and Wong (2001), Kutan and Aksoy (2004), Artigas (2010), Wang, Lee and Thi (2011) and Hoang (2012) had also investigated this area using different data sets. Cai, Cheung and Wong (2001) investigated the effects of macroeconomics announcements on the future gold prices in New York (Comex) from 1983 through 1997 with intra-day data. They found that announcements regarding inflation in the United States and Japan had significant impacts on the gold price. Wang, Lee and Thi (2011) found that gold was only partially effective in hedging against inflation in Japan in the long-run. In contrast, gold is able to hedge against inflation in the United States but not Japan in the periods of high momentum regimes.

Artigas (2010) found evidences that money supply growth has an impact on future gold performance. He demonstrated that changes in the United States money supply has the largest impact on the price of gold, while changes in money supply in countries where gold has a preeminent cultural role like India, is very important. Kutan and Aksoy (2004) argued that the Istanbul gold market does not serve as a hedge against inflation but is sensitive to development in real sector. They concluded that the traditional role of gold as a store of value in high-inflation countries like Turkey has disappeared with the development of alternative financial markets, such as the stock market. Recently, Hoang (2012) found that the correlation coefficients between gold return and inflation in the short-run are very low and insignificant while beta coefficients in the regression analysis are not significant. The study also identified that there are no cointegration between gold prices listed in Paris and French CPI.

In summary, the role of gold as an inflation hedge has been confirmed by most of the studies using gold quoted in London and New York where the price is in USD. At the same time, some studies have shown that the relationship between gold and inflation is not stable over time and is not significant in all countries (for instance, Japan, Turkey, and France), suggesting that the role of gold as a hedge against inflation is not always guaranteed.

METHODOLOGY AND DATA

Methodology

Most studies on the inflation hedging attributes of gold have followed the methodology of Fama and Schwert (1977). The form of regression that is used to determine if an asset is a hedge against inflation is:

$$R_{G,t} = \beta_1 + \beta_2 \pi_1 + e_t \tag{1}$$

where, $R_{G,t}$ is gold return in time t, π_t is ex-post inflation rate in time t and e_t is a disturbance term. β_1 is the constant term, β_2 is the hedging coefficient denotes how well gold investment can act as a hedge against inflation or the cross-price elasticity between gold return and inflation. If gold return is a perfect hedge against inflation, β_2 should be equal to one. This is classified as a full Fisher relationship. If β_2 is larger than one, the hedge is more than complete. Gold returns which provide an incomplete hedge or partial hedge will yield a β_2 between zero and one. A negative β_2 suggests that gold acts as a perverse hedge against inflation. Based on Equation (1), we further decompose inflation into expected and unexpected components. To this end, we adapt the framework used by Wurtzebach, Mueller and Machi (1991) by modifying Equation (1) as:

$$R_{G,t} = \beta_1 + \beta_2 E\pi_1 + e_t \tag{2}$$

$$R_{G,t} = \beta_1 + \beta_2 E\pi_1 + \beta_3 U\pi_t + e_t \tag{3}$$

where $E\pi_t$ is expected inflation in time t and $U\pi_t$ is unexpected inflation for time t. β_2 and β_3 are the hedging coefficients that denote how well gold investment can hedge against expected inflation and unexpected inflation, respectively. Gold is said to be a perfect hedge against expected inflation when β_2 in Equation (2) equal to one. Equation (3) presents the model of disaggregating inflation into two components, the expected and unexpected inflations. Gold is a perfect hedge against unexpected inflation when β_3 in Equation (3) equal to one. When $\beta_2 = \beta_3 = 1$, gold is said to provide a complete hedge against inflation.

Data

The selected period is from July 2001 to November 2011. The selling price of one troy ounce of Kijang Emas is used to represent domestic gold price while the domestic CPI is used to represent inflation rate. The selling price of Kijang Emas is based on the rate provided by the Central Bank of Malaysia while the CPI is derived from International Financial Statistics. Gold return and inflation rate were computed using continuous compounded return method. The descriptive statistics presented in Table 1 indicates that, on average, the return on gold is above the inflation rate while the mean return of gold is approximately 1.4% a month. Thus, gold exhibits more extreme values than inflation rate.

Table 1: Descriptive statistics

Variable	Mean (%)	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
$R_{G,t}$	1.3655	12.7675	–18.2382	4.7382	–0.5420	4.4295	16.6279
π_t	0.1971	3.8656	–1.1455	0.4546	4.2005	36.6645	6220.000

Figure 1 and Figure 2 show the time series plot of both series in level and first-differenced forms, respectively. The graph also shows that the domestic gold price and CPI move concurrently in most years except in 2008. Obviously when gold price and CPI move in tandem, it is consistent with gold as a hedge against inflation. In contrast, the year 2008 is different because there was an opposite movement between the two prices.

While Figure 1 shows that gold price and CPI in Malaysia might display the same trend in the long-run, Figure 2 provides the possibility of different short-run adjustments between gold price and CPI. The domestic gold price had been on an upward surge particularly since 2008. The returns series appear in bunches rather than being evenly spaced over time.

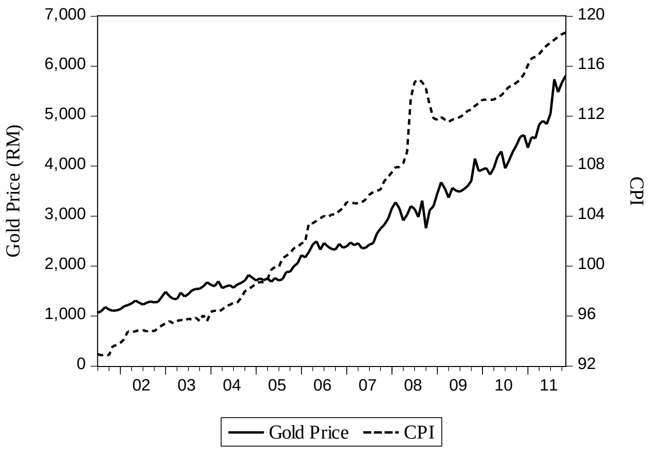


Figure 1: Gold price and CPI.

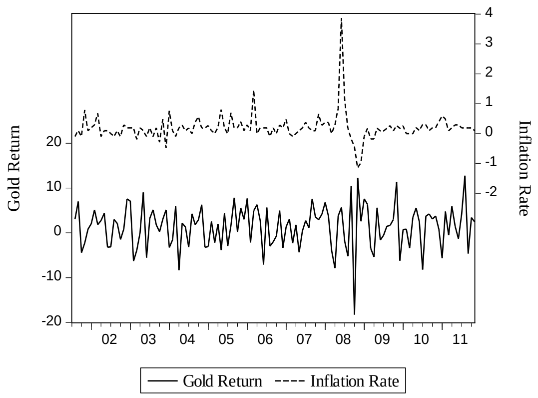


Figure 2: Gold return and inflation rate.

EMPIRICAL RESULTS AND DISCUSSION

Forecasting Expected Inflation

We apply seven different models to forecast inflation.[2] For AR model, one lag seems to be optimal since it provides the lowest Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC). For MA model, the lowest value is six for AIC and one for SIC. We found that AIC selects an ARMA (4,3), while SIC selects ARMA (1,0).

To compare the relative accuracy of the models, we compare two measures of predictive performance that is root mean square error (henceforth RMSE) and mean absolute error (henceforth MAE). As can be seen from Table 2, ARMA (4,3) model reports the lowest error and thus performs the best when compared to other models.[3] Based on RMSE and MAE, it can be determined that all models perform better than the random walk model. From Figure 3, we can see that monthly inflation rate is volatile, especially in 2008. On the other hand, expected inflation rate based on ARMA (4,3) is less volatile, causing the unexpected inflation rate to be quite large, especially in 2008.

Table 2: Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) for in-sample forecasts

Model	RMSE	MAE
Random walk (Naive)	0.5319	0.3082
AR (1)	0.4308	0.2277
MA (1)	0.4332	0.2249
MA (6)	0.4108	0.2264
ARMA (4,3)	**0.4049**	**0.2234**
Lag 1 inflation + Interest rate	0.4306	0.2281
Interest rate	0.4519	0.2247
Exponential smoothing	0.4531	0.2211

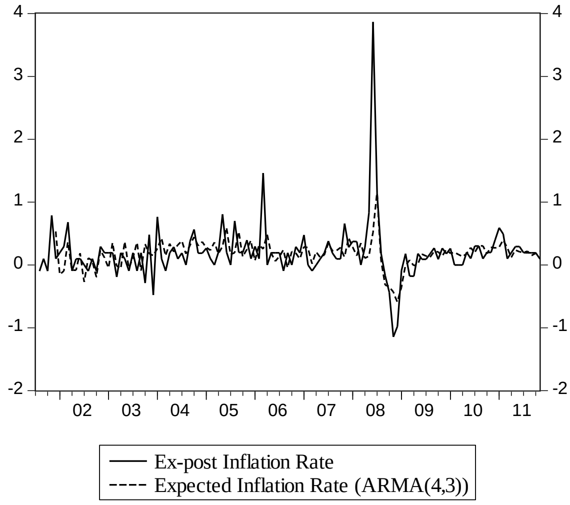


Figure 3: Plot of ex-post inflation and expected inflation with ARMA (4,3).

Correlation Coefficient

Gold can be considered as an instrument to hedge against actual, expected and unexpected inflation if its return moves in the same direction as inflation. Therefore, the gold return is positively correlated against the three measurements of inflation. Table 3 shows that although the correlation coefficients are positive, it is very low and not significantly different from zero, suggesting that there is no correlation between gold return and the three inflation measures in Malaysia from 2001 to 2011.

Table 3: The correlation between gold return and inflation rate, expected inflation and unexpected inflation

Inflation	0.0544 (0.6017)
Expected inflation	0.0003 (0.0036)
Unexpected inflation	0.0691 (0.7520)

Notes: Values in parentheses are *t*-statistics. The unexpected inflation is calculated by subtracting the expected inflation from the actual inflation.

Estimated Regression: OLS Results

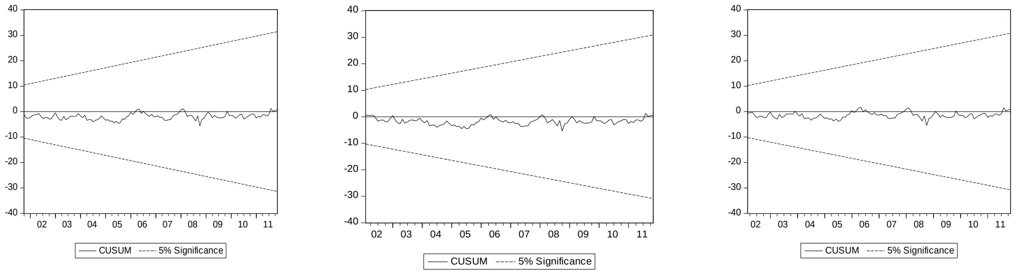
The OLS estimation results are reported in Table 4. We find that β_2 in Model 1, Model 2 and Model 3 as well as β_3 in Model 3 are positive but not significantly different from zero. The ***F***-statistics are insignificant and R^2 for all regressions are negligible. Wald statistics reject the null hypotheses, indicating that gold is not a perfect hedge against inflation, expected inflation as well as unexpected inflation. Ramsey Reset test shows there is no evidence of functional form misspecification.

Chow breakpoint test and Chow forecast test conclude that there is no evidence of parameter instability with respect to the break date. The results of CUSUM tests are graphed in Figure 4. As can be seen in Figure 4, the estimated coefficients are robust and exhibit remarkable stability. One the other hand, the plot of CUSUMSQ statistics in Figure 5 crosses the critical value line indicating some instability in gold return. Nonetheless, the issue does not seem to be too serious because the instability that was observed in the mid and late 2007 has vanished over time and after 2009, the plots of CUSUMSQ statistics are within the critical value bounds.

Table 4: OLS Estimation Results

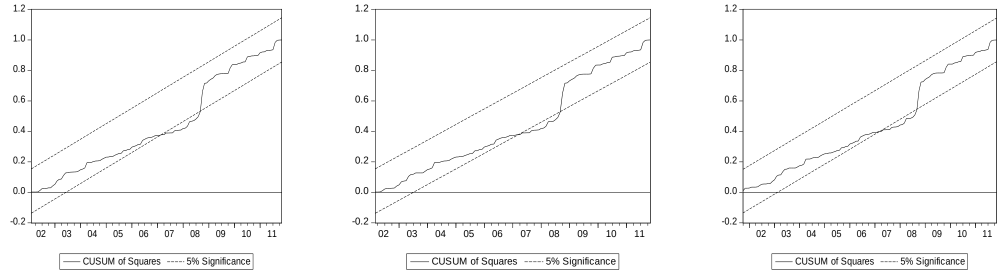
Model	1. $R_{G,t} = \beta_1 + \beta_2\pi_t + e_t$	2. $R_{G,t} = \beta_1 + \beta_2 E\pi_t + e_t$	3. $R_{G,t} = \beta_1 + \beta_2 E\pi_t + \beta_3 U\pi_t + e_t$
β_1	1.2537*** [2.6945]	1.3813** [2.4257]	1.3642** [2.3892]
β_2	0.5670 [0.6017]	0.0073 [0.0036]	0.0240 [0.0118]
β_3	–	–	0.8071 [0.7489]
Wald Statistics $\beta_2 = 1$	0.2112 {0.6467}	0.2376 {0.6269}	0.2288 {0.6333}
Wald Statistics $\beta_3 = 1$	–	–	0.0321 {0.8582}
Wald Statistics $\beta_2 = \beta_3 = 1$	–	–	0.1295 {0.8787}
Ramsey RESET Test	0.8862 (0.3484)	0.0170 (0.8964)	0.8184 (0.3675)
R^2	0.0030	0.0000	0.0048
F-stats	0.3620	1.28E-05	0.2804
Chow Breakpoint Test (2008:11)[4]	2.2962 (0.1050)	2.6435* (0.0754)	1.9953 (0.1187)
Chow Forecast Test (2010:11 – 2011:11)	0.9527 (0.5024)	0.9347 (0.5205)	0.9474 (0.5079)

Notes: Asterisk (***) and (**) denote that a test statistic is significant at the 1% and 5% significance level, respectively. Brackets, braces and parentheses contain *t*-statistics, probability and *F*-statistics, respectively.



Model 1 Model 2 Model 3

Figure 4: CUSUM Test Graph for Model 1, Model 2 and Model 3.
Note: The straight lines represent critical bounds at 5% significance level.



Model 1 Model 2 Model 3

Figure 5: CUSUMSQ Test Graph for Model 1, Model 2 and Model 3.
Note: The straight lines represent critical bounds at 5% significance level.

CONCLUSION

This study empirically investigated whether domestic gold can serve as a hedge against inflation, expected inflation and unexpected inflation in Malaysia using monthly data from July 2001 to November 2011. Since investors have to forecast inflation before making a decision whether or not to invest in gold, we started the analysis by building a model to forecast inflation rate. Then we looked at the relationship of inflation, expected inflation and unexpected inflation with gold returns via correlation and OLS regression. Although they are positively correlated and have positive beta, we found no significant evidences.

We conclude that domestic gold price makes it less viable for the metal to be used a hedge against inflation since there is no systematic relationship between the said variables over a shorter time frame. This indicates that gold as a hedge against inflation is not justified in Malaysia at least in the short-run. Although its value increases in times of crisis and can be used as a hoarding vehicle, gold is not a store of value in Malaysia. In addition, even if an investor has perfect foresight and knows that future inflation will be substantially different than market expectations, investors cannot set up a speculation strategy in the gold market that would profit from that information.

Inflation has the potential to erode the value of gold investment. Therefore, investors should hold a well-diversified portfolio such as stock, bond and property to earn sustainable returns and protections from inflation. Gold investors specifically can diversify their gold investment not only by purchasing physical gold, but also on gold exchange traded funds (ETF), gold mining stocks, gold futures and gold savings account to sustain their capital gains over time at a rate that exceeds inflation. Gold investment companies on the other hand should provide sustainable business models where the expansion of profit ought to be funded by mounting free cash flow to invite huge investment locally as well as globally.

NOTES

1. Based on information and queries received, Central Bank of Malaysia has released a list of 103 illegal investment companies and websites which are neither authorised nor obtained the permission from the Controller of Foreign Exchange under the Exchange Control Act 1953. Out of 103 illegal investment companies, 27 companies are illegal gold investment company, where the business model is unsustainable. These companies' operating schemes are not sustainable in providing the promised high returns nor would they be able to provide the buy back guarantee of gold, suspected of running a Ponzi scheme, taking deposit illegally, money laundering and tax evasion (Central Bank of Malaysia, 2013).
2. The first model is the random walk without drift, which means that we use the inflation rate of the prior period as the inflation rate for the next period. The second model is an autoregressive model with *p*, or AR(*p*), can be expressed as: $E(\pi_t)=\alpha+\varnothing_1\pi_{t-1}+\varnothing_2\pi_{t-2}+...+\varnothing_p\pi_{t-p}+u_t$, where $E(\pi_t)$ is the expected inflation rate, π_{t-p} is inflation *p* period back and u_t is white noise disturbance term. A simple moving average, or MA(*q*) is the third model, which can be expressed as: $E(\pi_t)=\alpha+u_t+\theta_1 u_{t-1}+\theta_2 u_{t-2}+...+\theta_q u_{t-q}$. A moving average model is a linear combination of white noise process, so that $E(\pi_t)$ depends on the current and previous values of white noise disturbance term. Fourth model is an ARMA(*p*,*q*). The model could be written as: $E(\pi_t)=\alpha+\varnothing_1\pi_{t-1}+\varnothing_2\Pi_{t-2}+...+\varnothing_p\pi_{t-p}+\theta_1 u_{t-1}+\theta_2 u_{t-2}+...+\theta_q u_{t-q}+u_t$. For the fifth and sixth models, an interest rate is used. Fama (1975) argued that through nominal interest rates, information can be obtained about future inflation. Therefore, we use treasury bill, and since inflation is highly auto correlated, we also add inflation of lag 1 as follows: $E(\pi_t)=\alpha+\varnothing\pi_{t-1}+\vartheta i_{t-1}+u_t$. where i_{t-1}

is the interest rate one period back. The sixth model only uses the interest rate as follows: $E(\pi_t) = \alpha + \vartheta_{t-1} + u_t$. Finally, the exponential smoothing that uses only a linear combination of the previous values of a series for modelling it and for generating forecasts of its future values. The equation for the model is: $(\pi_t) = \omega\pi_t + (1-\omega)(\pi_{t-1})$, where ω is the smoothing constant, with $0 < \omega < 1, \pi_t$ is the current realised inflation and $E(\pi_t)$ is the current smoothed inflation.

3. Expected monthly inflation averaged 0.50% (approximately 6% a year). Unanticipated inflation's average is zero to the second decimal place, suggesting the measure of expected inflation is unbiased.

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