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An Analysis of Gold Futures as an Alternative Asset: Evidence from India

Ritika Jaiswal[1]*, Rashmi Uchil[2]

[1]Visiting Assistant Professor, Department of Economics Bits Pilani, K K Birla Goa Campus, Goa, India, [2]Assistant Professor, School of Management, National Institute of Technology Karnataka, India. *Email: ritikastone@gmail.com

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ABSTRACT

This study incorporates the regime switching framework to investigate the hedge and safe haven property of gold futures against the stock and bond market movements. The Markov-Switching Vector Autoregression (MS-VAR) model is adopted, which splits the whole sample period into two extreme regimes. One of the regimes accounts for the period of high volatility in stock and bond returns and enables to verify the safe haven role of gold futures. Conversely, another regime represents the period of average stock returns and low volatility which allows to define the hedging potential of gold futures. The results demonstrate weak hedging potential of gold futures against the stock and bond market movements. However, during the financial turmoil and extreme market movements, gold futures cannot be used as a safe haven. In addition, portfolio analysis confirms that findings of MS-VAR are useful for investors and fund managers to get improved risk-adjusted return from the portfolio. The empirical findings nullify the conventional wisdom attached to the gold futures with respect to their safe haven property and have pervasive policy implication with respect to this.

Keywords: Gold Futures, Hedge, Markov-switching, Safe Haven
JEL Classifications: G10, G11, G12, G13

1. INTRODUCTION

The sequence of continuous global economic and financial crisis have been experienced by the market in recent years, increased the correlation among the assets. However, gold is still uncorrelated with other assets, despite the changing pattern of correlation among gold and other asset classes (Beckmann et al., 2015). Since gold is considered as a medium of exchange and store of wealth during political and economic turmoil (Baur and Lucey, 2010). During the period of uncertainty, investors are attracted towards gold due to storable and portable nature of gold and simplicity of gold market (Baur and McDermott, 2010). One of the fundamental reasons to invest in commodity specifically gold is its capability to provide a natural hedge against inflation (Conover et al., 2010). Normally, it is observed that the prices of an asset which move with inflation can be used as a hedge against stock and bond market plunge. As stock and bond markets fail to sustain their value during the period of unexpected inflation (Jaiswal and Uchil, 2015). These facts are providing the strong motivation to do an empirical analysis of hedge and safe haven property of gold futures against stock and bond market movements. Investment in gold futures is considered as one of the alternative ways to invest in gold. It is considered that gold futures can be included in a portfolio to get the benefit of diversification as expected spot prices are reflected in gold futures prices.

The theoretical justification for subsequent empirical analysis is based on the definitions of a hedge, diversifier and safe haven, given by Baur and Lucey (2010). According to them, an asset is qualified to be a hedge (safe haven) if it is uncorrelated or negatively correlated with other assets on an average (during extreme stock market movements). Baur and McDermott (2010) have further extended the work of Baur and Lucey (2010) and they defined the weak and strong form of hedge and safe haven.

The prime contribution of the study is the application of regime-switching framework of Markov-Switching Vector Autoregression (MS-VAR) to analyse the regime-dependent hedge and safe haven role of gold futures. The findings of the study are crucial for investors, investment fund managers and policy-makers for the following reasons. Firstly, it is essential that investors should hold a portfolio of distinct asset classes which should have a negative and low correlation among them, to get the diversification benefit. The reason is that the impact of different macroeconomic environment on different assets are not same. Such as, it is normally observed that high inflation rate causes the fall in the prices of stocks and bonds while it leads to the rise in the prices of gold (Ghosh et al., 2004; Worthington and Pahlavani, 2007; Beckmann and Czudaj, 2013). In addition, during a hard time of economic and financial disruption, diversification may not completely eliminate the risk but at least it can minimise the risk by providing protection against arbitrary movements in the market. Secondly, it is crucial for policy-makers of all the highest gold consuming countries such as India, China, Middle East, US, Europe, Turkey and Germany to reduce the consumption demand of precious metals by highlighting its features as an alternative asset class for creating a diversified portfolio. At the end of 2015, jewellery demand constitutes 57% of the total gold demand of world, out of which India and China account for 60% of demand. India, China and US are the three largest markets for gold jewellery due to their unique cultural and traditional significance with this metal. As per the report of World Gold Council, the total demand for gold for Q1'2016 is 1289.8 tonnes. Out of which, 481.9 tonnes of demand is for gold jewellery and 617.6 tonnes of demand is for investment purpose (www.gold.org, World Gold Council). However, the percentage demand of gold jewellery has reduced compared to demand in Q1'2015. These numbers show that despite a reduction in jewellery demand, it is still on the higher side.

The remaining part of the paper is structured as Section 2 providing the details of the literature review. Section 3 and 4 elaborate the methodology and data used. Section 5 contains the empirical results and discussion, followed by conclusion in Section 6.

2. LITERATURE REVIEW

Studies conducted to provide an insight into the diversification role of gold are discussed as follows. Baur and Lucey (2010) and Baur and McDermott (2010) confirmed that gold acts as a hedge and safe haven in extreme stock market movements for US, UK and European countries. However, according to Baur and McDermott (2010), gold is not able to act as a hedge and safe haven for the BRIC countries, Australia, Canada and Japan. Similarly, according to Pasutasarayut and Chintrakarn (2012), gold is neither a hedge nor a strong safe haven against the stock market of Thailand. However, the findings of Beckmann et al. (2015) suggested that hedge and safe haven properties of gold depend on the market-specific behaviour. In addition, Hillier et al. (2006), Summer et al. (2010), Coudert and Raymond (2011) and Ciner et al. (2013) have confirmed the low or negative correlation of gold with stocks.

The following literature discusses the combined analysis of diversification property of different commodity futures including the gold futures. According to Gorton and Rouwenhorst (2006), Chong and Miffre (2010), Mensi et al. (2013) and Bessler and Dominik (2015), the performance of a portfolio is enhanced with the addition of commodity futures. Conover et al. (2010) suggested that the investors can make substantial benefit by investing 5% and more in commodity during the period when the Federal Reserve is increasing the interest rates. Contrarian view was given by Erb and Harvey (2006), Daskalaki and Skiadopoulos (2011) and Lombardi and Ravazzolo (2013). Their overall results suggest that portfolio consists of commodities do not always produce the substantial benefits. However, significant variation in the time series of gold and equity prices due to structural changes causes the presence of different regimes in the economy. These regimes can be classified into a bull phase during the sub-prime crisis and bear phase during the European crisis and the recent economic slowdown in China. Thus, from a theoretical point of view, it is essential to perform a nonlinear estimation to check the hedge and safe haven role of gold futures under the state-dependent approach.

In literature, different measures are adopted to test the safe haven role of assets under the time-varying framework. To check the safe haven hypothesis of gold under extreme stock and bond market movement, Baur and Lucey (2010) took the threshold of 5%, 2.5% and 1% quantiles of stock and bond return distribution. If return exceeded these quantiles then the dummy variable took the value as zero. Similarly, to capture the extreme stock market movement Baur and McDermott (2010) considered the threshold of 10%, 5% and 1% of return distribution. The dummy variable accepted the value as one if the stock return exceeded these thresholds. In order to avoid using these arbitrary and discrete pattern of capturing extreme market movements, Beckmann et al. (2015) adopted the exponential transition function of smooth transition regression (STR) model. STR splits regression model into two extreme regimes. One regime characterises the period of average return while the other regime accounts for the high volatility in stock return.

The proposed study enriches the existing literature by analysing the diversification benefits of gold futures using the regime-dependent framework of MS-VAR in the Indian context. MS-VAR is more suitable than other time-varying models as it is based on state-dependent time series model which divides the total period into two or three extreme states. These unobservable states follow exogenous stochastic process rather than a deterministic process.

3. METHODOLOGY

The Markov-Switching model was originally proposed by Hamilton (1989) and was further continued by Krolzig (1997), who provided the overview of MS-VAR. MS-VAR allows for a shift of estimated parameters between stochastic and unobservable regimes. The unobservable regimes are generated using stationary, irreducible and ergodic Markov chain. MS-VAR is the generalization of basic VAR model with the finite order of p. Thus, VAR model of k-dimensional time series vector $X_t=(x_{1t},...x_{kt})$, $t=1,....,T$ and with autoregressive order of is defined in Equation (1):

$$x_t = \upsilon + R_1 x_{t-1} + ... + R_p x_{t-p} + \varepsilon_t \quad (1)$$

$$\varepsilon_t \sim \text{IID}\ (0,\Sigma)$$

Where IID refers to Independent and Identically Distributed data, υ is the intercept term and R_p,R_1 are the autoregressive parameters. A regime-switching framework is based on the assumption that the estimated parameters of data generation process of the time series vector X_t depend on unobservable state variable S_t. The process of regime generation is guided by Markov stochastic process with the finite number of regimes $S_t \in \{1,\ldots\ldots,M\}$ and constant transition probabilities. The transition probability of switching from regime i to regime j at time t+1 is independent of process history is depicted in Equation (2).

$$P_{ij} = P_r\,(S_{t+1}=j|S_t=i),\ P_{ij}>0,\ \sum_{j=1}^{M} P_{ij} = 1 \quad \forall_i, j \in (1,\ldots\ldots,M) \tag{2}$$

In this study, VAR (p) model is extended to MS-VAR with the autoregressive order of p and M number of regimes. This model allows regime shift in intercept term, autoregressive parameter, and variance-covariance matrix of the residuals as shown in Equation (3).

$$x_t = \upsilon(S_t) + R_1\,(S_t)\,x_{t-1} + \ldots\ldots + R_p\,(St)\,x_{t-p} + \varepsilon_t \tag{3}$$

$$\varepsilon_t|S_t \sim NID\,(0,\textstyle\sum(S_t)),\ t=1,\ldots\ldots,T$$

Where NID refers to Normally and Independently Distributed data, $\upsilon(S_t)$ shows the vector of regime-dependent intercept term. $R_1\,(S_t)$ and $R_p\,(S_t)$ are autoregressive parameters of an order in the regime S_t. $\upsilon(S_t)$, $R_1\,(S_t)$.,... $R_p\,(S_t)$ and $\sum(S_t)$ are the parameter shift functions which show the dependence of parameters υ, R_1...., Rp and...., R_p on the unobservable regime S_t.

The smoothed probability estimated in Markov-Switching model represents the conditional probability which uses all the information in sample up to future date T and as a result, it represents the ex-post measure. In Markov-Switching model, smoothed probability is estimated at each point which is used in regime classification for each observation. The classification rule specifies the assignment of observations into the first regime if $P_r\,(S_t=1|X_t)>0.5$ and into the second regime if $P_r\,(S_t=1|X_t) < 0.5$ for the case of two regimes. The MS-VAR model is estimated by using Grocer toolbox for Scilab (Dubois and Michaux, 2013). The parameters of MS-VAR model are estimated by maximum log likelihood function via Expected Maximum (EM) algorithm.

4. DATA AND SUMMARY STATISTICS

This study is conducted on gold futures traded on Multi Commodity Exchange (MCX) (www.mcxindia.com). In addition, Nifty (www.nseindia.com), a leading stock market index in India, is taken as a proxy for stock index and Clearing Corporation of India Ltd. (CCIL) liquid total return bond index (www.ccilindia.com) is taken as a proxy for a bond index. The monthly prices of gold futures, Nifty and bond index are used for the study period from June 2006 to April 2016. Based on the MCX rolling mechanism, the nearby futures contract are used to construct future price series as these are the most actively traded contracts. During the rolling period, series incorporates the next nearby future price series in a predetermined manner of rolling 20% for each day.

Summary statistics [1] on returns of Nifty and bond prices and gold futures prices are given in Table 1. The results show that gold futures have the highest mean return. Conversely, bond return shows the lowest mean return and standard deviation. The median value of gold return is higher than the median value of bond and Nifty return. The return distribution of Nifty has negative skewness while the distribution of gold and bond returns have positive skewness. Hence, the return distribution of Nifty is different from the return distribution of gold futures.

Continuously compounded logarithmic returns are used which are estimated by taking the first difference of natural logarithm of Nifty and bond prices and futures prices of gold.

5. RESULTS AND DISCUSSION

The analysis is done in the following different stages using broad overview of MS-VAR given by Krolzig (1997). The Augmented Dickey Fuller test and Kwiatkowski-Phillips-Schmidt Shin test are applied to check the stationarity of time series data. In addition, Zivot and Andrews unit root test is conducted to incorporate the possibility of a structural break. This test allows for a single break both in the intercept and in the trend. These test results confirm that the time series of gold futures, Nifty and bond are stationary at first difference. The autoregressive order of one is selected for the model of Nifty-Bond-Gold based on results of information criterion: Akaike Information Criterion, Schwarz Information Criterion and Hannan-Quinn Information Criterion.

Broock, Dechert and Scheinkman (BDS) as a test of nonlinearity is applied on the residual of linear VAR, estimated for the model. It tests the null hypothesis of I.I.D. data. The BDS test is performed with embedding dimension equal to two and ε equal to the standard deviation of the dataset. The null hypothesis of BDS test is rejected for the models of Nifty-Bond-Gold which confirm the presence of nonlinearity in the residual of linear VAR model.

5.1. Estimation of MS-VAR

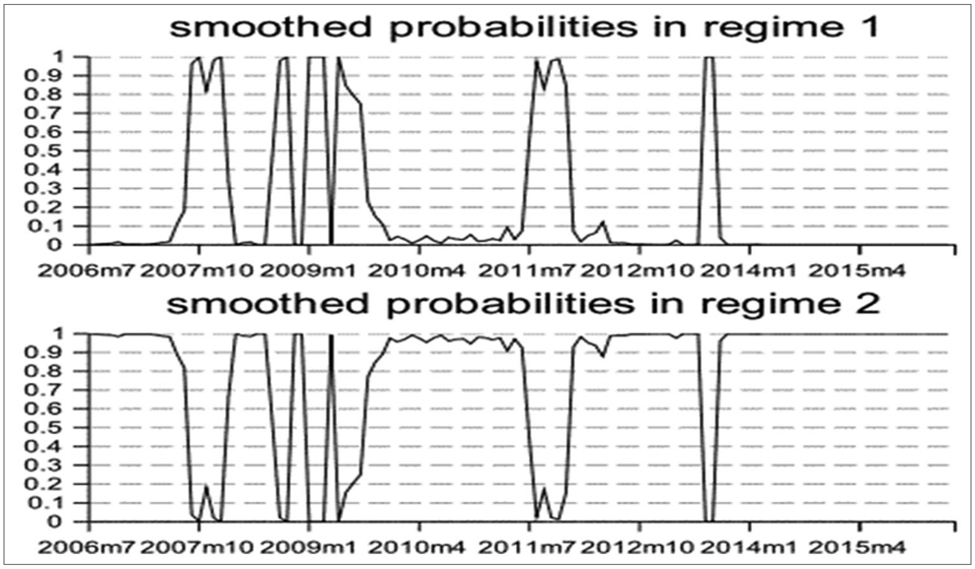
Based on BDS test and information criterion, the nonlinear model with two regimes is selected for the Nifty-Bond-Gold model. Values of information criterion suggest that MSIAH (2) VAR (1) [1] with two regimes, heteroscedastic error and an autoregressive order of one, as the most appropriate model to define the hedge and safe haven role of gold futures.

Observations are classified into the regimes based on smoothed probability as depicted in Figure 1. In the previous study, Beckmann

Table 1: Summary statistics

Series	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Kurtosis	Observation
Nifty	0.779	0.634	24.74	−30.67	7.01	−0.637	6.65	118
Bond	0.648	0.616	13.93	−7.93	2.36	1.58	15.06	118
Gold	1.01	0.925	16.19	−13.21	5.17	0.141	3.38	118

Figure 1: Smoothed probabilities of regimes for the model of Nifty-Bond-Gold



et al. (2015) used the low and high deviation of stock return, above and below the threshold value, as a criterion to discriminate between the state of 'normal" time and the state of "extreme" time. However, the characterisation of regimes based on daily volatility and mean return is considered as a reliable and accurate process of identifying the bull and bear market (Cakmakli et al., 2011). Hence, in contrast to threshold level criteria adopted by Beckmann et al. (2015), this study has taken the estimated value of daily volatility and mean return for each regime as a criterion to define the regimes. The daily volatility and mean return are estimated by taking the standard deviation and mean of Nifty and bond returns for the set of observations that fall under respective regimes. The regime with the highest volatility and lowest mean return is defined as a period of "extreme" or "bear" time and the regime with the lowest volatility and highest mean return depicts the "normal" period.

This model is referred to as Markov-Switching-Intercept-Autoregressive-Heteroscedastic-VAR or MSIAH-VAR, follows the notation as given by Krolzig (1997).

The first regime of Nifty-Bond-Gold model is characterised as "extreme" or "bear" period with the highest average monthly volatility of 11.69% in Nifty and 3.73% in bond and the highest negative mean return of −1.01% in Nifty and −0.192% in bond. It persists during the days when volatility in returns of Nifty is more due to major shocks. The most volatile periods during the sub-prime crisis are from January 2008 to September 2009 which fall under the first regime and allow to judge safe haven role of gold futures. For instance, the highest monthly fluctuation in the prices of Nifty for the study period are −30.21% and 24.74% and for the bond are −7.93% and 13.93% which are included in the first regime. Conversely, the second regime shows "low" volatility period with the monthly average volatility of 5.42% in Nifty and 1.89% in bond with the positive mean return of 1.19% in Nifty and 0.839% in bond. The ergodic probability and transition matrix suggest the predominance of the second regime than the first regime. The first regime persists for 19.1% of the time and lasts for 3.16 months on an average. While the second regime exists for 80.9% of the time and continued for 13.34 months on an average.

The estimated results show a significant and positive correlation of gold with Nifty (−1) and Bond (−1) for the first regime as shown in Table 2. Based on the definition given by Baur and McDermott (2010), this result signifies that the gold futures cannot be used as a safe haven against the extreme movement of stock and bond market. Similarly, the negative and insignificant correlation of gold with Nifty (−1) and positive and insignificant correlation of gold with the bond (−1) in the second regime confirm the weak hedging potential of gold futures.

The findings with respect to the safe haven property of gold futures are consistent with the findings of Baur and McDermott (2010). Their implicit analysis of crisis periods by defining the volatility levels using a threshold of 90%, 95% and 99% quantile, nullify the safe haven role of gold in BRIC countries. In addition, their explicit analysis of crisis periods by specifying the outbreak and end of the specific crisis period, discard the safe haven property of gold in India during the stock market crash in October 1987 and during the Asian crisis in October 1997. However, their analysis of the global financial crisis of 2007 confirms the safe haven property of gold in India. In addition, Kumar and Lagesh (2011) studied the hedge and safe haven property of gold during the financial crisis of 2007 in the Indian context by explicitly specifying the crisis period. Their results suggest that gold is hedge and safe haven in extreme stock market movements. However, the arbitrary and discrete manner of crisis period specification is less statistical and more complex (Dungey et al., 2004) compared to implicitly defining the crisis periods.

5.2. Regime Classification Measure

Regime Classification Measure (RCM) is applied to ascertain the quality of regime classification. The RCM is computed using Equation (4) (Ang and Bekaert, 2002).

$$RCM = 100\,M^2 \frac{1}{T} \sum_{t=1}^{T} \prod_{i=1}^{M} P_{i,t} \quad (4)$$

Where $P_{i,t}$ shows ex-post smoothed probability of regime i at time t. M is the total number of regimes. RCM is a sample estimate of

Table 2: Nonlinear MSIAH (2) VAR (1) estimation for the model of Nifty-Bond-Gold

Parameters	Regime 1 (Extreme or Bear)			Regime 2 (Normal)		
Intercept	Δ Gold	Δ Nifty	Δ Bond	Δ Gold	Δ Nifty	Δ Bond
	−3.08 (−2.94)*	−1.41 (−0.728)	1.92 (4.59)*	−0.067 (−0.393)	0.255 (1.28)	−0.046 (−0.715)
Δ Gold(−1)	0.856 (12.86)*	−0.18 (−1.49)	0.106 (4.38)*	0.949 (39.45)*	0.021 (0.725)	−0.017 (−1.86)
Δ Nifty(−1)	0.141 (2.47)**	0.973 (9.25)*	−0.00 (−0.001)	−0.034 (−0.989)	0.871 (21.62)*	−0.081 (−6.01)*
Δ Bond(−1)	0.462 (2.54)**	0.469 (1.39)	0.589 (8.14)*	0.119 (1.76)	0.092 (1.18)	1.13 (42.99)*
Variance-covariance matrix						
Δ Gold	0.003 (3.2)*	0.0001 (0.1)	−0.0003 (−1.25)	0.002 (6.68)*	−0.0006 (−2.49)**	−0.00004 (−0.64)
Δ Nifty	0.0001 (0.1)	0.011 (3.2)*	−0.001 (−2.1)**	−0.0006 (−2.49)**	0.002 (6.77)*	0.0003 (3.03)**
Δ Bond	−0.0003 (−1.25)	−0.001 (−2.1)**	0.0004 (3.17)**	−0.00004 (−0.64)	0.0003 (3.03)**	0.0002 (6.4)*

	Transition matrix			Persistence of regimes	
	Regime 1	Regime 2	Observations	Ergodic probability	Duration
Regime 1	0.684	0.075	22	0.191	3.16
Regime 2	0.316	0.925	96	0.809	13.34

Values in the square bracket exhibit the "t" statistics and *shows the significance level at 1%, ** at 5% and at 10% level of significance

Table 3: Portfolio analysis

Portfolio	Nifty and bond	Benchmark strategy		Regime-based strategy	Gold futures
	50:50:00	37.5:37.5:25	33.3:33.3:33.3		00:00:100
Nifty-Bond-Gold					
Return (μ)	0.714	0.787	0.811	0.712	1.00
Risk (σ^2)	3.68	2.83	2.73	2.23	5.17
Sharpe ratio	0.194	0.278	0.297	0.319	0.195

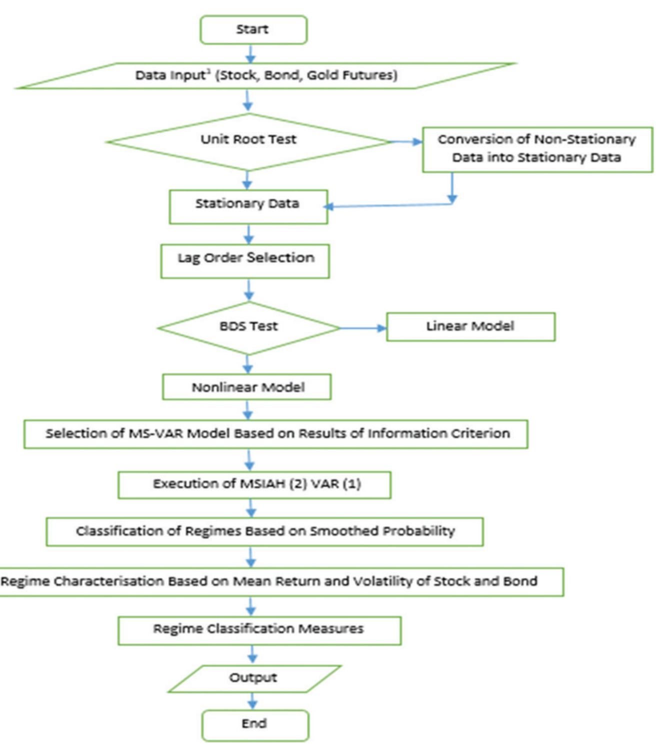
Nifty and bond represent 100% investment in Nifty and bond. Gold futures show 100% investment in gold futures. Benchmark shows two strategy; the first strategy is, to allocate 75% of portfolio in Nifty and bond and 25% of portfolio in gold futures. The second strategy is, to assign equal percentage of portfolio each in Nifty, bond and gold. The regime-based strategy shows allocation of gold futures, stock and bond in a portfolio based on hedge and safe haven property depicted by different regimes. Stock is mapped with Nifty index, bond is mapped with CCIL Liquid Total Return bond index and gold is mapped with gold futures

its variance as the regime variable is Bernoulli random variable. RCM takes the value between 0 and 100. For the Nifty-Bond-Gold model, RCM (0.957) is near to zero and shows perfect regime classification. Hence, RCM statistic suggests that MS-VAR model is properly specified and appropriate to investigate hedge and safe haven property of gold futures. Flowchart of MS-VAR execution is depicted in Figure 2.

5.3. Portfolio Analysis

As a final step, portfolio analysis is performed instead of out of sample analysis to check the performance of MS-VAR. The portfolio analysis confirms that the results of MS-VAR estimation for gold futures provide a significant direction to the asset managers and investors in the context of portfolio management. It indicates the importance of using regime-based strategy in contrast to benchmark strategy for portfolio construction. Taking into account, both benchmark and regime-based strategy, portfolio analysis is performed in two different ways. Firstly, naïve portfolio diversification as a benchmark strategy is used to show the linear strategy of portfolio construction (DeMiguel et al., 2009). As a benchmark strategy, the portfolio is constructed using two options. The first option allocates 25% of the portfolio in gold futures and 75% of the portfolio in Nifty and bond. Whereas, the second option allocates the fraction of 1/N of the portfolio to each of the N assets for constructing an equal-weighted portfolio. In addition, portfolio analysis is conducted for the scenarios where investors either invest 100% of the portfolio in Nifty and bond or in gold futures. Secondly, the regime-based strategy is used to construct the portfolio based on different regimes which represent hedge

Figure 2: Flowchart of Markov-Switching Vector Autoregression Execution



and safe haven role of gold futures. Based on MS-VAR results, the first regime accounts for no safe haven and the second regime for a weak hedge. The portfolio is constructed as per Beckmann et al. (2015) by allocating 20% of the portfolio in gold futures as a weak hedge and zero percent of the portfolio in gold during the first regime as gold futures does not act as a safe haven.

Table 3 shows results of Sharpe ratio which assess the risk-adjusted performance of all the strategies. The findings of Sharpe ratio indicate that regime-based strategy of portfolio construction performs better in contrast to benchmark strategies for gold futures.

6. CONCLUSION

This study revisits to explore the practical implication of conventional perception related to gold futures as a hedge and safe haven in real market situations. The results confirm weak hedging potential of gold futures against stock and bond market movements. Conversely, gold futures cannot be used as a safe haven against the extreme market movements. Hence, it is inferred that gold futures can be used as an alternative asset in a portfolio of stock and bond to get the benefit of diversification. However, the results do not suggest the use of gold futures as a safe haven asset during the financial and economic upheaval which is against the expectation of market participants. The possible explanation for these results could be, firstly, this study adopts the implicit method of defining the crisis periods which is more robust compared to the explicit specification of crisis period. Secondly, data is used for monthly frequency instead of daily or weekly frequency. Lastly, emerging economies such as, in India during the crisis period, investors liquidate their position in the stock market instead of running towards the safe haven assets (Baur and McDermott, 2010). In India, gold demand is due to the traditional and cultural affection of people rather than as a safe haven asset.

Notably, classification of regimes confirms that data fits well with regime-switching approach since all the regimes can be clearly distinguished with their unique characteristics. Regimes are characterised based on daily volatility and mean return estimated for the respective regimes. The findings of MS-VAR are also justified using portfolio analysis. It confirms that outcomes of MS-VAR provide a significant guidance to investors in the construction of diversified portfolio with enhanced risk-adjusted return performance. Hence, the results suggest that period of "normal" time with low volatility and stable mean return in stock and bond market is the best regime for investment in gold futures for getting the better risk-adjusted return from the portfolio.

It is always the prime concern of Indian policy makers to change the heavy consumption pattern of Indians in gold. The findings of this study confirm weak hedging potential of gold futures which will increase awareness among investors and probably help in changing the consumption pattern of Indians. The government should frame a policy to increase the investment demand for these precious metals in contrast to unproductive demand. Digging further into the inclusion of gold futures, denominated in local currency of other top gold consuming countries, in this framework and to measure the hedge and safe haven property of gold futures in these countries can be taken up as future work.

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