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Is gold a Sometime Safe Haven or an Always Hedge for Equity Investors? A Markov-Switching CAPM Approach for US and UK Stock Indices

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Abstract:

This paper re-examines gold's role as a tool for investors to manage their portfolio risk. We begin by assessing gold's average relationship to an investor's diversified equity portfolio by applying the basic Capital Asset Pricing Model (CAPM) to UK and US equity indices. Next, we apply a Markov-Switching CAPM to assess whether two distinct states exist between gold's relationship with the Market Portfolio. This approach allows the data to determine if two separate states exist and, if so, whether one state matches the definition of a Safe Haven from the literature. Using this new approach, we find that gold is consistently a Hedge, but that no distinct Safe Haven state exists between gold and UK or US stock markets.

Keywords: Gold, Hedge, Safe Haven, CAPM, Beta, Markov-switching model, stock markets, UK, US, FTSE100, S&P500.

Introduction

Gold has had a long and unique history as a financial asset over the last 6,000 years. Recently there has been a growing body of research assessing whether gold acts as a Safe Haven for investors in times of severe market stress. Since the 2008 financial crisis, gold has gained a renewed prominence for investors and researchers as its price rose from $252 in July 1999 to $1,900 dollars an ounce briefly on the 5th of September 2011 and many Exchange Traded Funds (ETFs) were set up to make it easier for smaller investors to buy gold.

Since gold prices have floated freely after 1968, gold's allure for speculators has waxed and waned in tandem with its price changes. Simultaneously gold has maintained a core group of investors often referred to as "gold bugs" who see it as the ultimate safe asset (Simon, 2013), one of the few assets with no counterparty risk once physically you hold it. The majority of recent research finds that gold does have a role as a hedge and/or a Safe Haven for investors (see O'Connor et al. (2015) for a review).

The first contribution of this paper is to offer an estimate of the Hedge characteristic in gold in a CAPM setting and assess whether gold's beta is zero, as is often assumed (Blose, 2010; Baur, McDermott, 2010; Reboredo, 2013). This assumption is based on gold's unusual economically inert nature. Unlike other assets it does not have any fundamental driver of its own., For example, dividends act as a driver for equity prices, because they should drive these prices lower or higher. However, macroeconomic drivers do affect its price, such as inflation (O'Connor et al. (2015)), but if you buy an ounce of gold it will remain an ounce of gold. It cannot default or go bankrupt as it has no offsetting liability.

Secondly, though there has been a large amount of recent research on whether gold acts as a Safe Haven for a number of asset classes, all these studies choose an arbitrary quantitative cut-off point to define when a Safe Haven period should be present. Generally it is defined as when an asset's returns being in the bottom 5% or 1% quartile of the sample. Authors then test the relationship between gold and the asset in that quantile; see for example Baur and Lucey (2010). The usual definition of Safe Haven comes from Baur and McDermott (2010:1889) which states that a "strong (weak) Safe Haven is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio in *certain periods only*, e.g. in times of falling stock markets" (our emphasis). Note that these periods can only be observed *ex post* as they depend on returns over the entire sample period. That severely reduces the use of such studies to guide investors' decisions.

Using a Markov-switching model, rather than an arbitrary cut off point, we allow the data itself to determine whether two natural and separate "regimes" exist between gold and other asset prices. If two states do exist in the Markov-switching approach, then the next step is to see whether there is any relationship between one of the states and periods of extreme stock market movements. We found that gold is always a Hedge, but that neither state corresponds to what might be thought of as a separate safe haven characteristic. We conclude that gold is always a Hedge for stock market risk. Neither state estimated by the model maps clearly onto times of large equity market price falls. This finding that there is no change in the relationship during is in keeping with a re-reading of the results in the literature on this topic, which is discussed in the following sections.

In Section 2 we review the previous research on gold, its Beta and its Safe Haven status. Section 3 presents the data used and the applied methodologies. Section 4 presents the empirical results and Section 5 presents our conclusions.

2. Literature Review

2.1 Gold's Beta under the CAPM

Despite the popularity of the Capital Asset Pricing Model (CAPM) it has been applied to gold in very few papers. Chua et al. (1990) discuss the application of CAPM using monthly gold prices, Toronto Stock Exchange (TSE) gold stock index, S&P gold index and S&P 500 index from September 1971 to December 1988 but the variables in the model are returns rather than excess returns as should be used per the CAPM (Sharpe, 1964, Lintner, 1965). Although the results suggest that gold's Beta, using the S&P 500 as a proxy for the market portfolio, is insignificantly different from zero in two sub-periods examined, the difference between two estimated Betas (0.03 and 0.22) is relatively large. These results may be due to a lack of power in the tests related to the small number of monthly observations.

Similarly, Dee et al. (2013) have applied a variant of the original CAPM by the application of arbitrage pricing theory (APT) (Ross, 1976) as they an inflation factor to the original CAPM. There has not been an application of the actual CAPM to gold to date in the literature.

2.2 Gold as a Hedge and a Safe Haven

Gold has been shown to be a hedge against a large number of primarily financial risks and offers significant diversification benefits within a portfolio. Baur & Lucey (2010: 220) define a hedge as "an asset that is uncorrelated or negatively correlated with another asset or portfolio on average." Lucey, Tully, and Poti (2006) point to gold's returns being positively skewed, in contrast to almost all other financial assets, as a major driver of its ability to reduce portfolio risk. Emmrich and McGroarty (2013) find that adding gold to a range of portfolios reduces their risk level.

Gold also hedges macroeconomic risks, such as inflation risk over the longer term (see Batten et al. (2014) for example). Some authors have also found it to be a hedge against exchange rate risk, such as Reboredo and Rivera-Castro (2014), but our focus here will be on gold's ability to hedge asset price risks.

Baur and Lucey (2010) and Baur and McDermott (2010) both define a Safe Haven in their analysis of whether gold serves as a hedge or a Safe Haven to stocks and bonds. These two papers have formed the basis of the research that has followed on the issue.

Using a GARCH model, Baur and Lucey (2010) assess whether the relationship between gold returns and other asset returns is different in the lowest quantiles of returns (1%, 2.5% and 5%). They find, for example, that the average relationship between gold and US equites is -0.0475 i.e. an almost zero correlation between gold and US equities, which is indicative of a hedge based on their definition above. In the three countries examined for stocks and bonds their average relationship with gold is between -0.18 and +0.1. These all indicate that gold offers significant diversification benefits when added to a portfolio due to the low or negative correlation with a diversified portfolio. In looking at the safe haven aspect they find that the relationship between gold and stock returns for the US in the extreme end of the distribution (the 1% quartile) is -0.0183 which does fit the definition of a safe haven above. But this a less negative relationship than the average described above (-0.0475). For the UK the figure for the 1% quartile is a lot lower at -0.29 (versus 0.18 on average) and the German estimate in the 1% quartile is -0.0727 versus 0.04 on average.

Looking at the definition of a Safe Haven above this means that while for the US your portfolio does benefit from gold in times of severe market falls, it does not act differently at these times. It remains a hedge rather than becoming a Safe Haven. For the UK it has a negative relationship in crisis periods, but also on average. So again, gold seems to remain an excellent hedge at all times rather than there being a significant shift in the relationship, at times of large share price falls, into a Safe Haven.

Baur and McDermott (2010), using daily, weekly and monthly data, also determine that gold is a Safe Haven. Similarly to Baur and Lucey (2010), no average relationship with the market examined in greater than 0.1, implying gold is a Hedge for all these markets. While most of these estimates are statistically significantly different from zero at a daily level, when the analysis is run at a monthly level far fewer are, suggesting that the statistical significance is due to the large sample size employed. As the estimates still give gold a strong diversifier role, perhaps the definition that to be a Hedge it must have zero correlation with the market portfolios is too strong.

Baur and McDermott (2010) also assess golds relationship in specific market crashes. For the October 1987 crash four of nine markets examined have a higher correlation with the market at this timwe than the average relationship. Of the remaining five only one has a statistically significant lower correlation (the US). Many do have a significantly lower correlation around the bankruptcy of Lehman brothers in 2008, but for the Asian crisis in 1997 no country has a statistically significant change in relationship between gold and markets. This again seems to imply that golds ability to diversify risk is something of a constant even during extreme stock market moves, rather than an increased or new ability.

Other studies also find a Safe Haven role for gold. Ciner, Gurdgiev, Lucey (2013) use a dynamic conditional correlations (DCC) GARCH model for the S&P500 and FTSE100 and confirm golds role as a Safe Haven by breaking the equity returns in to quantiles. Bredin, Conlon and Poti (2015) use wavelet multiscale analysis and find that gold offers a longer Safe Haven facility over a longer period than other studies at one year. Bechmann, Berger and Czudaj (2015) also find a Safe Haven role for gold.

Lucey and Li (2015) examined gold's role as a Safe Haven in a time-varying manner with the extension of three other precious metals: silver, platinum and palladium. Their results suggest that gold may not act as a Safe Haven at all times but that when it is not other precious metal can fill in for the role in an investor's portfolio.

All of the above research then agrees that in times of extreme stock market movement gold's low or even negative correlation with broader asset markets makes it valuable for investors. A re-reading of the results however implies that the safe have characteristic of gold is simply that it always remains a hedge.

3. Data and Methodology

3.1 Data

All the data used was collected at a daily frequency, which we convert to weekly or monthly frequencies when required. Sources are listed in Table 1. We use the US Dollar and Pound Sterling PM gold prices from the London market, known as the Gold Fixing until March 2015 as London has been found to be the dominate market for price formation in the global gold market (see Lucey, Larkin and O'Connor (2014)).

[Insert Table 1 about here]

3.1.1 Market proxy for UK and US market

As explained in Laura and Fahad (2017), the FTSE All Share index is a mix of the FTSE 100, FTSE 250 and FTSE Small Cap indices, which means that FTSE All Share contains a wide basket of equities. The FTSE All Share index represents about 99% of the UK's market capitalization. Thus, it is reasonable to apply the FTSE All Share as a proxy variable for the UK market portfolio in the analysis. We also use the S&P 500 and Dow Jones indices as the commonly used proxies for the US market portfolio.

3.1.2 Descriptive Statistics

Table 2 shows descriptive statistics for all the variables used.

[Insert Table 2 about here]

The Jarque-Bera test is used to examine whether the series is normally distributed or not. The null-hypothesis of this test is that the series follows a normal distribution. From Table 2 it can be deduced that there is evidence that none of the series are normally distributed.

Figures 1 (a) and (b) graph of gold's daily excess returns in Pounds Sterling and US Dollars from April 1985 to August 2017. The excess return on gold in US market has more extreme values than that in UK market. Figures 2 (a), (b) and (c) are the excess return on the FTSE 100, FTSE 350 and FTSE All share at a daily frequency. Figure 3 (a) and (b) show the excess return on the S&P 500 and Dow Jones respectively.

[Insert Figures 1, 2 and 3 about here]

3.2 Methodology

3.2.1 Capital Asset Pricing Model

The Capital Asset Pricing Model is applied in the analysis and accordingly we assume that the investors are risk averse and the market is complete (Blitz et al., 2014). In the following analysis, the returns on gold and the market portfolios with respect to indices are calculated as the following equations (Laura and Fahad, 2017):

$$R_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right), \tag{1}$$

where $R_{i,t}$ is the log-return on asset i in period t and $P_{i,t}$ is the price of asset i in period t.

Gibbons (1982) gives the following equation for the CAPM:

$$(R_{g,t} - R_{f,t}) = \alpha + \beta(R_{M,t} - R_{f,t}) + \varepsilon_t, \tag{2}$$

where $t = 1, 2, \dots, T$ denotes the time horizon. $R_{g,t}$ is the log-return on gold at time t, $P_{g,t}$ is the price of gold in time t, $R_{M,t}$ is the return on the market portfolio in period t, $P_{m,t}$ is price of the market portfolio in period t. $R_{f,t}$ the risk-free rate in period t, α the intercept term and ε_t

the error term. Note that ε_t is assumed to be an independent and identically distributed random variable that follows the normal distribution, $\varepsilon_t \sim N(0, \sigma^2)$.

Following the assumptions of the Sharpe-Lintner CAPM (Sharpe, 1964, Lintner, 1965), by taking expectations on both sides of equation (2), the following equation (3) must hold,

$$E(r_g) = \beta E(r_m) \tag{3}$$

where the excess log-return on asset gold is denoted by $r_g = R_g - R_f$, the excess log-return on market portfolio is denoted by $r_m = R_M - R_f$.

It implies that the intercept term α in equation (2) must be zero in order to be consistent with Sharpe-Lintner CAPM.

3.2.2 Markov-switching CAPM model

Markov-switching models estimate regime shifting endogenously. The Markov-switching model was introduced in Hamilton (1989) for the analysis of the non-stationary time series analysis of the business cycle.

We here apply a Markov-switching model to test whether there are regime shifts in gold's Beta within a CAPM framework. The only application of Markov-switching model in the research of the gold to our knowledge is Lucey and O'Connor (2013) who look at whether bubbles occur in gold prices. Here, the model is applied to see whether a data driven model finds a two distinct states exist between gold returns and returns on diversified equity portfolios.

Following Hamilton (1989) and Huang (2001), we denote by s_t the state variable that reflects the regimes in the market. Here, we assume that there are two different regimes in the model. The Markov-switching CAPM equation then takes the form of equation (12) below:

$$(R_{g,t} - R_{f,t}) = \alpha_{s_t} + \beta_{s_t}(R_{M,t} - R_{f,t}) + \varepsilon_{s_t}, \tag{12}$$

where $s_t = 1,2$ represent the two states of the model, the error term ε_{s_t} is assumed to be $iid\ N(0, {\sigma_{s_t}}^2)$. Here, s_1 represents one regime with the parameters $\alpha_{s_1}, \beta_{s_1}, {\sigma_{s_1}}^2$, while s_2 is another regime with corresponding parameters $\alpha_{s_2}, \beta_{s_2}, {\sigma_{s_2}}^2$. The reasons for allowing regime-switching in the variances of the error term will be explained in the next section.

Following the Markov-switching model in Hamilton (1989), the state variable s_t in this case will only take the binary values of 0 or 1. Thus, the transition probabilities in the first-order Markov process are modelled as the following (see Lucey and O'Connor (2013)),

$$Prob[s_t = 1 | s_{t-1} = 1\ ] = p \tag{14}$$

$$Prob[s_t = 2 | s_{t-1} = 1] = 1 - p \tag{15}$$

$$Prob[s_t = 2 | s_{t-1} = 2\ ] = q \tag{16}$$

$$Prob[s_t = 1 | s_{t-1} = 2] = 1 - q \tag{17}$$

Note that the probabilities *p* and q are determined endogenously.

4. Empirical Results

We have undertaken unit root tests on excess returns of gold in both currencies as well as for excess returns on all proxies for the market portfolio listed above. The null hypothesis of the augmented Dickey-Fuller (ADF) states the existence of a unit root. For all the time series examined this null is rejected at the 1% level. As a result, we will treat all variables as stationary series. Results are available on request from the authors.

4.1 Results of CAPM Estimation

The results in this section are estimated based on equation (2) applying an OLS regression model. The null hypothesis is that gold's Beta is zero, against a two-sided alternative.

[Insert table 3 about here]

According to Table 3 the assumption of no intercept in the CAPM holds as all estimates are found to be statistically insignificantly different from zero. Estimates of gold's Beta are surprisingly consistent across markets and Market Portfolio proxies at around -0.03 in all five cases. The Betas are also all found to be statistically significantly different from zero, but the estimates are close to zero and the statistical significance can be attributed to the large sample size employed. An estimated Beta of -0.03 means a 10% fall in an equity index is associated on average with a 0.3% increases in the price of gold, which economically is zero close to zero making gold a very good Hedge for stock market risk with significant diversification benefits for an investor's portfolio.

In addition, the R^2s for all regressions are extremely small. While in most research this would be a negative, here this is further evidence that gold is a good Hedge for stock market risk. The low R-Squares imply that stock market returns do not have any explanatory power for gold returns, making the gold price independent of the stock market indices looked at over the periods examined. Results using weekly and monthly data for golds Beta and the R^2 for all five markets result in the same interpretation as above and are available on request.

4.2 Results of Markov-switching Model

Next, we estimate the Markov-switching CAPM for both weekly and daily data, in that order. Table 4 shows the results of the weekly data. Two distinct regimes are identified for all five proxies of the market portfolio.

[Insert table 4 about here]

In UK market, the assumptions of CAPM do not all hold, because the intercept is significantly different from zero in regime 2 for the FTSE 100 and the FTSE 350. Although this assumption of CAPM holds in FTSE All Share, gold's Betas are all statistically insignificant for UK data. This suggests that gold's Beta in both regimes is zero. If we do not specify a threshold in advance to define what a Safe Haven might be, that data determines that there is none; instead, in both regimes, gold acts as a Hedge or diversifier for stock market risk.

The two regimes are, instead, differentiated by different levels of volatility, with regime two being two- to three-times more volatile than regime 1 for UK data. The switching probabilities are also quite high, with the probability of moving from regime 1 to 2 (*1-q*) based on FTSE 100 data being 7.96%, while a switch from regime 2 to 1 (*1-p*) has a 3.72% probability from week to week. Figure 4 shows the weekly excess returns on the FTSE 100. For a Safe Haven to exist we would expect that that large negative stock market excess returns would map well onto one of the regimes. The shaded area of Figure 4 represents times when the model has determined regime 1 is applicable. As can be seen, most of the large falls in the stock market occur in regime 1, which also includes the periods of quiet stock markets. Neither regime corresponds to a Safe Haven role for gold.

[Insert Figure 4 about here]

Results for the US in Table 4 are different from those we obtained for the UK, as has been the case in previous studies. Gold's Beta using both Dow Jones and S&P 500 data as proxies for the market portfolio show statistical significance in both regimes 1 and 2. In regime 1, gold has a negative Beta of about -0.08 and a positive Beta of between 0.16 and 0.20 in regime two. Both provide low Betas, which indicates that gold is a diversifier in both regimes and a strong Hedge for regime one.

[Insert Figure 5 about here]

Figure 5 shows the weekly excess return on the Dow Jones as well as the applicable regime. The shaded area of Figure 5 represents times when the model has determined that the negative beta regime is present, i.e., regime 1. This, then, is the more common regime for these markets to be in and would not correspond to a Safe Haven, which would be expected only to dominate at times of severe market stress. Looking at the graph, large market falls occur in both regimes with the 1987 crash occurring in regime 2 but the 2008 financial crisis falling into regime 1. This indicates that gold did play a distinct Safe Haven role between 1970 and 2017 in the US. The same observation can be made in Figure 6, where the S&P500 is used as the market portfolio proxy.

[Insert figure 6 about here]

Table 5 shows the results of the Markov-switching CAPM estimations using daily data. Using daily data may be a better way of determining whether gold acts as a Safe Haven, as some of the previous research indicates that gold only fulfils this role for about 15 days at a time (Baur and Lucey (2010)).

[Insert table 5 about here]

In regime one, gold's Beta relative to the FTSE100 index does show a much larger and significant negative Beta, at -0.22, than for the other two UK market proxies. The magnitude of gold's Beta declines as the index is broadened and, though the estimated Beta for the FTSE All Share is statistically significant at -0.0232, from an investor standpoint it is effectively zero. Regime one in both cases is also very unstable with a transition probability of moving from regime 1 to 2 ($1-q$) over 20% for both. The Betas estimated in regime two are close to zero with only one being statistically significant. Both regimes indicate that gold would act as a strong diversifier.

When we look at Figure 7, we can again see that neither regime maps onto the data well as a Safe Haven. Regime 2 (the non-shaded region of Figure 7) covers most of the period including the 2008 financial crisis and the 1987 crash indicating that gold's role does not switch for the UK at a daily level into a Safe Haven in times of severe market movements.

[Insert figure 7 about here]

For the US Market proxies, the results remain similar to when estimated with weekly data. Regime 2 has significant but very small negative Betas, but regime 1 now has Betas that are insignificantly different from zero, even with the large number of observations used. Looking at Figure 8, these regimes again do not bear any relationship to extreme movements in the stock market. Regime 1 (the non-shaded area) covers the global financial crisis in 2008 while regime 2 covers the 1987 crash. Again, these regimes do not map in a way that indicates that gold offers special characteristics that we might think of in terms of the definition of a Safe Haven.

[Insert Figure 8 about here]

5. Conclusion

This paper re-examines the idea that gold has a special relationship with other assets in times of severe market down moves, its Safe Haven characteristic. We achieve this by applying a Markov-switching model to allow the data to determine if such a relationship is present. Previous studies chose to set cut-off points to define when a Safe Haven could be present, which introduces a preconceived notion about what a Safe Haven should be.

We find that while gold does act as a very good diversifier in both regimes estimated by the model and for all proxies of the market portfolio in the US and the UK, neither one maps well onto periods of time where a Safe Haven would be beneficial to investors such as the 1987 crash or the 2008 financial crisis. Instead, we think that a review of the results from earlier papers on this issue, coupled with our findings, points to the fact that gold is *always a Hedge* or, at worst, always an excellent diversifier of portfolio risk. Gold's usefulness in managing risk does not disappear in a crisis when the prices of the vast majority of assets tend to be perfectly correlated.

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Table 1. Data Sources

Data	Date Range	Source
PM Gold Fixing price, £	01/04/1968 to 29/09/2017	DataStream
PM Gold Fixing price, $	01/04/1968 to 29/09/2017	DataStream
UK Treasury bill 3-month	04/01/1985 to 29/09/2017	Bank of England
US 3-month Treasury bill rate	01/01/1969 to 29/09/2017	FRED
FTSE 100	01/01/1985 to 29/09/2017	DataStream
FTSE 350	01/01/1985 to 29/09/2017	DataStream
FTSE All share	01/01/1985 to 29/09/2017	DataStream
S&P 500	01/01/1969 to 29/09/2017	DataStream
Dow Jones	01/01/1969 to 29/09/2017	MeasuringWorth.com

Table 2 Descriptive Statistics

	Gold price(UK) - £	Gold price(US) - $	FTSE All share(Index)	S&P 500	Dow Jones -$	3-month T-bill rate (UK) %	3-month T-bill rate (US) %
Mean	312.13	507.27	1605.27	710.	6145	0.5440	0.3875
Variance	277	417	1230	633	5588	0.3318	0.2675
Skewness	1.457	1.365	0.2526	0.7597	0.7386	0.0235	0.3926
Kurtosis	4.0465	3.9200	1.6249	2.4926	2.3948	2.1797	3.0112
Jarque-Bera	198***	62***	63***	15***	201***	52***	15***

Table 3: CAPM for Gold, UK and US market - daily data

	UK-FTSE 100	UK-FTSE 350	UK-FTSE All Share	US-S&P 500	US-Dow Jones
Intercept (α)	-0.0006 [0.9602]	0.0028 [0.8136]	-0.0005 [0.9653]	0.0095 [0.4102]	0.0106 [0.3619]
Beta (β)	-0.0302*** [0.0037]	-0.0375*** [0.0007]	-0.0357*** [0.0013]	-0.0288*** [0.0087]	-0.0371*** [0.0009]
R-squared	0.0011	0.0015	0.0009	0.000594	0.0010
Durbin-Watson	2.0273	2.0277	2.3793	2.0758	2.0738
Note: **, *** represent the statistical significance at 5% and 1% & level.					

Table 4: Markov-Switching CAPM for Gold – Weekly data

	UK-FTSE 100	UK- FTSE 350	UK-FTSE All share	US-Dow Jones	US-S&P 500
Regime 1					
Intercept (α)	-0.0649 [0.2508]	-0.0567 [0.3223]	-0.0442 [0.4830]	0.0584 [0.1883]	0.0550 [0.2166]
Beta (β)	0.0429 [0.1454]	0.0456 [0.1462]	0.0197 [0.5798]	-0.0832*** [0.0000]	-0.0808*** [0.0001]
log(σ)	0.4487*** [0.0000]	0.4468*** [0.0000]	0.4592*** [0.0000]	0.4617*** [0.00000]	0.4563*** [0.0000]
Regime 2					

Intercept (α)	0.311138* [0.0357]	0.319169* [0.0345]	0.170272 [0.2792]	0.308839 [0.0612]	0.3023 [0.0591]
Beta (β)	-0.0101 [0.8535]	-0.0161 [0.7803]	0.0430 [0.4916]	0.1622** [0.0156]	0.2042*** [0.0013]
log(σ)	1.1528*** [0.0000]	1.1579*** [0.00000]	1.0892*** [0.0000]	1.4154*** [0.0000]	1.3999*** [0.0000]
P_{12}	0.0796	0.0760	0.2514	0.0118	0.0117
P_{21}	0.0372	0.0353	0.0980	0.0387	0.0380
Note: **, *** represent the statistical significance at 5% and 1% & level. P-values are shown in parentheses.					

Table 5: Markov-Switching CAPM for Gold – Daily data

	FTSE 100	**FTSE 350**	**FTSE All Share**	**Dow Jones**	**S&P 500**
Regime 1					
C	0.0021 [0.9911]	0.0214 [0.6765]	-0.0064 [0.9717]	0.0153 [0.0772]	0.0144 [0.0923]
β	-0.2207** [0.0167]	-0.1272*** [0.0002]	-0.0232*** [0.0160]	-0.0466*** [0.0000]	-0.0388*** [0.0004]
log(σ)	1.3495*** [0.0000]	0.5820*** [0.0000]	1.3497*** [0.0000]	-0.3907*** [0.0000]	-0.3905*** [0.0000]
Regime 2					
C	-0.0037 [0.7079]	-0.0061 [0.5547]	-0.0038 [0.7048]	-0.0160 [0.6710]	-0.01937 [0.6053]
β	0.0207** [0.0486]	0.0268*** [0.0002]	0.0208 [0.0641]	-0.0050 [0.8673]	0.0064 [0.8281]
log(σ)	-0.1941*** [0.0000]	-0.2973*** [0.0000]	-0.1941*** [0.0000]	0.6954*** [0.0000]	0.7062*** [0.0000]
P12	0.2061	0.0710	0.2062	0.0186	0.0194
P21	0.0136	0.0168	0.0136	0.0449	0.0475
Note: **, *** represent the statistical significance at 5% and 1% & level. P-values are shown in parentheses.					

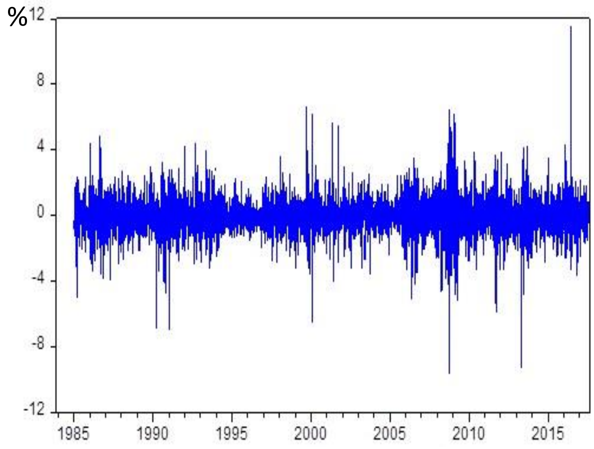

Figure 1 (a) **Excess return on gold in UK market (daily)**

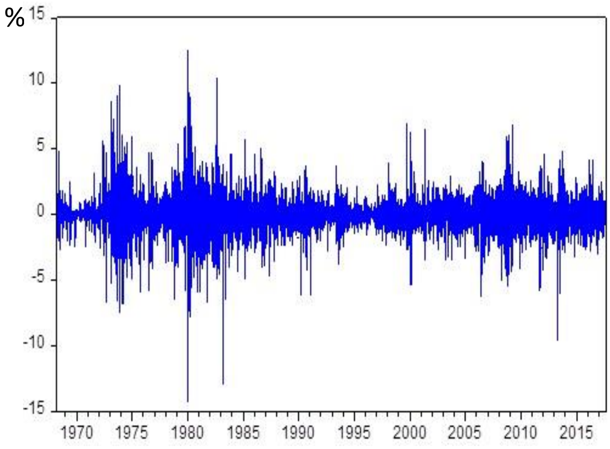

Figure 1 (b) **Excess return on gold in US market (daily)**

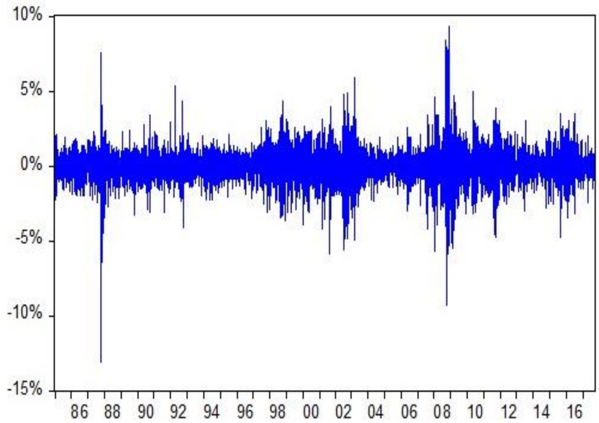

Figure 2 (a) **Excess return on market portfolio (FTSE 100 daily)**

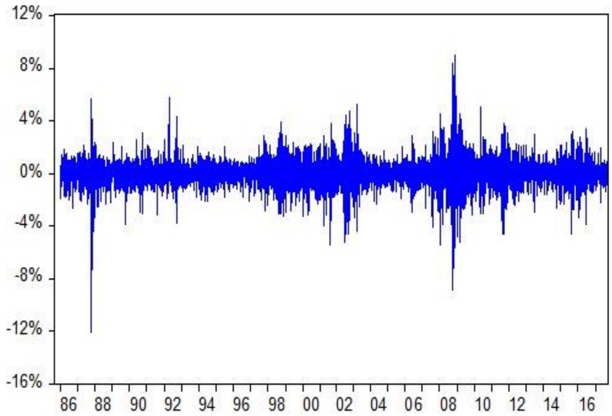

Figure 2 (b) **Excess return on market portfolio (FTSE 350 daily)**

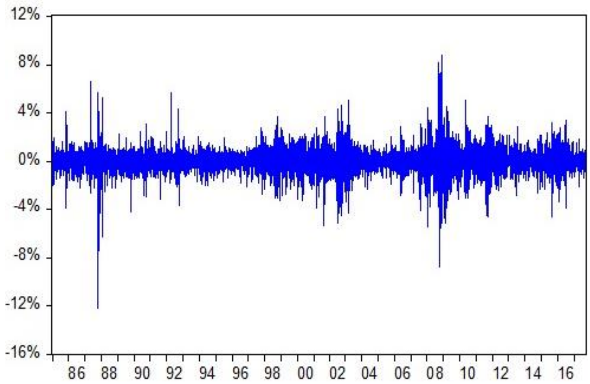

Figure 2 (c) **Excess return on market portfolio (FTSE All share daily)**

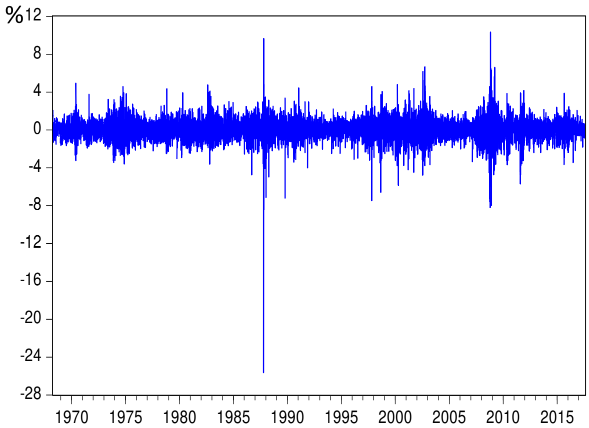

Figure 3 (a) **Excess return on market portfolio (S&P 500 Daily)**

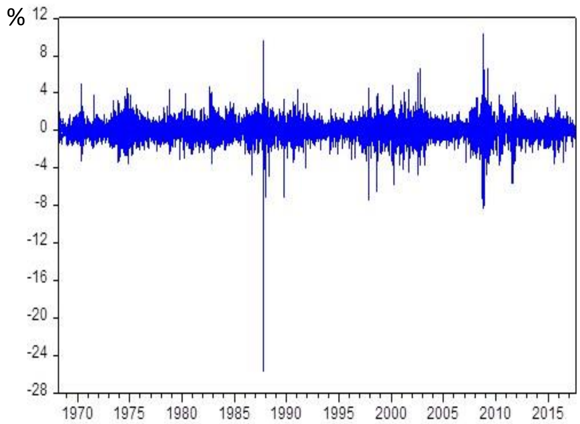

Figure 3 (b) **Excess return on market portfolio (Dow Jones daily)**

Figure 4: Excess Return on Market Portfolio (FTSE 100) and Regime - Weekly

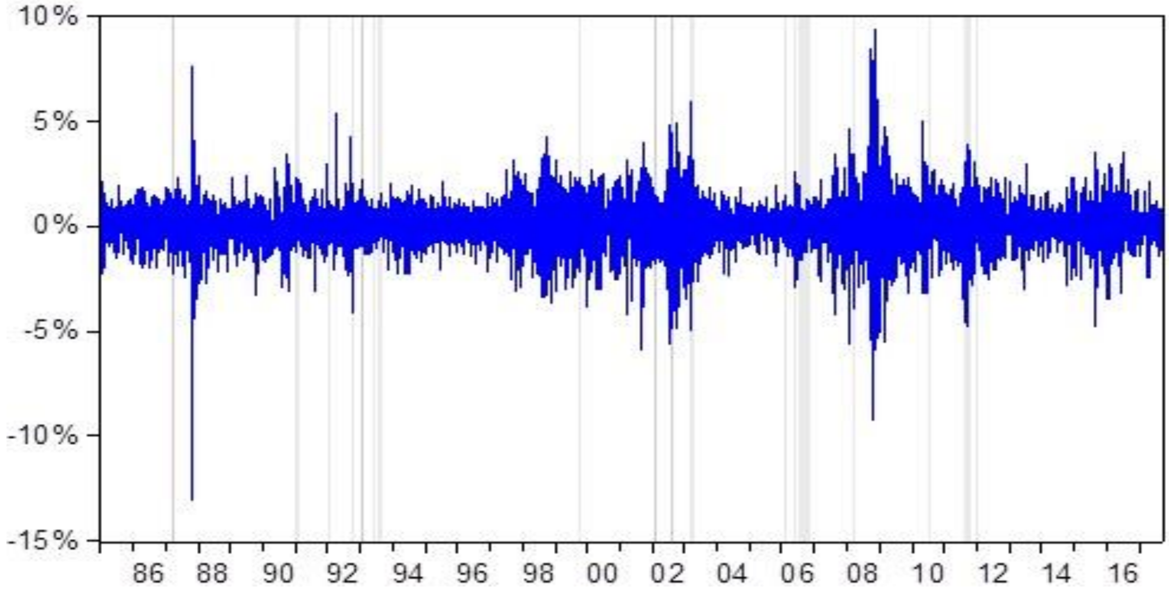

Figure 5: Excess Return on Market Portfolio (Dow Jones) and Regime - Weekly

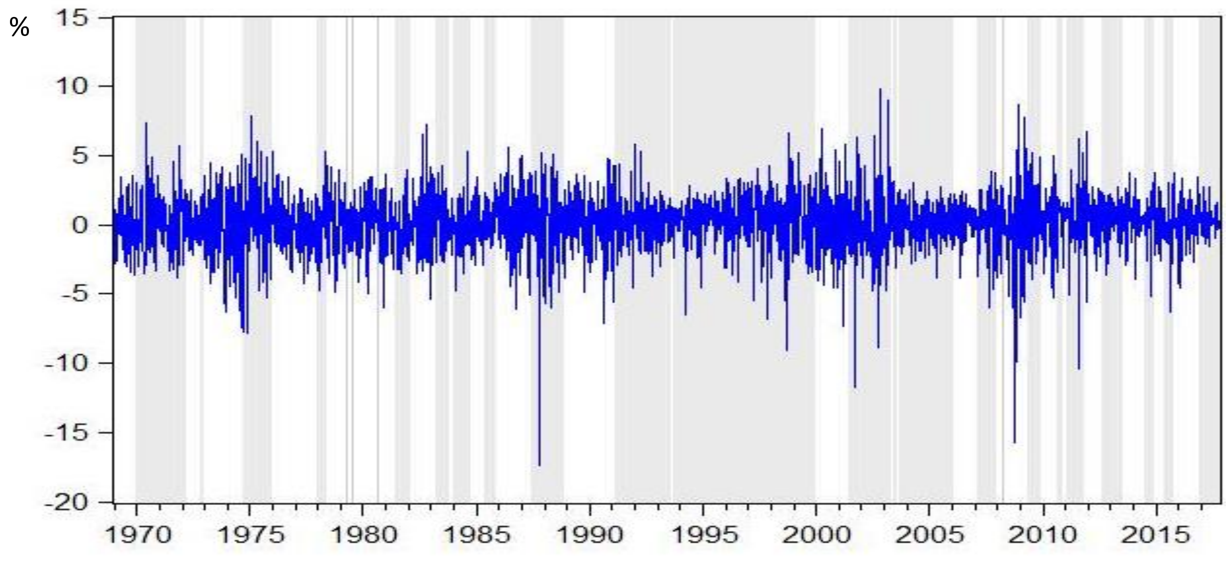

Figure 6: Excess Return on Market Portfolio (S&P500) and Regime - Weekly

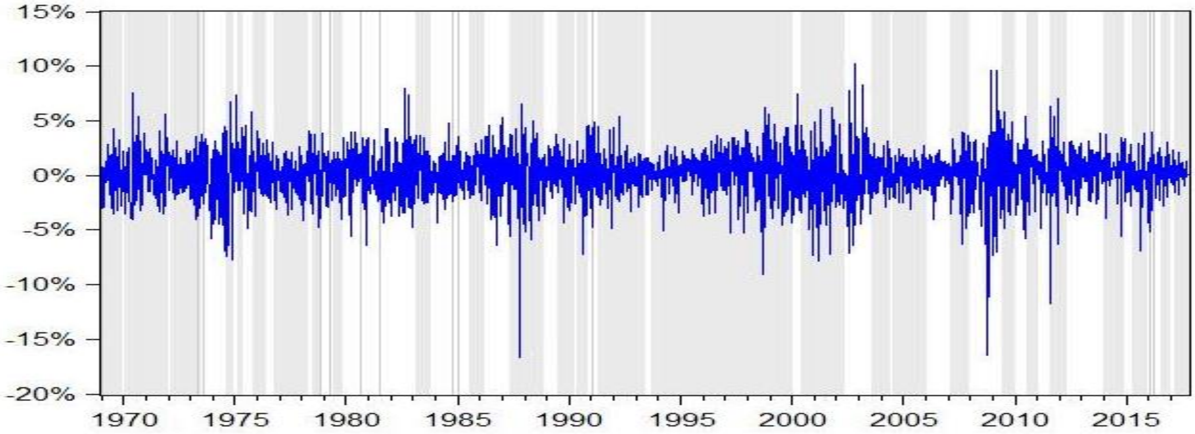

Figure 7: Excess Return on Market Portfolio (FTSE 100) and Regime - Daily

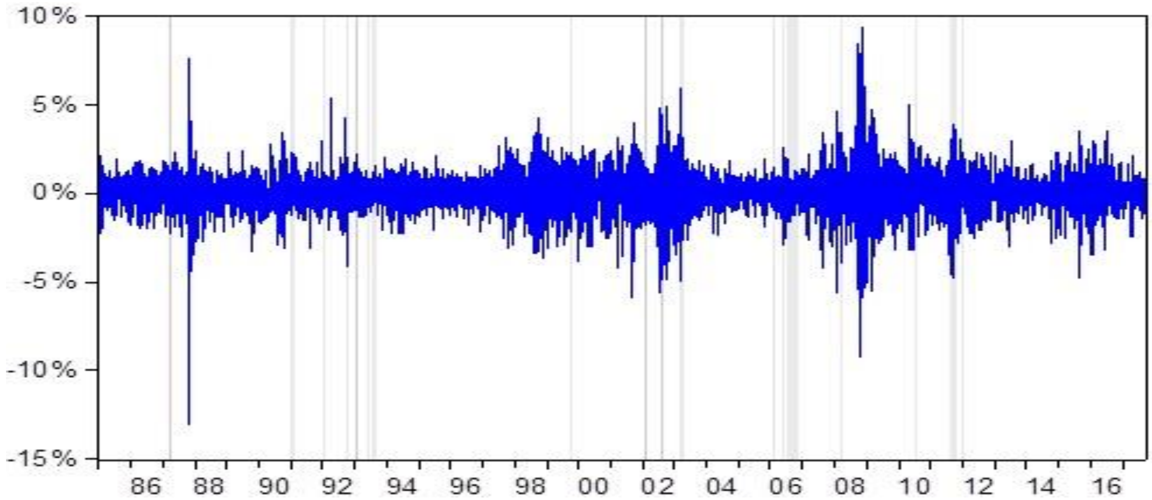

Figure 8: Excess Return on Market Portfolio (S&P 500) and Regime - Daily