GDE ASE Project 2020

**Gold returns in volatile markets**

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Gold is widely used as a hedge against volatility in investment portfolios and a financial safe haven in times of market turmoil. These beliefs suggest that gold is negatively correlated or uncorrelated with market performance. This projects uses daily data to construct a linear time series regression model to study the relationship between gold and US market returns over the long- and short-run, using the recent COVID-19 pandemic and the 2008 financial crisis to evaluate how gold prices have behaved during recent episodes of financial market instability and whether these relationships coincide with its popular denomination as a safe haven and its use as a diversification instrument.

**Word count:** 2000-3000

**Program(s):** EViews

**1. Introduction**

Gold is widely believed to be negatively correlated with the performance of the stock market. This belief has fuelled its status as a hedge against volatility and a financial safe haven in times of market turmoil.

Baur and Lucey (2010) define a safe haven “as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil” and a hedge as “a diversifier is defined as an asset that is positively (but not perfectly correlated) with another asset or portfolio on average”. Combined with economic theory, which suggests prices rise as demand increases, we would expect gold to be negatively correlated with market performance.

The COVID-19 crisis has led to the most recent period of financial instability since the 2008 financial crisis. The pandemic – declared by the World Health Organisation on March 11, 2020 – has been a decisive factor in ending one of the longest US bull markets, which had seen stock markets like the Standard and Poor (S&P) 500 rally since 2009. A week after alreadu Shortly after , unlike on previous occasions, sharp runs of negative returns in the S&P 500 have been complemented by similarly sharp falls in the price of gold in the short-run.

This project will use daily data on gold and S&P 500 returns to construct a linear time series regression model to evaluate the relationship between gold and the US market during two recent episodes of instability in financial markets: the COVID-19 pandemic in 2020 and the subprime mortgage crisis in 2008. My aim is to determine whether the attribute of gold as a safe haven holds in the long-run or in the short-run.

Section 2 details the data and the four subsamples used in my analysis. Section 3 provides an overview of gold and US stock market prices since gold records began in April 1968 to May 2020. Section 4 evaluates the correlation between gold returns and market returns in the different subsamples. The correlation results are then used to establish a regression model in section 5. This project concludes with section 6, in which I present my findings and draw conclusions from the data. An appendix at the end provides statistical details in the form of graphs and tables not included in the main text.

**2. Data**

**2.1 Gold**

For the gold prices, I used the Gold Fixing Price 3:00 P.M. (London time) from the Federal Reserve Economic Data database (<https://fred.stlouisfed.org/>) (reference: GOLDPMGBD228NLBM). Units are in U.S. Dollars (USD) per Troy Ounce. Frequency is daily (not seasonally adjusted). Both the daily prices (raw data) and daily returns (first difference logged data) are used for analysis.

**2.2 S&P 500**

For the S&P 500 prices, I used the closing price of the S&P 500 from the Yahoo! Finance database (<https://finance.yahoo.com/>) (reference: ^GSPC). Units are in U.S. Dollars (USD). Frequency is daily (not seasonally adjusted). Both the daily prices (raw data) and daily returns (first difference logged data) are used for analysis.

**2.2 Subsamples**

To understand how the relationship between gold and market returns behaves over time, I analysed four subsamples: two long-run (10-year period) and two short-run (6 months) periods (**Table 1**).

**Table 1.** Subsamples

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Dates** | **Duration** | **Description** |
| **Long-run 1** | Jan 2000 - Jan 2010 | 10 years | Dotcom bubble and subprime mortgage crisis |
| **Long-run 2** | Jan 2010 - Jan 2020 | 10 years | European debt crisis and COVID-19 pandemic |
| **Short-run 1** | Sep 2008 - Mar 2009 | 6 months | Subprime mortgage crisis |
| **Short-run 2** | Dec 2019 - May 2020 | 6 months | COVID-19 pandemic |

The data from short run 1 (corresponding to the subprime mortgage crisis) are found in the long run 1 subsample (corresponding to the decade 2000-2010). Similarly, the data from the COVID-1 pandemic (short run 2) are contained in the 2010-2020 subsample (long run 2).

Six months was chosen as the duration of the short-run analysis because this was the duration of the COVID-19 pandemic at the time of writing, and the same duration was used for the 2008 subsample for comparison. Similarly, a duration of 10 years was chosen for the long-run analysis to analyze the correlation between gold and S&P500 over longer periods of time. However, the long-run relationship could also be studied over briefer periods, such as over 1 years or over 5 years.

**3 Descriptive statistics**

**3.1 Historical relationship**



**Figure 1.** Historical prices of gold and S&P 500 (1968-2020) in USD.

**Figure 1** shows the prices of gold and S&P 50 from 1968 to 2020. Prices in both markets have steadily increased over time and are clearly higher at the end of the sample than in the beginning. With similar price levels, the values of gold and the S&P 500 coincided at three points: 1990 (A), 2000 (B), and 2009 (C).

(A)

(B)

(C)

By contrast, gold prices show a different pattern. In general, prices have been rising for the entire sample period with relatively short periods of falling markets compared to stock prices. The bond prices of all three markets are clearly higher at the end of the sample than in the beginning of the sample period. Gold prices are also higher at the end of the sample compared to the beginning but there was no obvious trend of the price for gold. Two gold price regimes are easily discerned: the gold price fell until 2000 and increased afterward.

The relationship appears to change over time, seemingly negatively and positively correlated at times, but uncorrelated at others.



**Figure 2.** Historical returns of gold and S&P 500 (1968-2020)

**The two variables have similar levels of volatility. Notes on what these graphs say:** volatility, changing relationship.

**3.2 Long-run relationship: 2000-2010 and 2010-2020**

To evaluate the relationship between gold and US market returns, I look at a 10 year timeframe: (i) 2000-2010 (including 2008 financial crisis) and (ii) 2010-2020 (including COVID-10 pandemic).

*3.2.1 2000-2010*

10-year period, including 2008 financial crisis

Underlying factors:

Volatility level:

*3.2.2 2010-2020*

10-year period, including 2020 financial crisis.

Underlying factors:

Volatility level:

**3.3 Short-run relationship: COVID-19 pandemic (2020) and Financial crisis (2008)**

To evaluate the relationship between gold and US market returns, I look at a 6-month timeframe of COVID-19 pandemic in 2020 and the subprime mortgage financial crisis in 2008. The subsamples were chosen at 6-month intervals with the common feature of containing the worst down days of each crisis (**Table 2**).

**Table 2.** Worst down days in subsamples

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Dates** | **Return** | **Lowest return** | **Length** | **S.D.** |
| **COVID-19** |  |  |  |  |  |
| **S&P 500** | Feb 20 – Mar 23, 2020 | -33.7% | -11.9% | 33 days | 5.0% |
| **Gold** | -5.8% | -5.0% |  | 2.1% |
| **Subprime mortgage crisis** | | | | | |
| **S&P 500** | Sep 26, 2008 – Mar 9, 2009 | -47.3% |  | 165 days |  |
| **Gold** |  |  |  |  |

(3373 to 2237)

(1619 to 1525)

(1298 to 683)

*3.3.1 Relationship during COVID-19 pandemic*

 

**Figure 2** Prices (left) and returns (right) of gold and S&P 500 during COVID-19 pandemic.

Underlying factors:

Volatility level:

*3.3.2 Relationship during 2008 financial crisis*

 

**Figure 3** Prices (left) and returns (right) of gold and S&P 500 during 2008 financial crisis.

Underlying factors:

Volatility level:

**4. Correlation analysis** (~250)

A correlation analysis of the prices alone shows a significant negative correlation between the prices of gold and S&P 500. Although this is what was expected from the theory, a regression of gold prices on market prices alone does not provide an accurate description of the relationship due to it’s reliance on time.

To remove reliance on time, I chose to used data on the price returns. The raw data was transformed into returns using first difference logs.



(i) 2000-2010 (ii) 2010-2020 (iii) COVID-19 (iv) Financial crisis

**Figure 4** Scatterplots

**Table 3** Correlation between gold and market returns.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Correlation (r) | P-value | No. of observations |
| Long-run 1 | 0.0028 | 0.0028 | 2338 |
| Long-run 2 |  |  |  |
| Short-run 1 |  |  |  |
| Short-run 2 |  |  |  |

\*Significant at 5% level (p<0.05)

Historical sample: 1968-2020. 12/02/2013 12/15/2017 - uncorrelated

Sample 1 (long run) (1): 2000-2010 (2008 crisis)

Sample 2 (long-run) (2): 2010-2020 (2020 crisis)

Sample 3 (short-run) (1): 12/15/2017 12/16/2019 - no correlation

Sample 4 (short-run) (2): 12/20/2019 5/20/2020 - positive

1978-2020 and 2000-2020 No significant long-run correlation

Negative correlation

Positive correlation

Null hypothesis: H0 = no correlation

**5. Regression** (~250)

*3.1 Model*

* Present model equation and reason for this model.
* Present results in an equation and explain what each term means.

*3.2 Results*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Correlation** |  | **p-value** |
| **Long-run 1** | Jan 2000 - Jan 2010 |  | 10 years |
| **Long-run 2** | Jan 2010 - Jan 2020 |  | 10 years |
| **Short-run 1** | Sep 2008 - Mar 2009 |  | 6 months |
| **Short-run 2** | Dec 2019 - May 2020 |  | 6 months |

*3.3. Analysis*

DW < 1.5 Positive autocorrelation

DW > 1.5 No autocorrelation

DW < 2.5 Negative auto correlation

**6. Conclusion** 500 words

*4.1 Long-run vs. short-run*

Gold has no long-run relationship with the US market

Gold has a changing short-run relationship with the US market. During the recent COVID-19 crisis, we have seen a change in the relationship between the stock market and gold price: as the market index fell, so did the price of gold.

Rather than the behaviour of gold, the anomaly here seems to be rapid rebound in the stock market, which has resulted in gold and S&P 500 to rise in unison.

*4.2 Volatility*

*4.3 Limitations*

**Bibliography**

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