Contents lists available at ScienceDirect



Finance Research Letters

journal homepage: www.elsevier.com/locate/frl

The gold-stock market relationship during COVID-19

Check for

Finance Research

Pamela Peterson Drake

Department of Finance and Business Law, James Madison University, Harrisonburg, Virginia, 22807, USA

ARTICLE INFO	A B S T R A C T
JEL Clacification: G10 G11 G14	The belief that investors shift to gold during times of economic stress, resulting in a negative correlation between gold returns and stock returns, is not supported in both the 2007–09 financial crisis and during COVID-19. However, the gold-stock market relationship is positive in periods of negative real rates of return. The evidence points to gold as a safe haven in times of stock market volatility and negative interest rates.

The flight to gold during times of economic stress has resulted in a common belief that investors shift investments to gold when they are concern about a drop in the market; that is, gold is viewed as a safe haven. There is also a belief that the low or negative correlation of gold and stock returns provides an opportunity for risk reduction through hedging.

The financial press has focused on gold as a safe haven in times of stress, especially before and during the early days of the COVID-19 crisis. The inverse relation between gold and stocks is cited by many in the popular press.¹ However, some have observed that the relationship has changed in 2020. For example, Mark DeCambre noted in MarketWatch in August 2020 that "Gold is on a historic tilt."² The positive correlation between gold and stocks was observed early into the COVID-19 period. For example, Zhang et al. (2020) posit that "When gold and equities become positively correlated, it usually signals a market regime driven by liquidity and changing real yields."³ This implies that there is more to the gold-stock market relationship than a simple inverse relation.

McCown and Zimmerman (2006) examine gold as a financial asset and support that idea that gold is an inflation hedge. Hiller et al. (2006), Do et al. (2009), and Do and Sriboonchitta (2010) also support gold as a portfolio hedging opportunity. Baur and Lucey (2010) observe that gold is generally a safe haven because returns to gold are uncorrelated with those of stocks in the event of a severe market downturn, yet this relationship is short-lived. However, they also observe that gold is a hedge because its returns are uncorrelated with those of stocks.

Choudhry et al. (2015) note that gold was not a safe haven during the 2007–09 financial crisis because of the unidirectional relationship between gold returns and market returns (gold returns to stock returns) but not bidirectional. They also observe that there is nonlinear causality, arguing that gold may have been used as a hedge before the financial crisis, but not during the crisis period. AlAmeer et al. (2018) observe a differing correlation and Granger causality for the periods before, during, and following the 2007–08 financial crisis.

The purpose of this study is to explore the gold-stock market relationship, considering the recent COVID-19 recession and the role of interest rates. The results indicate that the inverse relationship observed in the past is not supported in the two most recent recessions, and that this relationship is affected by the real rates of interest and stock market volatility. When real rates of interest are negative,

* Corresponding author.

Received 14 January 2021; Received in revised form 16 March 2021; Accepted 2 May 2021 Available online 8 May 2021 1544-6123/© 2021 Elsevier Inc. All rights reserved.

E-mail address: drakepp@jmu.edu.

¹ For example, Saefong (2021).

² DeCambre (2020).

³ Keown (2020).

https://doi.org/10.1016/j.frl.2021.102111



Exhibit 1. The performance of the stock market versus gold, JAN1990-MAR2021.

there is a positive relationship between gold and market returns.

Data and methodology

The analysis covers the period from January 2, 1990 through March 3, 2021. The daily returns to gold are calculated using the gold fixing price at 10:30 a.m. (London time). in the London Bullion market, based in US dollars. The daily returns to the stock market are proxied using the S&P 500 Total Return Index. Recessionary periods are identified using the National bureau of Economic Research's US Business Cycle Dates.⁴ The volatility of the market is proxied using the CBOE VIX index. The data for the real rate of interest on a 30-year US Treasury Inflation-Indexed Bond. However, this latter data is only available from 2000 onward.⁵

The goal is to analyze whether the typical relationship observed by researchers in the past persists in the COVID-19 recessionary period. The first tests involve simple correlations between the returns to gold and the returns to the market for both recessionary and non-recessionary periods. Additionally, we calculate rolling correlations to explore the correlations over time, focusing on the COVID-19 period.

Granger causality tests are applied to investigate any lead-lag relation between these two time-series. That is, we test whether the market returns "Granger cause" gold returns and whether gold returns "Granger cause" market returns.

There are different approaches available to examine the role of gold as a hedge. The ideal hedge would have returns that are negatively correlated with those of the market. In other words, it requires estimating the model of the returns on gold, R_G , regressed against the returns on the market, R_M :

$$R_{Gt} = \alpha + \beta_G R_{Mt} + \varepsilon_t \tag{1}$$

If there is no diversification potential, the slope, β_G , will be one. Further, the greater this slope is from one, the greater the diversification potential. Capturing the volatility of the market, an interactive term is added to the model that takes on the value of the market return when volatility of the market increases, and zero otherwise:

$$R_{Gt} = \alpha + \beta_G R_{Mt} + \delta V I X M K T_t + \varepsilon_t$$
⁽²⁾

The coefficient on *VIXMKT* allows the testing of whether gold is safe haven. If the coefficient is significant and positive, this indicates that the driver of the gold-market relationship is the volatility in the market. Testing whether the gold-stock market relationship is based on the lack of investment opportunities, the model is expanded to include an interaction variable, *MR*, that takes on the value of the market return when real rates are negative, zero otherwise.

$$R_{Gt} = \alpha + \beta_G R_{Mt} + \delta VIXMKT_t + \gamma M R_t \varepsilon_t$$
(3)

Establishing the correlations for these different periods, the next step is to examine the long-term relationship of the two time-series using the Robert and Granger (1987) and the Johansen (1988) and Johansen and Juselius (1990) cointegration tests. The test of cointegration is a test of the long relationship underlying the relationship between two stationary series' co-movement. However, these tests require that the series be stationary, so the Augmented Dickey-Fuller (ADF) test is performed for each series (Dickey and Fuller,

⁴ Available at nber.org/research/business-cycle-dating.

⁵ Results are similar to the 5-year US Treasury Inflation-indexed note, but a longer span is available with the 30-year.

Pearson correlations between the returns to gold and the returns to the stock market.

	Number of			
	days	Correlation	p-value	
July 1990 – March 1991	185	-0.2007	0.0062	
March 2001 – November 2001	182	-0.1830	0.0134	;
December 2007-June 2009	386	-0.0398	0.4324	
COVID-19 recession	271	0.1544	0.0106	;
Non-recessionary, non-COVID-19 days	6686	0.0041	0.7851	

Exhibit 2. Correlations of returns of gold and the stock market during recessionary and non-recessionary periods.

Panel A Descriptive statistics

Mean	-0.0092
Minimum	-0.6647
Maximum	0.6843
Standard deviation	0.2177
Skewness	-0.1938
Kurtosis	-0.0753



Exhibit 3. Distribution of 30-day rolling correlations between market and gold daily returns.

1979). The ADF is used to test whether a series has a unit root; failure to reject the null hypothesis in the ADF test indicates that the time series is nonstationary.

Results

Comparing the returns of the two time-series using the value of \$1 invested January 2, 1990, reveals that the stock market has outperformed gold investments over time, as shown in Exhibit 1.

Correlations

The first examination of correlation focuses on recessionary and non-recessionary periods of time, as we show in Exhibit 2. The correlations for the 1990–91 recession and the 2001 recession are negative and different from zero, but the correlations in the 2007–09 recession and non-recessionary periods are not different from zero; in the COVID-19 recession, there is a significant, positive relation between gold and stock market returns. Gold appears to be a diversification asset class during the first two recessions and have little diversification potential during the 2007–09 crisis and COVID19. These results do not support the argument that gold is either a hedge or a safe harbor in times of economic stress. This contrasts with previous evidence by Baur and McDermott (2010) that supports gold as





The null hypothesis is that the series is unit root or, in other words, non-stationary. Rejection of this null hypothesis is in favor of the alternative of a stationary series. The p-values are in () below the test statistic.

Time-series	Level	Returns
Market	-0.5737	-17.736*
	(0.98)	(< 0.01)
Gold	-1.7384	-17.293*
	(0.68)	(< 0.01)

Exhibit 5. Augmented Dickey Fuller tests for stationarity.

a safe haven, but is consistent with the evidence by Choudhry et al. (2015).

The second examination involves rolling correlations between the returns on the market and those of gold. The 30-day rolling correlations are described in Exhibit 3, with statistics provided in Panel A and the histogram provided in Panel B.⁶ The mean correlation is -0.0007, but the ranges are from -0.66 to +0.68. With a 5% level of significance, two-sided test, correlations outside the range of +0.3871 result in the rejection of the null hypothesis of no correlation.

During the 1990–2021 period, 3.7% of the positive rolling correlations are significant at the 5% level and 6.1% of the negative rolling correlations are significant, which we would expect by chance. Of the negative rolling correlations, only 11% occur during recessionary periods. This evidence does not support that idea that gold and market returns are negatively correlated in periods of economic stress.

The rolling correlations for 30-day correlations during the COVID-19 portion of 2020–1 are provided in Exhibit 4. Overall, as suggested in Exhibit 3, the correlation is not predominately positive or negative during the COVID-19 recession.

Test of stationarity

The examinations of the time series using Granger causality and tests of co-integration require first establishing whether a time series is stationary. The Augmented Dickey Fuller test is employed for this test, as shown in Exhibit 5 for both the time series of the levels and the time series of the returns.

Regarding the levels, the time series are non-stationary. In terms of the returns, however, the evidence suggests that the series are stationary. The implications of these findings are the (1) examining levels and relationships among these levels is fraught with problems because of non-stationarity, and (2) tests for Granger causality and co-integration of the return series are possible because of the stationarity of these series.

Granger-causality

The relationship between gold returns and market returns is explored further using a Granger test of causality, with the results provided in Exhibit 6. The null hypothesis is that the dependent variables is explained by its own past values and the alternative

⁶ The 30-day rolling window is an arbitrary length, but similar results but are generated with smaller windows, as small as 5-days.

Ontimal

Granger causality test results examining whether lagged gold returns "Granger cause" stock returns and whether lagged market returns "Granger cause" gold returns.

Panel A	Linear tests	

Explanatory variable	F-test	p-value	lag
Market returns	4.2114	< 0.01	7
Gold returns	1.5536	0.213	1

Panel B Nonlinear tests

Explanatory variable	F-test	p-value
Market returns	0.7838	0.5355
Gold returns	0.1184	0.9760

Exhibit 6. Granger causality tests.

Estimates of the regression models in equation (1), (2), and (3)

(1)
$$R_{Gt} = \alpha + \beta_G R_{Mt} + \varepsilon_t$$
,
(2) $R_{Gt} = \alpha + \beta_G R_{Mt} + \delta_t VIXMKT_t + \varepsilon_t$
(3) $R_{Gt} = \alpha + \beta_G R_{Mt} + \delta VIXMKT_t + \gamma MR_t \varepsilon_t$

The p-values are in () below estimated statistic. Sample size = 5179.

Variable	(1)	(2)	(3)
Intercept	0.0004*	0.0005*	0.0005*
	(0.0082)	(0.0006)	(0.0009)
R_M	0.0006	0.0177	-0.0226
	(0.9609)	(0.1334)	(0.0813)
VIXMKT		0.0070*	0.0067*
		(0.0001)	(0.0002)
MR			0.2016*
			(0.0000)
_			
F	0.0024	7.524	11.68
	(0.9609)	(0.0005)	(0.0000)

* Indicates significance at the 5 percent level.

Exhibit 7. Regression estimates.

hypothesis is that it is explained by its own past values and that of the other variable. The maximum lag is determined by the AIC information criteria.

The linear Granger tests are in Panel A and the nonlinear Granger tests are in Panel B. The results indicate that, on average, gold returns "Granger cause" the market returns, but the other direction of this testing does not indicate that market returns "Granger cause" gold returns.

The interpretation of the results is that past values of gold returns help predict value of market returns, but (1) this is a short-run phenomenon, and (2) the reverse relation is between gold and returns and market returns is not supported. The use of lagged values of gold returns to predict market returns provides better forecasting than simply using lagged values of market returns, as indicated by F-test. But the other direction is not supported: lagged values of the market returns do not predict gold returns better than lagged values of gold returns.

Gold as a hedge

The results of estimating the regression models in Eqs. (1), (2) and (3) are in Exhibit 7. The results indicate that the negative relation between the market and gold returns is not evident, contrary to the evidence by Hiller et al. (2006) and Do et al. (2009).

The relationship between gold returns and market returns does not support the role of gold as a hedge [Baur and McDermott (2010] and as an asset that provides diversification potential, contrary to Hillier et al.. The results support the idea that the market volatility and the lack of investment opportunities drive gold returns, indicating gold as a safe haven.

Test statistics for the rank, r, with critical values for a 5% level of significance in [] below test statistics.

Test	Test statistic	Critical value
r = 0	4500.04	17.95
r <u><</u> 1	2088.63	8.18

Exhibit 8. Co-integration tests: Gold returns and stock market returns.

Period	Correlation between gold and stock market returns	Number of days
Positive real interest rates	-0.0181 (0.2063)	4856
Negative real interest rates	0.2328* (0.0000)	320

Exhibit 9. Correlations based on real interest rate periods, JAN2000-MAR2021.

Co-integration of series

Applying the Engle-Granger and Johansen co-integration approaches, the time-series are examined for bivariate co-integration. The results of these tests are shown in Exhibit 8. The basic idea is that:

- If one cannot reject that the rank, r, is = 0, the series are integrated but there is no co-integration.
- If one rejects r = 0, but the significance stops before the maximum rank, this means that the series are integrated and cointegrated, and the cointegration rank is the highest rank for which there is significance.
- If one rejects all cases including the maximum rank, which is r = 1 in this case, the series are not integrated and therefore no cointegration is possible.

The results in Exhibit 9 indicate that the two time-series of market and gold returns are each not integrated and there is no cointegration of the series.⁷ As a check, the Engle-Granger test for cointegration was also performed on these series with the same conclusion: there is no cointegration.

The explanation for the shifting relation between gold and the stock market, observed over the financial crisis and COVID-19, is left unexplained by simply looking at gold and stock market returns. Applying correlation for various sub-periods defined by real interest rates offers some insight into the gold-stock market relationship. The correlations are provided in Exhibit 9. There is a positive correlation between the returns for gold and the stock market when there are negative real rates of return, but no correlation during periods of positive real rates.

Conclusions

The well-worn adage that gold can be used to diversify a portfolio because of its lack of correlation with the market in general is dispelled under COVID-19. A possible driver of the gold-stock market relation may be the real rate of interest; as real rates fall below zero percent, the relation between gold and the stock market tends to be positive. A simple explanation is possible: as real rates fall below zero, investors shift funds to both gold and stock markets. The evidence from the relationship between gold and stock market returns during the 2007–09 financial crisis and COVID-19 should cast doubt on the role of gold as a hedge.

CRediT authorship contribution statement

Pamela Peterson Drake: Conceptualization, Methodology, Formal analysis, Data curtion, Writing – original draft, Writing – review & editing.

References

AlAmeer, M., Hammad, W., Ismail, A., Hamdan, A., 2018. The relationship of gold price with the stock market: the case of Frankfurt Stock Exchange. Int. J. Energy Econ. Policy 8 (5), 357–371.

Baur, DG., McDermott, TK., 2010. Is gold a safe haven? International evidence. J. Bank. Finance 34 (8), 1886–1898 (August).

Choudhry, T., Hassan, S., Shabi, S., 2015. Relationship between gold and stock markets during the global financial crisis: evidence from nonlinear causality. Int. Rev. Financ. Anal. 41 (C), 247–256.

Baur, DG., Lucey, BM., 2010. Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold. Financ. Rev. 45 (2), 217-229.

DeCambre, M., 2020. What does a stratospheric rally for gold mean for the stock market?". MarketWatch 2021. Accessed March 13.

⁷ Dividing the time series into recessionary and non-recessionary time periods and testing for cointegration yields similar results.

Dickey, DA., Fuller, WA., 1979. Distribution of the estimators for autoregressive time series with a unit root. J. Am. Stat. Assoc. 74, 427-431.

Do, G.Q., Mcaleer, M., Sriboonchitta, S., 2009. Effects of international gold market on stock exchange volatility: evidence from ASEAN emerging stock markets. Econ. Bull. 29 (2), 612–623.

Do, G.Q., Sriboonchitta, S., 2010. Cointegration and Causality Among International Gold and ASEAN Emerging Stock Markets (January 9, 2010). Available at SSRN. https://ssrn.com/abstract=1533919.Engle.

Robert, F., Granger, CW.J., 1987. Co-integration and error correction: representation, Estimation, and Testing. Econometrica 55 (2), 251–276.

Hiller, D., Draper, P., Faff, R., 2006. Do precious metals shine? An Investment perspective. Financ. Anal. J. 62 (2), 98-106.

Johansen, S.Ø., 1988. Statistical analysis of cointegrating vectors. J. Econ. Dyn. Control 12, 231-254.

Johansen, S.Ø., Juselius, K., 1990. Maximum likelihood estimation and inferences on cointegration – with application to the demand for money. Oxf. Bull. Econ. Stat. 52 (2), 169–210.

Keown, C., 2020. Gold and stocks have been moving together for weeks. Here's what it means. Barron's, p. 2021. Accessed March 13.

McCown, J.R., Zimmerman, J.R., 2006. Is Gold a Zero-Beta Asset? Analysis of the Investment Potential of Previous Metals (July 24, 2006). Available at SSRN: https://ssrn.com/abstract=920496 or https://doi.org/10.2139/ssrn.920496 . Accessed March 13, 2021.

Saefong, MP., 2021. Inverse Relationship between Gold, Stocks has never been this Extreme. Market Watch. Accessed March 13.

Zhang, J., Chen, B., Hamilton, MJ., 2020. Chart Room: What in the World is Going on with Gold?" Fidelity International, Editorial. Accessed March 13, 2021.