Original Article

Stock market returns and the price of gold

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ABSTRACT Contrarian investors attempt to buy low and sell high in stock markets. They may demand gold to secure their gains when they sell their winning portfolios, as they need marketable securities. On the other hand, when investors find an opportunity to buy stocks at lower prices, they may demand less gold because they need capital to buy losing portfolios. Unlike the traditional view, this study predicts the price of gold to increase (decrease) subsequent to significant positive (negative) stock returns. We provide some evidence to support this hypothesis, against the traditional view, arguing that investors may demand more or less gold to take advantage of market fluctuations.

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INTRODUCTION

Since the early 2000s, not only has the price of gold quadrupled, but the volatility of it has also increased significantly (See Figure 1). The traditional explanation of this increase, in both academia and the popular media, is constructed around the perception that gold is a safer asset and investors demand gold because it is a hedge or a safe haven against macroeconomic shocks.[1]

However, a fact that seems to be overlooked in the literature regarding gold is that during the period of 2000–2013, there were significant daily drops in the price of gold while the overall trend was considerably upward. The data set that is used in this study shows that in 46 trading days, the price of gold dropped by 3 per cent or more, and in 24 trading days, it dropped 5 per cent or more. We argue that these drops in the price of gold, traditionally viewed as a hedge and a low risk asset, in 1 day are mysterious, [2] as people do not necessarily become optimistic about the future of the economy overnight.

This study suggests that an almost 500 per cent increase in the price of gold over the past decade cannot be mainly because of gold being a safer asset and proposes an alternative view. In this view, short-term investors use

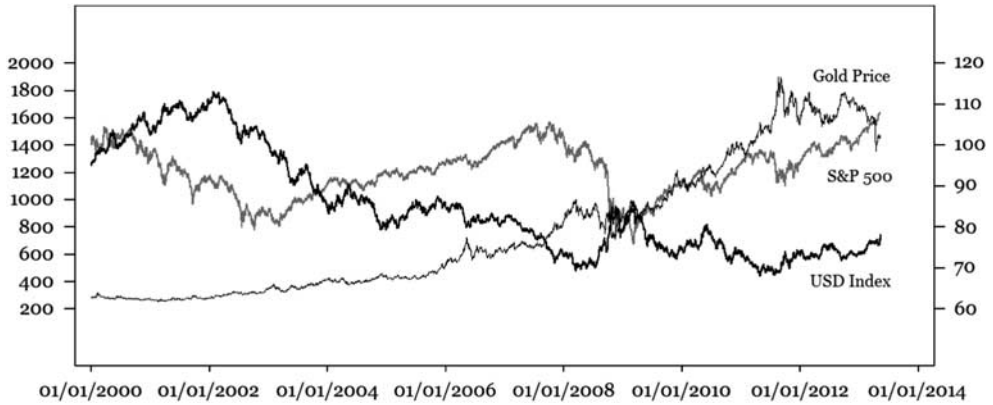

Figure 1: The price of gold and the S&P 500 index which are scaled by the left axis and the USD Index are plotted for the period of 1 January 2000 through 30 June 2013. All data is obtained from the Global Financial Database.

Table 1: Survey on the price of gold

Date	*Participants*	*Responses*	*Up*		*Neutral/sideways*		*Down*	
3 May 2013	35	27	10	(37%)	5	(19%)	12	(44%)
10 May 2013	36	25	8	(32%)	6	(24%)	11	(44%)
24 May 2013	36	28	14	(50%)	5	(18%)	9	(32%)
31 May 2013	36	27	17	(63%)	6	(22%)	4	(15%)
Average	35.75	26.75	12.25	(46%)	5.5	(21%)	9	(34%)

Notes: The Kitco News (2013b,c,d,e) Gold Surveys on 3 May, 10 May, 24 May, and 31 May of 2013 are summarized. The Kitco News surveys opinions of professionals in the industry. In the month of May of 2013 four surveys are published. *Participants* are the professionals that are invited to participate to the surveys. *Responses* show the number of professionals who agreed to participate to the survey. *Up/Down* is the number of participants who expect an increase/decrease in the price of gold in the next seven days. *Neutral/sideways* is the number of participants who do not expect a change in the price of gold.

gold as a temporary asset during stock market fluctuations, therefore driving the demand for gold even when the market is on the rise. That is, short-term contrarian[3] investors sell the winning portfolios (that is, sell high) and herd to gold; conversely, when they find losing portfolios, they liquidate their gold position to buy these portfolios (that is, buy low). It is possible, and advantageous, to use gold as a temporary asset because (i) in the past decade, returns on government bonds have been near 0 per cent because of the stimulating efforts of the US government; (ii) gold has been appreciating since the early 2000s; and (iii) buying and selling gold is more convenient (especially since mid-2000s) than it used to be because of the availability of physically-backed gold exchange traded funds.[4]

In order to test this view, we examine the spillovers from stock returns to the price of gold. Our analysis consists of more than 3000 daily observations in the period of 2000 through the first half of 2013. We collect data from the Global Financial Database and Kenneth French's Website.[5] All of our models are estimated with a Generalized Autoregressive Conditional Heteroskedasticity method (GARCH), which is the standard method used in the current literature when analyzing the price of gold. For robustness, we use the US Dollar Index as the control variable throughout our empirical analysis as it is considered to be the major macro-economic variable which consistently has an affect on the price of gold (Tully and Lucey, 2007).

In our regression models, the change in the price of gold is the dependent variable, while the independent variables are the returns of portfolios formed on firm size, book-to-market (BtM) ratio, and industry. If the traditional view holds, the price of gold should decrease subsequent to high-portfolio returns. According to the view that is developed in this study, however, a positive shock (PS) (i.e., a sudden increase in the stock market) may motivate contrarian strategists to sell their winning portfolios and buy gold until they find a losing portfolio in which to invest. Conversely, after a negative shock (NS) in the stock market, they are predicted to demand less gold, decreasing the price of gold. Thus, unlike the prediction of the traditional view, PS/NSs in the stock market, which are captured via dummy variables, may increase/decrease the price of gold.

Our results show evidence that the price of gold reacts differently to shocks than it does to small stock market swings. Namely, when the stock market generates high returns (that is, PS), the price of gold increases, whereas it decreases subsequent to high losses (that is, NS). While the latter finding is more significant, both of these findings are in contrast with the traditional view. The implication of this finding for investors is that gold may not serve as a hedge against large stock market swings and it may not be a good portfolio diversifier.

To examine whether the 2008 financial crisis had an effect on the relations between stock returns and the price of gold, we compared the pre- and post-financial crisis eras. The traditional view predicts higher demands for gold because of a lower sentiment in the post-financial crisis era. Confirming this, we find that the negative relation between the stock market returns and the price of gold became stronger after the crisis. However, we also find that NS/PSs in the stock market affect the price of gold negatively/positively with a higher magnitude and significance after the financial crisis. This may suggest that in order to take advantage of stock market fluctuations, the demand for gold increased as well, as risk-taking resulted in higher returns in the post-crisis era.[6]

Overall, this study develops an alternative view to the mainstream argument that gold is demanded beacuse of investor pessimism and questions the unexpected increase in the price of gold by proposing that investors may use gold as a temporary asset until they find losing portfolios. The findings of this study show some evidence that when the stock market goes up, the demand for gold may be fueled by investors who are selling winning portfolios and looking for a short-term asset that is liquid and keeps its value.

This article is organized as follows: Section 2 is a literature review on the behavior of the price of gold and formulates the hypothesis regarding the relationship between stock market fluctuations and the demand for gold. In Section 3, empirical analysis investigates the relationship between the price of gold and stock market fluctuations. Finally, Section 4 summarizes and concludes the study.

LITERATURE REVIEW

There is a general belief that gold is a safe asset because it is a hedge or a safe haven against macroeconomic shocks.[7,8] However, empirical findings in the literature do not necessarily concur. For instance, Ghosh *et al* (2004) show that investors hedge themselves against US inflation by investing in gold. Cai *et al* (2001) find that employment, gross domestic product (GDP), consumer price index, and personal income are the most significant determinants of the volatility of the gold price, while Lawrence (2003) find no relation between the price of gold and inflation, growth rate of GDP, interest rate, real rate of return on 10-year US bond, and money supply.

However, Levin *et al* (2006) argue that there is a direct link between the general price level in the United States and the price of gold. Even though there is a conflict among most findings regarding the impact of macroeconomic variables on the price of gold, there is a consensus on the relationship between the behavior of the dollar against other currencies and the price of gold. For example, Capie *et al* (2005) show that gold works as a hedge against the dollar (See also Pukthuanthong and Roll (2011)), and Tully and Lucey (2007) conclude that the only macroeconomic variable affecting gold is the US dollar.

The other vein of literature, which is closely related to this article, provides an analysis on the effect of stocks and bonds on the price of gold. Baur and Lucey (2010) investigate whether return on stocks and bonds affects the demand for gold in the United States, United Kingdom and Germany. Their empirical analysis examines whether gold is a hedge, a diversifier, or a safe haven.[9] They conclude that gold is mostly demanded during market crashes and sold when the confidence in markets is restored. Similarly, using international data, Baur and McDermott (2010) confirm that stock market panics increase the demand for gold. Lastly, this study is also related to the contrarian investment literature; some examples are DeBondt and Thaler (1985) and Cooper (1999).

Motivation and hypothesis development

To the best of our knowledge, empirical findings regarding the effect of stock returns on the price of gold are scarce and limited to gold's ability to decrease portfolio risk. In this study, we investigate the possibility of using gold to take advantage of market fluctuations. Specifically, some investors follow contrarian strategies and liquidate winning portfolios. In such a case, gold could be used as a temporary asset, as it holds its value, especially, in the short run. Empirically speaking, in this scenario, investors have a counter-cyclical investment behavior; thus, they sell high and buy low in stock markets. We propose that these investors may demand less gold when the market is at the bottom in order to exploit abnormal returns in stock markets. This hypothesis contradicts the traditional view, which posits that NSs in stock markets depress investors and make them seek safer assets. In reality, however, some investors are risk-takers and try to take advantage of market swings. The reason for this behavior is that some investors overreact to current information and cause asset prices to deviate from their true value (See DeBondt and Thaler (1985)). This study investigates whether arbitrageurs use gold as a temporary asset, which is safe and liquid, to take advantage of these misvaluations.

Finally, we examine whether the recent near-collapse of the financial system permanently impacted the demand for gold. In the traditional view, investors demand gold when there is less confidence in the economy. After the crisis, it is expected that investors will be more sensitive to market fluctuations and demand more gold after negative market shocks. On the other hand, the post-crisis era can be a window for risk takers to realize above average returns, as conservative investors may overreact to economic developments, thus causing larger market imperfections. Related to this proposition, Lord Abbett's weekly market view (1 July /2013)[5] shows that in the post-crisis era, risk-taking resulted in higher returns. The article suggests that this is because many investors played it less risky because of the pessimism in the economy, which in turn created extraordinary investment opportunities. Therefore, the comparison of pre- and post-crisis eras is among the empirical analyses of this study.

The contribution of this study

Overall, this study contributes to the literature in several ways, as it: (i) investigates the possibility of using gold as a temporary asset to supplement contrarian strategies; (ii) examines the reactions of the price of gold to returns on portfolios formed on firm industry, size and growth opportunities; and (iii) examines the effect of the recent near-collapse of financial system on the price of gold.

DATA AND METHODOLOGY

The variables used in this study are as follows: the price of gold in USD, per troy ounce in New York, the USD exchange rate index (USDI) provided by the Federal Reserve which consists of major currencies. This information, as well as the Standard and Poor's 500 index, are obtained from the Global Financial database. Lastly, portfolio returns are constructed on firm size and BtM ratio are obtained from Kenneth French's Website.[5] Daily data is used in order to scrutinize short-term swings and to investigate if gold is used to take advantage of short-term market fluctuations. More importantly, we derive dummy variables based on the magnitude of returns to capture shocks that is, large positive shock (LPS), PS, NS, negative large shock (LNS). To derive these dummy variables, we rank all portfolio returns into quintiles and refer to the fall in returns in the middle quintile as normal returns. The dummy variable, *LPS*, is 1.0 for returns that fall into the fifth quintile and 0.0 for all other returns. The dummy variable *PS* is 1.0 for returns that fall into the fourth or the fifth quintile and 0.0 for all other returns. The dummy variable *NS* is 1.0 for returns that fall into the second or the first quintile and 0.0 for all other returns. The dummy variable *LNS* is 1.0 for returns that fall into the first quintile and 0.0 for all other returns. Note that even though the NS dummy variables capture negative returns,[10] the variable itself can only be 1.0 or 0.0. While our main concern is to test the effect of PS and NSs, we also use dummy variables to account for large shocks, allowing us to examine whether the market reactions to larger shocks is higher.

Following prior literature (for example, Capie *et al* (2005); Tully and Lucey (2007); Baur and Lucey (2010) and so on), all estimations are done by GARCH models. The GARCH (1, 1) specification fits well not only to stocks, bonds, exchange rates but also commodity returns (Engle, 2004). We use GARCH (1, 1) models to examine the link between the stock market and gold, where the control variable is the change in the USDI. To capture positive and NSs, each model is estimated with the addition of four dummy variables, as defined above.

On the basis of the traditional view, when stock returns are high (returns in the fourth or the fifth quintile or PS), the demand for gold should be low, pushing the price of gold lower. Conversely, when investors realize large losses with stock portfolios (returns in the first or the second quintile or NSs), they may panic and invest in gold, which increases the price of gold. Hence, in a regression in which the dependent variable is the return on gold, the signs of the dummy variables *PS* and *NS* should be negative and positive, respectively.

Unlike the traditional view, the scenario offered in the current study predicts investors sell winning portfolios and invest in safe assets, one of which may be gold. If this scenario holds, then the coefficient of the dummy variable *PS* will be positive. When the stock market generates a large loss, however, investors may liquidate their position in gold and invest in losing portfolios. Thus, the sign of the dummy variable *NS* should be negative.

Descriptive statistics and preliminaries

Table 2 shows descriptive statistics of all variables used in this study. The main variable

of interest is the change in the price of gold. Results show that the standard deviation of gold price change is almost as high as that of the market. Median, minimum and maximum values of gold price change and the market are very close as well. Both series exhibit negative skewness and large kurtosis, indicative of fat tails. The Jarque and Bera (1980) test statistics reject normality for both series at the 1 per cent level (See Table 1). Thus, gold prices behave in a very similar manner to the stock market. This evidence cast doubts on the perception that gold is a safe asset. Correlation coefficients among our variables are presented in Table 3. The table shows that the change in the price of gold is negatively correlated with the USD. The results also show that the return on gold is not correlated with the return on S&P 500 index (that is, the market), but is correlated with portfolio returns formed on industries. Note that the return on gold is positively correlated with some portfolios and negatively with the others. Hence, gold may not be a hedge or a safe haven against all types of portfolios. Our study helps scrutinize this finding as we capture larger returns and larger losses via dummy variables.

MULTIVARIATE ANALYSES

In our first multivariate analysis, we examine the effect of the control variable (USD index) on the S&P 500 index and PS and NSs on the change in the price of gold. Results in Table 4, Panel A, confirm the prior literature as we find a one-to-one negative relationship between the USDI and returns on gold (*t-stats:*−29.74). The rest of the study uses the USDI as the control variable. Results in Panel B of Table 4 show that there is a negative relationship between the return on the S&P 500 and gold, indicating that investors buy/sell gold when the stock market goes down/up. Namely, when the S&P 500 decreases by 1 per cent, the price of gold increases by 0.15 per cent. This finding coincides with the traditional view that investors demand more gold when there is fear in the stock markets.

Next we test the scenario we developed in which investors sell winning portfolios and buy gold or sell gold to buy losing portfolios. To test this, four dummy variables are added to the model to proxy PS and NSs, that is, PS, NSs, LPS, and LNS, in the S&P 500 index. If the signs of PS or LPS are positive, this will suggest that when the market generates high returns, the price of gold increases. If the signs of NS or LNS are positive, this will indicate that when the marker generates high losses the price of gold increases.

Results presented in Table 4, Panel C, show that after adding dummy variables, the significance and magnitude of both the USDI and return on market increased. Including a

Table 2: Descriptive statistics

Variable	*N*	*Standard deviation*	*Minimum*	*Q1*	*Median*	*Q3*	*Maximum*	*Skewness*	*Kurtosis*
ΔGold	3168	1.14	−7.37	−0.52	0.05	0.68	10.39	−0.16	5.34
ΔS&P500	3168	1.32	−9.47	−0.59	0.05	0.61	10.25	−0.31	6.68
ΔUSDI	3168	0.47	−4.06	−0.28	0.00	0.25	2.11	−0.30	3.69
Small Low BtM	3168	1.60	−9.97	−0.81	0.06	0.90	7.40	−0.20	2.93
Small Mid BtM	3168	1.44	−10.19	−0.73	0.09	0.83	7.19	−0.20	3.99
Small Big BtM	3168	1.48	−10.97	−0.66	0.11	0.81	8.36	−0.28	5.20
Big Low BtM	3168	1.26	−8.37	−0.58	0.05	0.62	9.81	−0.02	5.16
Big Mid BtM	3168	1.32	−9.22	−0.56	0.06	0.63	10.15	−0.19	7.21
Big High BtM	3168	1.52	−12.38	−0.58	0.09	0.69	11.16	−0.28	10.72

Notes: Descriptive statistics of all the variables that are used in this study are presented. All numbers are in percentages. Change in the price of gold, the S&P 500 index, and the USD (that is, ΔGold ΔS&P500 and ΔUSDI) are the percentage changes in the value of the variables from time $t-1$ to time t. Other six variables represent the returns on portfolios formed on firm size (Small and big) and book-to-market ratio (low, mid, and high) (i.e. Small Low BtM, Small Mid BtM, Small Big BtM, Big Low BtM, Big Mid BtM and Big High BtM),which are also obtained from French's Website.

Table 3: Pearson correlation coefficients

	ΔGold	ΔS&P	ΔDI	Small low BtM	Small mid BtM	Small high BtM	Big low BtM	Big mid BtM
ΔS&P	0.00818 (0.6417)							
ΔUSDI	−0.39955 (<0.0001)	−0.12320 (<0.0001)						
Small Low BtM	0.01826 (0.2924)	0.87555 (<0.0001)	−0.11569 (<0.0001)					
Small Mid BtM	0.02144 (0.2164)	0.88803 (<0.0001)	−0.13391 (<0.0001)	0.95734 (<0.0001)				
Small High BtM	0.01519 (0.3813)	0.86748 (<0.0001)	−0.14696 (<0.0001)	0.91822 (<0.0001)	0.97684 (<0.0001)			
Big Low BtM	−0.01310 (0.4500)	0.98036 (<0.0001)	−0.10541 (<0.0001)	0.88463 (<0.0001)	0.86214 (<0.0001)	0.82196 (<0.0001)		
Big Mid BtM	0.02325 (0.1801)	0.96328 (<0.0001)	−0.15200 (<0.0001)	0.84832 (<0.0001)	0.89618 (<0.0001)	0.88946 (<0.0001)	0.90770 (<0.0001)	
Big High BtM	−0.00021 (0.9904)	0.90701 (<0.0001)	−0.14098 (<0.0001)	0.79727 (<0.0001)	0.86474 (<0.0001)	0.88809 (<0.0001)	0.82629 (<0.0001)	0.94241 (<0.0001)

Notes: Changes in the price of gold, the S&P 500 index and the USD (that is, ΔGold ΔS&P500, and ΔUSDI) are the percentage changes in the value of the variables from time *t*–1 to time *t*, respectively, which are obtained from Kenneth French's Website. Finally other six variables represent the returns on portfolios formed on firm size (Small and big) and book-to-market ratio (low, mid and high) (that is, Small Low BtM, Small Mid BtM, Small Big BtM, Big Low BtM, Big Mid BtM and Big High BtM),which are also obtained from French's Website. Numbers in the parentheses are *P-values*.

Table 4: The dollar index, the stock market return and the price of gold

Panel A		
	Coefficient	*t-stat*
c	0.0351	2.25***
ΔUSDI	−1.0038	−29.74***
Conditional volatility		
ω	0.0107	5.93***
α	0.0566	19.45***
γ	0.9353	267.96***
Panel B		
	Coefficient	*t-Value*
c	0.0310	1.97
ΔUSDI	−1.0145	−29.35***
ΔS&P	−0.0411	−3.38***
Conditional volatility		
ω	0.0106	6.00***
α	0.0575	19.12***
γ	0.9345	265.29***
Panel C		
	Coefficient	*t-stat*
c	0.1093	3.14***
ΔUSDI	−1.0182	−29.62***
ΔS&P	−0.1569	−6.38***
S&P PS (1,0)	0.0551	1.10
S&P LPS (1,0)	0.0358	0.62
S&P NS (1,0)	−0.2237	−4.59***
S&P LNS (1,0)	−0.0889	−1.56
Conditional volatility		
ω	0.0101	5.53***
α	0.0580	18.42***
γ	0.9345	256.43***

Notes: In these regressions, the dependent variable is the return on gold. The return on gold (ΔGold), the return on S&P500 index (ΔS&P), and the change in the US Dollar index (ΔUSDI) are percentage changes from time *t–1* to time *t*. The returns on S&P500 Index are divided into quintiles. The observations that fall into the middle quintile are considered as normal returns. The observations that are above/below the middle quintile are considered as positive/negative shocks and are assigned dummy variables (i.e. S&P PS and S&P NS). The observations that fall into the top/lowest quintile are considered as large positive/negative shocks and assigned dummy variables (i.e. *S&P LPS* and *S&P LNS*). ***, ** and * indicate significance at 1, 5 and 10 per cent, respectively.

Following models are estimated respectively:

$\Delta\text{Gold} = c+\beta_1\Delta\text{USDI}_t+e_t,$

$\Delta\text{Gold} = c+\beta_1\Delta\text{USDI}_t+\beta_2\ \Delta\text{S\&P}+e_t,$

$\Delta\text{Gold} = c+\beta_1\Delta\text{USDI}_t+\beta_2\ \Delta\text{S\&P}+\beta_3\ \text{S\&P PS}_{t-1}+\beta_4\ \text{S\&P LPS}_{t-1}+\beta_5\ \text{S\&P NS}_{t-1}+\beta_6\ \text{S\&P LNS}_{t-1}+e_t,$

where the conditional volatility is estimated as follows:

$h = \omega+\alpha\ e^2_{t-1}+\gamma\ h_{t-1}$

dummy variable in GARCH models as a regressor could lead to multimodality problems where the maximum likelihood estimates of the coefficient for the dummy variable might not be unique (Doornik and Ooms, 2008). In untabulated robustness tests, we address this problem by including dummy variables with lag in the variance equations as suggested by Doornik and Ooms (2008). However, our conclusions remained virtually unchanged. The dummy variable NS has a negative coefficient and is significant at the 1 per cent level. Hence, after a NS, the price of gold decreased by 0.22 per cent. This is evidence indicating investors do not necessarily demand gold subsequent to drops in the stock market. However, this finding support the scenario we develop in this study. The coefficient of LNS is insignificant, suggesting investors do not react differently with *LNS* than they react with *NS*. More importantly, the dummy variables *PS* and *LPS* are insignificant, which does not add to the view we developed based on contrarian strategies. It may be that the price of gold does not react symmetrically to PSs as it does to NSs. Last but not least, in all the models, USDI has the largest coefficient that is consistently negative and with the highest significance. On average, 1 per cent increase in USDI, decreases the price of gold by 1 per cent.

FIRM SIZE AND THE BTM RATIO PORTFOLIO RETURNS AND THE PRICE OF GOLD

We continue our analysis with the investigation of the relationship between portfolios formed on firm BtM, firm size and gold price change. The goal is to examine whether investors react differently to market fluctuations depending on their portfolios' riskiness. Generally speaking, smaller, high BtM firms are considered to be riskier and yield higher returns than larger, low BtM firms (Fama and French, 1992; Fama and French, 1993). In Panels A through F of Table 5, variables 'Small (Big) Low BtM','Small (Big) Mid BtM', and 'Small (Big) High BtM' represent the returns on portfolios with these characteristics. As before, in addition to portfolio returns, we also use dummy variables to capture the effect of PS and NSs on the price of gold.

Similar to the previous findings, the results in Table 5 indicate that an increase in the value of portfolios formed on smaller or larger firms with low, medium and high BtM ratios affect the price of gold negatively at the 1 per cent level. In economic terms, 1 per cent increase in the value of a portfolio, based on firm size and BtM ratio, decreases the price of gold by 0.11–0.15 per cent. This finding is in line with the traditional view predicting that investors demand more gold when stock returns plummet. However, the dummy variable NS is negative and significant at the 1 per cent level in all six models, indicating that the price of gold decreases subsequent to large drops in portfolio values. Further, in five out of six models, PSs affect the price of gold positively, four of which are significant at the 1 per cent level, while the other is significant at the 5 per cent level. Economically speaking, higher returns in portfolios based on size and BtM ratio decrease the price of gold by 0.10 to 0.15 per cent. Different than the previous findings, LNSs affect the price of gold significantly in three models, as shown in panels B, C and F at the 1, 5 and 10 per cent, respectively. This may be evidence indicating that investors react even more to larger NSs and invest more in losing portfolios, which decreases the demand for gold even more.

Finally, the reactions of the price of gold to stock market swings before and after the 2008 near-collapse of the financial system are compared and results are presented in Table 6. First, note that the magnitude of USDI's effect on the price of gold is lower in the post-crisis period (−1.08 compared with −0.74) with a lower *t*-value (−26.75 compared with −11.72), implying that gold is not as good of a hedge against USDI in the post-crisis era as it was in the pre-crisis era. Second, the coefficient of the return on S&P 500 is more

Table 5: Firm size and the book-to-market ratio portfolio returns and the price of gold

Panel A. Small and low BtM firm

	Coefficient	*t-stat*
c	−0.00113	−0.03
ΔUSDI	−1.0074	−29.88***
Sml Low BtM	−0.1296	−5.96***
Sml Low BtM PS (1, 0)	0.2202	4.49***
Sml Low BtM LPS (1, 0)	0.0899	1.62
Sml Low BtM NS (1, 0)	−0.1102	−2.18***
Sml Low BtM LNS (1, 0)	−0.1065	−1.77
Conditional volatility		
ω	0.007729	4.91***
α	0.0476	14.37***
γ	0.9456	250.09***

Panel B. Small and medium BtM firm

	Coefficient	*t-stat*
c	0.0398	*1.16*
ΔUSDI	−1.0105	−29.56***
Sml Mid BtM	−0.1537	−6.45***
Sml Mid BtM PS (1, 0)	0.1843	3.67***
Sml Mid BtM LPS (1, 0)	0.0776	1.39
Sml Mid BtM NS (1, 0)	−0.1420	−2.73***
Sml Mid BtM LNS (1, 0)	−0.1456	−2.47***
Conditional volatility		
ω	0.007958	5.03***
α	0.0470	14.29***
γ	0.9459	251.00***

Panel C. Small and high BtM firm

	Coefficient	*t-stat*
c	0.0633	1.88**
ΔUSDI	−1.0100	−29.25***
Sml High BtM	−0.1055	−4.90***
Sml High BtM PS (1, 0)	0.0999	2.06***
Sml High BtM LPS (1, 0)	0.0457	0.81
Sml High BtM NS (1, 0)	−0.1240	−2.44***
Sml High BtM LNS (1, 0)	−0.1098	−1.91**
Conditional volatility		
ω	0.007940	4.89***
α	0.0468	14.12***
γ	0.9461	244.55***

Panel D. Big and low BtM firm

	Coefficient	*t-stat*
c	0.0789	2.36***
ΔUSDI	−1.0077	−29.78***
Big Low BtM	−0.1397	−5.82***
Big Low BtM PS (1, 0)	0.0781	1.57
Big Low BtM LPS (1, 0)	−0.002981	−0.05
Big Low BtM NS (1, 0)	−0.1526	−3.16***
Big Low BtM LNS (1, 0)	−0.0649	−1.12
Conditional volatility		
ω	0.007895	4.99***
α	0.0486	14.18***
γ	0.9445	246.71***

Panel E. Big and medium BtM firm

	Coefficient	*t-stat*
c	0.0777	2.22***
ΔUSDI	−1.0106	−29.71***
Big Mid BtM	−0.1517	−6.73***
Big Mid BtM PS (1, 0)	0.0959	1.90**
Big Mid BtM LPS (1, 0)	0.0641	1.17
Big Mid BtM NS (1, 0)	−0.1990	−4.02***
Big Mid BtM LNS (1, 0)	−0.0485	−0.88
Conditional volatility		
ω	0.007714	4.97***
α	0.0471	14.57***
γ	0.9461	260.95***

Panel F. Big and high BtM firm

	Coefficient	*t-stat*
c	0.0798	2.34***
ΔUSDI	−1.0140	−29.81***
Big High BtM	−0.1196	−6.40***
Big High BtM PS (1, 0)	0.1069	2.15***
Big High BtM LPS (1, 0)	−0.0188	−0.34
Big High BtM NS (1, 0)	−0.1581	−3.20***
Big High BtM LNS (1, 0)	−0.0884	−1.63*
Conditional volatility		
ω	0.007894	5.06***
α	0.0469	14.44***
γ	0.9461	259.98***

Notes: In these regressions, the return on gold is the dependent variable. The return on gold (ΔGold) and the change in the US Dollar index (ΔUSDI) are percentage changes from time *t–1* to time *t*. Small (Big) Low BtM, Small (Big) Mid BtM and Small (Big) High BtM represents the returns on portfolios which are formed on small and low BtM ratio firms, small and medium book-to-market ratio firms, and small and high BtM ratio firms, respectively. The returns of portfolios which are formed on firm size and BtM ratio are divided into quintiles. The observations that fall into the middle quintile are considered as normal returns. The observations that are above/below the middle quintile are considered as positive/negative shocks (for example, Small Low BtM PS and Small Low BtM NS). The observations that fall into the top/lowest quintile are considered as positive/negative large shocks (for example, Small Low BtM LPS and Small Low BtM LNS). ***, ** and * indicate significance at 1, 5 and 10 per cent, respectively.

The following model is estimated:

$$\Delta Gold = c+\beta_1 USDI_t+\beta_2 r_{p,t}+\beta_3 r_{p,t}\, PS_{t-1}+\beta_4 r_{p,t}\, LPS_{t-1} +\beta_5 r_{p,t}\, NS_{t-1}+\beta_6 r_{p,t} LNS_{t-1}+e_t,$$

where the conditional volatility is estimated as follows:

$$h = \omega+\alpha\, e^2_{t-1}+\gamma\, h_{t-1}$$

significant and larger in the post-recession era. While a 1 per cent increase in S&P 500 decreased the price of gold by 0.12 per cent in the pre-recession era, after the recession, it decreases the price of gold by 0.19 per cent.

Table 6: The comparison of pre- and post-2008 financial crisis eras

Panel A. Pre-recession era		
	Coefficient	*t-stat*
c	0.1115	2.82***
ΔUSDI	−1.0864	−26.75***
ΔS&P	−0.1098	−3.64***
S&P PS (1,0)	−0.007250	−0.13
S&P LPS (1,0)	−0.0122	−0.18
S&P NS (1,0)	−0.1602	−2.72***
S&P LNS (1,0)	−0.0695	−0.99
Conditional volatility		
ω	0.004608	3.31***
α	0.0446	12.64***
γ	0.9528	247.33***
Panel B. Post-recession era		
	Coefficient	*t-stat*
c	0.1086	1.54
ΔUSDI	−0.7467	−11.72***
ΔS&P	−0.2535	−5.94***
S&P PS (1, 0)	0.2146	2.02*
S&P LPS (1, 0)	0.2093	1.86***
S&P NS (1, 0)	−0.3839	−4.43***
S&P LNS (1,0)	−0.2396	−2.18***
Conditional volatility		
ω	0.0211	4.06***
α	0.0787	11.69***
γ	0.9099	113.15***

Notes: The return on gold (ΔGold), the return on S&P500 index (ΔS&P), and the change in the US Dollar index (ΔUSDI) are percentage changes from time $t-1$ to time t. The returns on S&P500 Index are divided into quintiles. The observations that fall into the middle quintile are considered as normal returns. The observations that are above/below the middle quintile are considered as positive/negative shocks (that is, S&P PS and S&P NS). The observations that fall into the top/lowest quintile are considered as positive/negative large shocks (that is, S&P LPS and S&PLNS). ***, ** and * indicate significance at 1, 5, and 10 per cent, respectively.
Following model is estimated for both pre- and post-recession eras:
$\Delta Gold = c+\beta_1 \Delta USDI_t+\beta_2\ \Delta S\&P+\beta_3\ S\&P\ PS_{t-1}+\beta_4\ S\&P\ LPS_{t-1}+\beta_5\ S\&P\ NS_{t-1}+\beta_6\ S\&P\ LNS_{t-1}+e_t$,
where the conditional volatility is estimated as follows:
$h=\omega+\alpha\ e^2_{t-1}+\gamma\ h_{t-1}$

This suggests that the link between the stock market and the price of gold is strengthened after the crisis, and gold may have become a better hedge against the stock market. However, while the price of gold was affected only by NSs in the pre-crisis era, LPSs, NSs and LNSs have a statistically significant effect on the price of gold after the crisis. Namely, a LPS increases the price of gold by at least 0.2 per cent[11] and a NS decreases the price of gold by 0.38 per cent. If the NS is large, the effect of it increases another 0.24 per cent, implying that the price of gold decreases by 0.62 per cent subsequent to a large NS. We find that in the pre-crisis period, the only dummy variable that is statistically significant is NS, showing that the price of gold decreased by 0.16 per cent subsequent to NSs. In the post-crisis period, on the other hand, three out of four dummy variables that capture positive and NSs turn significant at the 1 per cent level while the other dummy variable is also significant at the 10 per cent level. In economic terms, in the post-crisis period, we find that the price of gold decreases by 0.38 per cent subsequent to NSs; and if the shock is large, this drop is −0.62 per cent (−0.38 per cent −0.24 per cent).

In sum, we find that while gold may still be a hedge against the USDI and the S&P 500, it started reacting to stock market shocks with a higher significance in the post-crisis period. While our results do not reject the traditional view that suggests gold may serve as a hedge against the stock market, we find evidence showing that the price of gold may react differently to large swings, especially NSs, in the post-crisis era. These findings coincide with the central argument of this article that some investors may use gold to take advantage of stock market fluctuations.

CONCLUSION

Prior studies concur that gold is a good hedge against macroeconomic shocks as it is considered to be a safe asset. If gold is a safe asset, then why has the price of gold increased greatly since early 2000s? Some investors sell winning portfolios, requiring them to invest their gains in a safe assets prior and buy losing portfolios when the opportunity is presented. Gold is suitable for such a purpose because gold is an easy-to-trade and relatively liquid asset and has been appreciating over the past

decade. There might be other reasons to invest in gold other than a safe asset, perhaps one of them is buying gold temporarily between market shocks. This would mean that large swings in the stock market might affect the demand for gold and as a result the price of gold. This causes the traditional negative link between the stock market and gold to be temporarily out of line because of shocks to the equity market.

We find fair amounts of evidence indicating when the market, or portfolios formed on firm size, BtM ratio, generate higher negative returns – the price of gold decreases. We also find some evidence that the price of gold increases subsequent to PSs. Our results do not reject the traditional view that gold is demanded as it is a safe asset. However, the results also show that gold may be demanded by investors who sell high and buy low. This may impact the riskiness of portfolios holding gold for hedging and diversification purposes.

NOTES

1. This is a common belief among investors as stated in The Economist: 'People have long viewed gold, rightly or wrongly, as a hedge against high inflation and a weak dollar.' (Haring away, 26 Feb 2009, http://www.economist.com/node/13185396/print) Also, Baur and Lucey (2010, p. 218) propose that 'while there is no theoretical model which explains why gold is usually referred to as a safe haven asset, one major explanation could be that it was among the first forms of money and was traditionally used as an inflation-hedge'.
2. Chris Preston of Wyatt Research defines sudden overnight drops in the price of gold as a mystery because there is no legitimate explanation to these drops other than speculations. (Wyatt Investment Research, 2012, http://www.wyattresearch.com/article/overnight-gold-price-drop-a-mystery/29057) In fact, regarding to the price of gold, some forecasts are speculative and somewhat sentimental. For instance, some comments of 'professionals' regarding price of gold are as follows 'I remain short-term positive, but get nervous at the $1,520-$1,530 level…' or 'I'm bearish for next week…' (see Kitco News 2013a). Related to the mysteriousness of the price of gold, the other aspect is that there are conflicting views about the price of gold in a given week among analysts. For instance, The Kitco News surveys the opinions of professionals in the industry every week. An overview of the results of surveys that are employed in May 2013 is presented in Table 1. On average, 46 per cent of the responses predict an increase while 34 per cent predicted a decrease in the price of gold. However, the data shows that the price of gold decreased by around 3.5 per cent in May 2013. That is, even the majority of professionals (56 per cent) failed to correctly anticipate the change in the price of gold.
3. The contrarian strategy consists of buying losing portfolios or stocks and selling winning ones. The general idea is that the stock market overreacts to new information and thus it is assumed that winning portfolios or stocks are overvalued and expected to reverse down back to their intrinsic values while losing portfolios are assumed to be undervalued and expected to rise back to their intrinsic value.
4. Kevin Mahn (2013) of Forbes argues that the SPDR Gold Shares make gold more 'user-friendly' to buy and thus easier to trade, http://www.forbes.com/sites/advisor/2013/01/14/what-will-influence-the-price-of-gold-in-2013/.
5. These portfolio definitions and returns are obtained from Kenneth French's Website http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.
6. See, Lord Abbett Market View (1 January 2013) https://www.lordabbett.com/advisor/commentary/marketview/010713/.
7. In Abken (1980, p. 4) it is concluded that people may demand more gold in the presence of 'political and economic uncertainty'.
8. As summarized in Lawrence (2003), this is because 'firstly, assayed gold is homogeneous; secondly, [it] is indestructible and fungible; and thirdly, the inventory above-ground stocks is astronomically large relative to changes in flow demand'.
9. Baur and Lucey (2010) define hedge '… as an asset that is uncorrelated or negatively correlated with other asset or portfolio on average', a diversifier '… as an asset that is positively (but not perfectly correlated) with another asset or portfolio on average,' and safe heaven 'as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil'.
10. In untabulated results we confirm that all observations that are classified as negative/positive shocks are negative/positive returns.
11. Note in Table 6 in the post-recession panel that the dummy variable S&P PS is significant at only 10 per cent level. To be conservative, we state that the effect of the S&P LPS is at least 0.2093 per cent.

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