Use of Gold in Financial Risk Hedge

ELENA SMIRNOVA
State University of New York at Old Westbury

Commodities very often are added to a diversified market portfolio to protect individual investors and firms from tail risk events. Recently, banks that have to comply with the new liquidity and risk management requirements joined this trend. This paper finds that for the period of 2004 to 2012 gold acted as a safe haven and a diversifier. The findings suggest that gold ETFs and gold mining stocks act as a safe haven in market downturn. Gold mining stocks are strongly correlated with the market factor during the normal market conditions, but they do show diversification benefits in the turbulent investment climate. This finding is consistent with the notion that mining companies stocks act as call options on the price of gold. The moneyness of these call options changes across periods of market volatility.

Introduction

Commodities very often are added to a diversified market portfolio to protect investors and firms from tail risk events. Recently, this trend is amplified by institutions that hold large positions in commodity futures for hedging purposes and by banks that have to comply with the new liquidity and risk management requirements. This development is known as the financialization of commodity markets.

Historically, it has been shown that commodities, like gold, serve as a safe haven in times of market turmoil.[1] When the stock market plummets, gold prices increase, making a diversified investor immune to recession. The

[1] Several academic studies considered a link between precious metals, stock, bond and exchange rate markets. See, for example, Bredin, D., Conlon, T. and Poti, V. (2015); Conlon, T., Lucey, B. and G. Uddin (2015); Ciner, C., Gurdgiev, C. and Lucey, B. (2013); Reboredo (2013); Sari, R., Hammoudeh, S. and Soytas, U. (2010); Hillier, D., Draper, P. and Faff, R. (2006); Baur, D.G. and Lucey, B.M., (2010) and Hammoudeh, Malik and McAleer (2011), among others.

hedging feature of gold is reflected in the reduction of a portfolio's Value at Risk (VaR), as well as in a low correlation of gold with the stock market index.

Prior research has looked at the ability of gold to act as a safe haven or a hedge in times of extreme market volatility. However, the literature in this area focuses on precious metals and not as much on their Exchange-Traded Funds (ETFs) or on gold mining companies. I extend the analysis to include both ETFs and the stocks of gold mining companies. Investors and hedgers alike will find the results of this paper to be of interest. In particular, I show that gold ETFs and gold mining stocks can serve as safe havens during market turmoil.[2]

This paper finds that for the period of 2004 to 2012 gold acted both as a safe haven and a diversifier. These two novel findings suggest that gold ETFs and gold mining stocks serve as a safe haven in market turmoil. Gold mining stocks are strongly correlated with the market factor during the normal market conditions, but they do show diversification benefits in the turbulent investment climate. This noteworthy finding is consistent with the notion that gold mining companies stocks act as a call option on the price of gold. The moneyness of this call option changes in periods of market stress, making gold mining stocks act more like gold and less like a typical equity.

This paper takes a look at prior research that has been done in relation to gold as a portfolio diversifier and adds a new dimension to the topic. My research contributes to the prior literature in three distinct ways. First, the paper estimates gold price as a function of the Fama-French (1993) benchmark factors and not just a stock index or a bond index, as others have done. Second, this research considers Exchange-Traded Funds that are linked to gold price as an alternative to gold holdings. The results suggest that gold ETFs are independent of the market index, have low betas and can serve as a diversification tool. Third, the paper checks whether the gold mining stocks have the same underlying factors as gold itself. The last hypothesis holds in the events of high market volatility and low equity returns. The results are robust to different model specifications.

The current paper touches upon several aspects of the literatures

[2] I thank an anonymous referee for suggesting that I explore this issue.

discussed. Section 2 conducts a review of the relevant literature. Section 3 examines the sample and methodology employed in the paper. Section 4 discusses the empirical findings for gold, ETFs and the Gold Mining Index in a normal investment climate. Section 5 analyzes the safe haven quality of gold bullions, ETFs and mining stocks during the periods of high market volatility and low market returns. Section 6 concludes.

Literature Review

The critical step in evaluating any financial risk management strategy is to correctly measure the underlying risk exposure after the hedge. This research is closely related to prior literature on commodity hedging and portfolio diversification. In particular, gold can be used as a risk management vehicle and as an instrument for capital preservation. First of all, gold increases portfolio diversification through its low correlation, on average 0.1, to other assets (World Gold Council [WGC] 2013). In addition, gold reduces portfolio losses during tail-risk events. For example, WGC (2010) finds that portfolios with 3-9% allocation to gold outperform those without gold during recessions.

This feature of gold is referred to as safe haven, or the ability to have negative or zero correlation with a portfolio in adverse market conditions (Baur and Lucey 2010). As a source of capital preservation, gold hedges extreme inflation scenarios and exchange risk in currencies. It is found that on average gold has a -0.5 correlation against the U.S. dollar and negative correlation against most developed market currencies (WGC 2010). Reboredo (2013) evaluates dependence between gold and the US dollar using copula functions that capture movements of two random variables across marginal market movements and extreme market movements. He finds evidence of the hedging properties of gold against USD rate movements as well as symmetric tail dependence between gold and a USD exchange rate, which indicates that gold can serve as a safe haven against extreme fluctuations of the US currency.

In an inflationary climate gold has been shown to dynamically protect against changes in the consumer price index (Conlon, Lucey and Uddin 2015). Using continuous wavelet transformation, Conlon et al. (2015) examine gold hedging properties against realized inflation for the United

States, Japan, Switzerland and the United Kingdom and establish that it is a good short-term and long-term hedge. They also show comovements of gold with unexpected inflation and the ability of gold futures and gold stocks to act as a hedge against inflation.

Gold serves an important function of reducing tail risk, which can be assessed in various ways. The concept of Value at Risk (VaR) was introduced to portfolio management field of finance in the 1990s and became very popular for its ease of interpretation and appealing rationale. The most prominent type of risk in portfolio management is market risk, or uncertainty of future earnings due to unforeseen changes in market conditions. It reflects the potential economic loss caused by the decrease in the market value of a portfolio.

Value at Risk gives an estimate of the largest losses that a portfolio is likely to suffer during all but very exceptional days. It is defined as the maximum potential loss of portfolio value with a given probability over a certain time period.[3] For example, a fund manager specifies time period as one day and the frequency of maximum loss as 99%. Suppose further, that the VaR is calculated to be $1 million. Then, on the average, 99 out of 100 days of trading, the fund would not lose more than $1 million. Put differently, the fund would expect to exceed losses by more than $1 million once every 100 days on average.

There is a variety of models that may be used to estimate VaR. First, one can use a parametric prediction of conditional volatilities where the underlying distribution of returns is specified (JP Morgan Risk Metrics is the best known example of such approach). Second, there is a non-parametric prediction of unconditional volatilities (historical simulation or stress testing method). Third, semi-parametric method combines non-parametric historical simulation with parametric estimation of the tail of the return distribution (Chung 2003).

However, the most widely used technique to calculate VaR utilizes historical covariance between different risk factors to assess the effect of shocks on a portfolio whose positions can be mapped to those risk factors. This is the approach that WGC (2010) takes to justify its recommendation

[3] For a more detailed discussion of Value at Risk approach see Manganelli and Engle (2001) and Basak and Shapiro (2001).

of holding from 2.5% to 9% of assets in a form of gold. The rationale behind this advice is the reduction of such a portfolio's weekly VaR by 0.1% to 15.5%.

The ability of gold to diminish investors' losses without sacrificing return makes portfolios optimal in a sense of decreasing VaR. WGC (2010) research produces two alternative scenarios. First, it considers portfolios based on average correlations between assets designed to maximize expected returns over the long run. Second, it creates portfolios based on correlations observed in the periods of market turmoil. These are formally defined as the period when U.S. equities decrease by more than two standard deviations from the expected value. The latter portfolios are designed to maximize returns during the periods of higher risk. Then, for each scenario, the WGC (2010) finds the optimal asset allocation with and without gold. These scenarios are summarized in Table 1.

The WGC posits that relatively small allocations of gold (from 3% to 9%) help investors reduce potential losses without substantially sacrificing expected return. Using the data from January 1987 to July 2010, they compute average returns, volatilities and weekly VaR for selected portfolios. Table 1 shows that including gold in a portfolio reduces volatilities and VaRs and yet delivers similar expected returns. For example, adding 3% gold to the portfolio mix produces a 6.5% annual return and reduces weekly VaR by 6.4%, from $76,000 to $71,000, for a 2.5% confidence level.

Simply put, for 97.5 out of 100 weeks, the $10 million portfolio with a 3% gold allocation would not lose more than $71,000 on average. If we change the confidence level to 1%, meaning that we now look at 99 out of 100 weeks, then the portfolio with 3% gold would not lose more than $96,000 as compared to $108,000 losses without gold.

Furthermore, if we increase allocation of gold to 9% and assume that the market is in turmoil (high risk portfolio), Table 1 shows that the annualized portfolio variance goes down from 11% without gold to 10.4% with gold. The weekly VaR drops by 5.5% from $318,000 to $301,000 for a 2.5% confidence level, meaning that for 97.5 weeks out of 100 weeks, portfolio losses would not exceed $301,000. For a 1% confidence level, the VaR drops by 3.3% from $443,000 to $429,000. This finding implies that for 99 out 100 weeks, high-risk portfolio losses would not exceed

$429,000 on a $10 million portfolio.

Adding gold to a portfolio not only mitigates losses but increases gains during negative market events. In periods of financial distress, portfolios with gold perform better. The WGC (2010) finds that during the 2007-2009 recession, for example, including a 3% allocation of gold increased gains by $173,000 on a $10,000,000 portfolio. A 6% allocation of gold increased the portfolio's value by $426,000 during the same time period.

As another example, Hammoudeh, Malik and McAleer (2011) compute the VaR for gold, silver, platinum and palladium using four specifications of return volatility structure: Risk Metrics, the GARCH model with normal, the GARCH model with t-distribution and the Filtered Historical Simulation (FHS) approach. They use daily returns based on closing spot prices for the four precious metals during the period of January 4, 1995 to November 12, 2009. Based on an out-of-sample forecast performance, they find that the GARCH with t-distribution produces a VaR with the most accurate and robust estimates of the actual VaR thresholds for all four precious metals.

Hillier, Draperand and Faff (2006) examine the role of gold, silver and palladium in financial markets using daily return data from 1976 to 2004. They find that all three metals have low correlation with stock market index returns, and they possess a hedging capacity as safe havens during periods of abnormal stock market volatility. During that period of time, financial portfolios with precious metals perform better than standard equity portfolios.

Baur and Lucey (2010) distinguish between a safe haven, a hedge and a diversifier. They define a hedge as an asset that is uncorrelated or negatively correlated with another asset or portfolio. A hedge does not reduce losses in times of market turmoil since the correlation property is only required to hold on average; in other words, a hedge can exhibit a positive correlation in periods of recession. A diversifier is an asset that is positively but not perfectly correlated with another asset or portfolio on average. Similar to the hedge, it does not necessarily reduce losses in adverse market conditions. A safe haven, on the other hand, is an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress.

The specific property of a safe haven asset is the non-positive correlation with a portfolio in extreme market conditions. This property does not force the correlation to be positive or negative on average but only to be zero or negative in specific periods. Hence, in normal times or bullish market conditions, the correlation can be positive or negative. If the haven asset is negatively correlated with the other asset or portfolio in extreme and adverse market conditions, it is compensating the investor for losses since the price of the haven asset rises when the price of the other asset or portfolio falls.

Using the return data on international stocks, bonds and gold from November 30, 1995 to November 30, 2005, Baur and Lucey (2010) find gold to be a hedge against stocks, on average, and a safe haven in extreme market conditions, but the latter property is short-lived. They illustrate the change in a portfolio comprising gold and stocks over the 50 trading days after the occurrence of an extreme negative stock return. The cumulative gold return increases slightly at the time of the initial shock, then remains around zero in the United States and Germany and turns negative after about 15 trading days in the United Kingdom.

Conover, Jensen, Johnson and Mercer (2009) present evidence on the benefits of adding precious metals (gold, silver and platinum) to U.S. equity portfolios. They evaluate different weights (from 5% to 25%) of these metals in a typical portfolio and find that adding a 25% allocation of precious metals in a portfolio consisting of equities substantially improves the portfolio performance. They report that gold, relative to platinum and silver, has a better standalone performance and appears to provide a better hedge against the negative effects of inflationary pressures. Similarly, Lucey and Li (2015) consider several precious metals, such as gold, silver, platinum and palladium, to act as safe havens and find that this quality is time-varying. For example, in the U.S. during certain periods of time, silver is the best choice for portfolio investors, while gold is the strongest haven at other times.

Using the autoregressive distributed lag approach, Sari, Hammoudeh and Soytas (2010) examine the co-movements and information transmission among the spot prices of four precious metals (gold, silver, platinum and palladium), oil price and the US dollar-euro exchange rate. They find

evidence of a weak long-run equilibrium relationship but strong feedbacks in the short-run. They conclude that investors may diversify a portion of the risk by investing in precious metals, oil and the euro.

Bentes (2015) examines the volatility of gold returns using daily data from August 1976 to February 2015. He employs three models - GARCH(1,1), IGARCH(1,1) and FIGARCH(1,d,1) - and finds that the last model is the best to capture linear dependence in the conditional variance of the gold returns as given by the information criteria. The full return sample is divided into two sub-periods. The first in-sample period (August 2, 1976 - October 24, 2008) is used to estimate model coefficients. The second out-of-sample period (October 27, 2008–February 6, 2015) is used for forecasting purposes. Bentes (2015) also shows that FIGARCH(1,d,1) is also the best model to forecast the volatility of gold returns.

Another emerging stream of literature utilizes technical analysis and high frequency intraday trading data to assess benefits of gold (O'Connor, Lucey, Batten and Baur 2015; Urquhart, Batten, Lucey, McGroarty and Peat 2015). The Urquhart et al. (2015) study examines the intraday profitability of spot gold and silver during the period of 2008 – 2015, which is an interesting time frame in terms of the effect on the gold and silver markets of the central bank quantitative easing. Urquhart et al. (2015) point out that gold and silver comprise an important asset for central banks. Additionally, the introduction of new capital requirements for banks has enhanced demand for liquid assets, including gold and silver, which serve as a tool for the banks' risk management.

The paper by Urquhart et al. (2015) examines three popular moving average rules on 5-minute intervals over the trading day for gold and silver markets. The results show that only the Simple Moving Average (SMA) rule for gold generates significant profits in the in-sample as well as the out-of-sample period. An important implication is that intraday technical trading rules can be profitable in the gold market, but investors need to select parameters appropriate to the frequency of the data. These parameters will be different for investors who trade on daily data. The authors also find that silver offers no significant profits, suggesting that the silver market is weak form efficient.

The two important findings of this study are that gold ETFs and

gold mining stocks can serve as effective safe havens. Prior research on gold mining companies finds that gold mining firm exposures are inversely related to the level of gold prices, the volatility of gold returns, the level of diversification by the firm and the amount of its gold production that it hedges (Tufano 1998). Average gold mining beta using daily data for the period of April 1990 to March 1994 is reported to be 2.21, while the median gold beta is 2.09. This implies that for a 1% return on gold, the mean and median gold mining stock moves by about 2%. Tufano (1998) posits that gold mining firms selling their product at higher forward prices should experience less gold price shocks. Hedging and financial engineering used by gold mining companies affects their risk exposure and, ultimately, their valuation.

A vast literature on the information content of options market is also relevant to this paper since gold mining companies can be viewed as a call option on the price of gold. The seminal research by Chowdhry and Nanda (1991) and Easley, O'Hara and Srinivas (1998) show that informed traders choose options market to trade first, and it leads the underlying stock market. Cremers and Weinbaum (2010) find the predictability of stock returns from violations in put-call parity. More recently, An, Ang, Bali and Cakici (2014) develop a noisy rational expectations model of informed trading in both stock and options market. It shows that stock-level information predicts the options returns and, at the same time, option volatilities can predict future stock returns.

This implies that option prices contain predictive information about stock returns and vice versa. Hayunga and Lung (2014) examine information content in the options market around the announcements of a consensus revision by analysts. Approximately three days prior to announcement options, investors start trading in the right direction of the revision (both upgrade and downgrade). The findings indicate that options market leads the stock market before the revision in option-implied prices, implied volatilities and options trading volume.

The advances in hedging techniques by institutions created an influx of research in the developing area called "financialization" of commodities.[4] Policy makers and academics hypothesize that the flows of financial commodity investors had a great impact on commodity futures prices and

return dynamics. In the literature, this is referred to as the financialization of commodity markets. Tang and Xiong (2012) study the rising co-movement between oil and other commodities, especially those belonging to popular indices. Singleton (2014) examines the 2008 run up in oil prices by using vector autoregressions and tests whether commodity index traders Granger cause commodity futures returns.

He finds evidence that flows from institutional investors are to blame for the oil price bust. Buyuksahin and Robe (2014) investigate the recent increase in the correlation between commodities and equity indices. They find that it is due to the activity of the hedge funds in the futures market. Basak and Pavlova (2015) develop a multi-good, multi-asset dynamic model with institutional investors and standard futures markets participants to test three interesting hypotheses. First, the paper discovers that the prices of all commodities futures go up with financialization, more so the prices of futures belonging to the index. Institutional investors have a mandate of hedging against commodity prices or a mandate of matching a benchmark index for performance evaluation. Therefore, institutions value assets that pay off more when the benchmark index does well. Second, the volatilities of index and non-index futures returns go up with financialization. The volatilities of index futures rise more since they are especially attractive to institutional investors because of their comovements with the index. Finally, Basak et al. (2015) find the emergence of a commodity index as a new factor that leads to an increase in correlation among commodity futures and in equity-commodity correlations. The paper models demand shocks and allows disentangling the effects of institutional investors from the effects of the supply and demand fundamentals. Basak et al. (2015) conclude that the effects of financialization are substantial.

Henderson, Pearson and Wang (2015) provide novel evidence on commodity-linked notes (CLN) and their effect on commodity futures prices. Over-the-counter CLNs are issued by a financial institution and have a payoff linked to the price of a single commodity, commodity futures contract, commodities index or basket of commodities futures. Henderson

[4] For the effects of financialization on commodity markets see Henderson, Pearson and Wang (2015), Tang and Xiong (2012), Singleton (2014), Basak and Pavlova (2015) and Buyuksahin and Robe (2014).

et al. (2015) find that the underlying futures prices increase on the CLN pricing dates when the hedge trades are likely to be executed and decrease on determination dates when the trades are likely to be unwound. The price increase averages 34, 39 and 49 basis points depending on the proceeds ($2 million, $5 million and $10 million, respectively). The negative price impacts are sized similarly, with no price reversion within 20 trading days. The finding implies that CLN issues impact commodity spot prices and that financial institutions play an important role in price formation of commodities.

Empirical Sample

The goal of this paper is to take a closer look at the role of gold in portfolio diversification in recent years. First, the paper addresses the issue of low correlation between gold and stock prices. Then, gold Exchange-Traded Funds (ETFs) and Gold Mining stock index are discussed as possible diversification alternatives.

The data on gold and S&P 500 prices are provided by the American Institute for Economic Research. Gold price is the end-of-the-month London PM gold fixing price, which is compared to the S&P500 closing price for the period of January 1970 to August 2012. Figure 1 shows the two time series. Shaded areas on the graph indicate recessions. There are two main points evident from Figure 1. First, it is notable that gold and the S&P500 move in opposite directions. That has a significant implication for portfolio management since investors who hold gold can protect themselves from adverse market movements. Portfolio return is affected not only by individual asset volatilities but also by the degree to which different assets interact with each other or their correlation structure. Gold tends to have low or negative correlation with many asset classes.

Second, the shaded areas in Figure 1 indicate the periods of distress: early 1970s recession (December 1972- September 1974), Iran-Iraq war (January 1980-March 1980), 1980s recession (July 1981- August 1982), Great Recession (October 2007- March 2009) and European sovereign debt crisis (November 2009 – June 2010). Preliminary evidence suggests that during serious market downturns gold not only holds its value but tends to go up on average, thus serving a safe haven by protecting the portfolio value in times of distress.

The next section examines the response of gold returns, gold ETF returns and Gold Mining Index returns to Fama-French (1993) benchmark factors. The data on these factors are obtained from the Kenneth French data library accessible through the Dartmouth College Tuck School of Business.[5] Some investors find it more convenient to hold gold ETFs rather than actual gold bullions in their portfolio. An ETF gives investors the chance to include the metal in the portfolio but trade the metal like a stock.

ETFs eliminate the need for a safe storage facility used for actual gold bullions. Investors who buy shares in a gold ETF do not see the gold, which is stored in vaults around England and Switzerland. Gold ETFs did not exist in the U.S. until 2004, and now they have more than $50 billion in assets (Pearlman 2011). The price of the largest gold ETF, SPDR Gold Shares, is pegged to 10% of gold's price. Table 2 shows the correlation structure of Fama-French benchmark factors and gold, gold ETFs and the Gold Miners index. The Gold Miners index is a collection of the stocks of the largest gold mining companies.

Table 2 demonstrates that a SPDR Gold ETF is negatively correlated with the market benchmark and High minus Low (HmL) growth factor. However, these correlations are very small in magnitude and not statistically significant. The correlation coefficient between SPDR Gold ETF and Small minus Big (SmB) benchmark factor is positive but still insignificant. A different picture appears when we look at the Pearson correlation between Gold miners and Market factor. It is positive, large in magnitude (0.396) and statistically significant. A preliminary conclusion from this correlation structure points to the fact that gold and Gold ETF might be better candidates for portfolio diversification than gold mining stocks due the low insignificant correlation with the stock market factors. The next section explores this point through regression analysis.

Methodology

[5] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

GOLD RETURNS

Diversification of portfolio risk is achieved when assets have low correlation with each other. In this section, the Fama and French (1993) asset pricing model is used to check whether gold returns move together with the three benchmark factors. Those factors are the excess return on the market (Rm-Rf), the size factor (SmB) and the book-to-market factor (HmL).[6] The hypothesis is that gold is not significantly related to any of the stock market movements.

$$\text{Gold Returns} = a + b^{*}(r_m - r_f) + c^{*}\,\text{SmB} + d^{*}\,\text{HmL} \qquad (1)$$

The results of the regression are provided in Table 3. The simple model in specification (1) shows a powerful result. Most gold returns are explained by factors other than stock market attributes. This is evident from a regression R-square of only 0.003. None of the coefficients is significant except for the intercept. The hypothesis that gold does not depend on stock market movements holds based on the sample period of 1970 to 2012. Thus, investors can use gold as a diversification tool in their stock portfolios.

Additionally, as a robustness check, equation (1) is estimated using daily gold returns and daily Fama-French factor returns. Prior research shows that GARCH (1,1) error covariance structure is more appropriate for daily time-series financial data, which is often plagued with contemporaneous correlation.[7] Here, daily data is collected from November 2004 to August 2012. The results are presented in specification (2) of Table 3. The results are similar to the simple OLS model design. Daily gold returns are not correlated with Fama-French market factors, with the exception of (Rm – Rf), whose coefficient is small in magnitude (0.000521) and has a marginal significance level of 15%. This means that if the excess market return changes by 1%, the gold return changes by 0.0521% in the same direction.

[6] Rm-Rf, the excess return on the market, is the value-weighted return on all NYSE, AMEX and NASDAQ stocks (from CRSP) minus the one-month Treasury bill rate (from Ibbotson Associates). SmB (Small minus Big) is the average return on three small portfolios minus the average return on three big portfolios. HmL (High minus Low) is the average return on two value portfolios minus the average return on two growth portfolios.

[7] See, for example, Baur and Lucey (2010) and Hillier et al. (2006).

We can infer a small degree of positive correlation between gold returns and market returns, which still makes gold a good candidate for portfolio diversification.

GOLD EXCHANGE-TRADED FUNDS (ETFS)

The previous subsections show that allocating gold to a portfolio of stocks might be beneficial in terms of VaR reduction and low correlation with the stock market factors. In addition, this section explores if gold alternatives, such as Gold ETFs, provide similar diversification advantages. ETFs came into existence in 2004. Therefore, regression (2) uses returns of the largest and the most active SPDR Gold ETF from November 20, 1994 to August 31, 2012.

$$\text{Gold ETF Returns} = a + b^{*}(r_m - r_f) + c^{*}\,\text{SmB} + d^{*}\,\text{HmL} \qquad (2)$$

Table 4 reports regression results of SPDR Gold ETF returns on the benchmark Fama-French factors. Specification (1) of Table 4 shows a very low explanatory power of regression (2) evident from R-square of 0.007. This means that Gold ETF returns are explained by fundamentals other than the Fama-French benchmark factors. Gold ETFs provide a good diversification instrument for an equity investor. Beta coefficients are consistent with the previously reported correlation structure of SPDR Gold to the three benchmark factors. As expected, none of the coefficients is significant.

Specification (2) of Table 4 reports results of GARCH (1,1) specification of ETF daily returns regression on Fama-French factors. A surprising result is the positive and significant beta coefficient of 0.001304 for the Market risk factor. This means that gold ETF returns move together with the market index on a daily basis; when the excess market return changes by 1%, the Gold ETF return changes by 0.1304% in the same direction. The result can be interpreted as an indication of Gold ETFs being less advantageous to the portfolio investor than gold itself.

GOLD MINING INDEX

Gold mining stocks have received much attention in commodity literature as a popular way to gain exposure to gold. These stocks were

considered "[g]old in the ground" by many analysts.[8] Over 300 gold mining companies are listed and publicly traded on various U.S. stock exchanges alone. The World Gold Council (2013) reports that the gold mining sector is capitalized at over U.S. $220 billion globally. Capitalizations range from U.S. $50 – 300 million to the large cap gold mining stocks of over U.S. $10 billion.

The value of the gold mining stocks is driven significantly by the price of gold, but it is also impacted by the mines, projects, reserves of gold below ground and mining royalty income streams. Numerous factors are involved in the pricing and valuation of gold mining equities. These can include: the maturity and geographic spread of mining projects, gold reserves, ore grades, costs, margins, profitability, strength of balance sheet, the debt profile and the quality of management. A combination of these forces will cause the share prices of gold stocks to act in a leveraged manner around the value of gold (WGC 2013).

However, the mining stocks' performance was not satisfactory since the onset of financial crisis in 2008. While gold holdings provided a safe haven for investor's portfolios, gold mining companies exhibited negative returns (-2.67% for NYSE Arca Miners Index, for example) and high volatility (37.38% for the same index).[9] These sub-par performance results are due to rising costs of gold production and political unrest in gold mining countries.

Several other risk factors influence the supply of gold by mining companies. Exploration investment is a necessary part of the mining process. Expenditures on the discovery of new deposits have risen almost four-fold over the last decade.[10] According to the gold industry report, the exploration phase accounts for more than 15% of total mining capital expenditures, and this cost is likely to increase in the future. Additionally, gold ore grades are declining, and developed gold deposit depths are increasing. These trends indicate that mines will increasingly be located underground and incur higher costs of gold extraction.

[8] AIS. "Reassessing Gold Mining Stocks." AIS Investment Guide. Great Barrington, MA: AIS, Inc., 30 April 2013.
[9] Ibid.
[10] "European Capital Goods: Mining and Marine – A Deep Dive Into Two Demand Super-Cycles." Bernstein Black Book Industry Report. Hong Kong: Sanford C. Berstein & Co, LLC, 2012. 68.

It is interesting to explore whether the Gold Miners Index provides a diversification tool to stock investors. This hypothesis is tested through a regression of NYSE Arca Miners Index daily returns on Fama-French benchmark factors from 1994 to 2012.

$$\text{Arca Gold Miners Returns} = a + b^{*}(r_m - r_f) + c^{*}\,\text{SmB} + d^{*}\,\text{HmL} \qquad (3)$$

The regression estimation results are presented in Table 5. It is evident from specification (1) of Table 5 that gold mining companies do not provide the same diversification benefit to stock investors as gold holdings do. The returns of the gold mining index are positively and significantly correlated with the market benchmark (Rm – Rf), Small-minus-Big size factor and High-minus-Low growth factor. The R-square is higher than in the previous tables, explaining 17.1% of Gold Miners variation.

Specification (2) of Table 5 estimates the same regression with a GARCH (1,1) variance structure to correct for contemporaneous return correlation. The results show a strong positive correlation with the market excess return but no correlation with the other two factors. Overall, Table 5 confirms the previously found high correlation of the Gold Miners index with the market factor. When the market goes up by 1%, the miners index moves up by 0.787%, reflecting a positive and statistically significant market risk beta.

Gold as a Safe Haven during Periods of High Volatility

The previous section established that gold and, to some degree, gold ETFs serve as a good hedge for market portfolios over the period of 1970 to 2012 (1994 to 2012 for ETFs). Another quality of gold is serving as a safe haven during times of market turmoil (Baur and Lucey 2010). To gauge whether gold, gold ETFs and the gold mining index possess this quality in the current sample, I employ methodology of Hillier et al. (2006) and the World Gold Council (2010) with some modifications. There are two interaction variables which proxy for low market returns and excess market volatility that are included in the regressions. Indicator variable Turmoil is equal to 1 if the market returns fall two or more standard deviations below

the S&P500 average return. This variable serves as a proxy for the market downfall. Another indicator variable, Volatility, assumes the value of 1 if the market volatility, measured by the standard deviation of market historical returns, is more than two standard deviations above the mean volatility.[11] This indicator is a proxy for the market instability.

Assessing the safe haven quality of gold with these new variables modifies the existing regression model as follows.

$$\text{Gold Returns} = a + b^*(r_m - r_f) + c^* \text{SmB} + d^* \text{HmL} + \gamma^*(r_m - r_f)^*\text{Turmoil} + \tau^*(r_m - r_f)^* \text{Volatility} \quad (4)$$

Following the work of Hillier et al. (2006), equation (4) permits four cases with respect to gold's response to market factors. These cases are summarized in Table 6. A period of stable volatility (Volatility=0) and below average market return (Turmoil =0) signifies a normal investment climate in which safe haven properties of gold are less important. When volatility is high (Volatility=1) and market returns fall two standard deviations below average (Turmoil=1), investors are turning to safe haven properties of gold and would want a negative gold elasticity, given by $a + \gamma + \tau$. Table 6 sets up several hypotheses.

Ho_1: $\gamma + \tau < 0$ (gold provides safe haven in times of market turmoil and high volatility)

Ho_2: $\gamma < 0$ (gold is safe haven during periods of market turmoil and low volatility)

Ho_3: $\tau < 0$ (gold is safe haven in times of high volatility and normal returns)

Table 7 reports several specifications of model (4) for different dependent variables of interest: gold returns, ETF returns and Arca Gold Miners index returns. Specification (1) in Table 7 shows how gold returns react to market factors and Turmoil and Volatility indicator variables. As

[11] Market volatility is calculated with Rogers-Satchell (1991) model. This model was chosen because it uses intraday high and low S&P500 prices to improve the efficiency of the volatility estimate. The model is especially suitable for the geometric Brownian motion price process with non–zero drift when the drift dominates volatility, i.e., periods of crisis.

implied by Ho_3, the coefficient on Volatility indicator is significant and negative, meaning that as the market becomes more volatile, gold provides a safe haven to investors. This result is consistent with Hillier at al. (2006). Ho_2 is rejected since the Turmoil coefficient is positive and insignificant; during periods of low market returns but stable volatility, safe haven properties of gold are not present in our sample. However, combined coefficients of Turmoil and Volatility indicators produce a negative sum of -0.0006963, giving validation to Ho_1; in the periods of both low returns and high volatility, gold has a tendency to move opposite to the market.

Specification (2) in Table 7 shows the result of Gold ETF regression on the explanatory variables. We can see a strong support for all three hypotheses - coefficients on Turmoil, Volatility and the sum of the two are negative and statistically significant. During periods of high market risk, when returns are low and volatility is high, Gold ETFs can serve as a good hedging vehicle and provide investors with diversification benefits.

Specification (3) in Table 7 provides an important yet unexpected result of a negative and significant coefficient of Gold Miners returns on the Volatility indicator. This shows that gold mining stocks can diversify an equity portfolio in times of high market volatility, providing support for Ho_3. The coefficient on Turmoil variable is negative but insignificant, which points to a limitation in the diversifying role of mining stocks. The sum of the two coefficients is negative, providing some support for the Ho_1.

As mentioned on the onset, Tufano (1998) finds that gold mining companies can dynamically adjust the sensitivity of their stock returns to gold prices by altering their use of financial leverage, hedging techniques and diversification into other minerals. This makes gold mining stocks a noteworthy tool for practitioners and investors. If gold mines are viewed as call options on the price of gold, then as market volatility rises, the moneyness of the call options makes gold mining stocks act less like a typical equity and more like gold itself.[12] Thus, gold mining investments are beneficial in periods of high market volatility. The same result, only in a stronger form, holds for gold ETFs – investors will be well protected both

[12] I am grateful for this comment made by an anonymous referee and reiterated by the journal editorial board.

from market volatility and from market turmoil if they include gold ETFs in their portfolios.

Conclusions

In recent years the popularity of including commodities and index strategies on those commodities in investors' portfolios garnered much attention in the literature. Gold holdings in particular tend to have low correlation with many assets, which make it a great diversification tool. During periods of economic turmoil this correlation becomes negative. This benefits investors since gold tends to protect against tail risks, like the recent financial crisis. This feature of gold is called safe haven. Largely, the academic and anecdotal evidence on the use of gold and other precious metals in a form of ETFs, jewelry and bullions proves that these investments are advantageous in times of turmoil.

This research compares gold performance against the Fama-French benchmark factors and finds that gold is a great portfolio diversification tool because its returns are unrelated to market performance, as well as to size and growth factors. The paper also takes into consideration a recent trend of holding Gold ETFs instead of physical gold bullions. ETF returns are found to have a positive beta in relation to the market factor, providing limited diversification benefits to the investors. Gold mining companies show high correlation with the market portfolio. They do not have a diversification advantage such as gold in normal market conditions. However, during periods of instability, gold ETFs serve as a good substitute for gold.

Inclusion of precious metals, such as gold, gold ETFs or a gold mining stock index, in an equity portfolio can reduce systematic risk in market downturn. This paper shows that gold and gold mining stocks serve as safe havens for investors during periods of high market volatility, and gold ETFs provide a safe haven quality both in times of low returns and unstable volatility. Gold mining companies act as a call option on gold prices, and moneyness of that option changes during the periods of market decline.

The results provided in this research cover the most recent period, which includes the turbulent years of the recent financial crisis of 2008. While some results are consistent with prior academic and applied research,

there is new evidence of some limitations of gold mining stocks and gold itself during periods of low equity returns. Gold ETFs, on the other hand, should gain more popularity due to their low correlation with the market index, safe haven qualities in market turmoil, ease of trading and high liquidity.

Overall, this paper suggests that some exposure to gold (preferably, in the form of ETFs) is beneficial to a well-diversified investor. This research can be of particular interest to the managers of mutual funds, financial planners and the investors' community at large.

References

American Investment Services. "Is Gold a Safe Haven?" Investment Guide 34.9(2012): 66-68.

American Investment Services. "Reassessing Gold Mining Stocks." Investment Guide 35.4(2013): 33-35.

An, B., A. Ang, T.G. Bali, and N. Cakici. "The Joint Cross Section of Stocks and Options." *Journal of Finance* 69.5(2014): 2279-2337.

Basak, S., and A. Pavlova. "A Model of Financialization of Commodities." Working paper, London Business School and CEPR, 2015.

Basak, S., and A. Shapiro. "Value-at-Risk-Based Risk Management: Optimal Policies and Asset Prices." *Review of Financial Studies* 14.2(2001): 371-405.

Baur, D.G., and B.M. Lucey. "Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold." *The Financial Review* 45.2(2010): 217–229.

Bentes, S.R. "Forecasting Volatility in Gold Returns under the GARCH, IGARCH and FIGARCH Frameworks: New Evidence." *Physica A: Statistical Mechanics and Its Applications* 438(2015): 355-364.

Bredin, D., T. Conlon, and V. Poti. "Does Gold Glitter in the Long-Run? Gold as a Hedge and Safe Haven across Time and Investment Horizon." *International Review of Financial Analysis* Forthcoming, 2015.

Buyuksahin, B., and M. Robe. "Speculators, Commodities and Cross-Market Linkages." *Journal of International Money and Finance* 42.C(2014): 38-70.

Chowdhry, B., and V. Nanda. "Multimarket Trading and Market Liquidity." *Review of Financial Studies* 4.3(1991): 483-511.

Chung, S. "The Estimation of a Firm's Hedging Effects: Marginal Value at Risk (M-VaR) Approach." *Derivatives Use, Trading & Regulation* 9.2(2003): 117-132.

Ciner, C., C. Gurdgiev, and B. Lucey. "Hedges and Safe Havens: An Examination of Stocks, Bonds, Gold, Oil and Exchange Rates." *International Review of Financial Analysis* 29.C(2013): 202-211.

Conlon, T., B. Lucey, and G. Uddin. "Is Gold a Hedge Against Inflation? A Wavelet Time-Frequency Perspective." Working paper, Trinity College, Dublin, Ireland, 2015.

Conover, C.M., G.R. Jensen, R.R. Johnson, and J.M. Mercer. "Can Precious Metals Make Your Portfolio Shine?" *Journal of Investing* 18.1(2009): 75–86.

Cremers, M., and D. Weinbaum. "Deviations from Put-Call Parity and Stock Return Predictability." *Journal of Financial and Quantitative Analysis* 45.(2010): 335-367.

Easley, D., M. O'Hara, and P.S. Srinivas. "Option Volume and Stock Prices: Evidence on Where Informed Traders Trade." *Journal of Finance* 53.2(1998): 431-465.

Fama, E., and K. French. "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics* 33.1(1993): 3-58

Hammoudeh, S., F. Malik, and M. McAleer. "Risk Management of Precious Metals." *Quarterly Review of Economics and Finance* 51.4(2011): 435-441.

Hayunga, D.K., and P.P. Lung. "Trading in the Options Market around Financial Analysts' Consensus Revisions." *Journal of Financial and Quantitative Analysis* 49.3(2014): 725-747.

Henderson, B., N. Pearson, and L. Wang. "New Evidence on the Financialization of Commodity Markets." *Review of Financial Studies* 28.5(2015): 1285-1311.

Hillier, D., P. Draper, and R. Faff. "Do Precious Metals Shine? An Investment Perspective." *Financial Analysts Journal* 62.2(2006): 98–106.

Manganelli, S., and R. Engle. "Value at Risk Models in Finance." Working paper No.75, The European Central Bank, 2001.

O'Connor, F.A., B.M. Lucey, J.A. Batten, and D.G. Baur. "The Financial Economics of Gold—A Survey." *International Review of Financial Analysis* 41(2015): 186-205.

Pearlman, R. "The Power of Gold: The Risks and Rewards." *Smart Money Magazine* 14 February 2011.

Reboredo, J.C. "Is Gold a Safe Haven or a Hedge for the US Dollar? Implications for Risk Management." *Journal of Banking & Finance* 37.8(2013): 2665–2676

Rogers, L., and S. Satchell. "Estimating Variance from High, Low and Closing Prices." *Annals of Applied Volatility* 1.4(1991): 504-512.

Sari, R., S. Hammoudeh, and U. Soytas. "Dynamics of Oil Price, Precious Metal Prices, and Exchange Rate." *Energy Economics* 32.2(2010): 351–362.

Singleton, K. "Investor Flows and the 2008 Boom/Bust in Oil Prices." *Management Science* 60.2(2014): 300-318.

Tang, K., and W. Xiong."Index Investing and the Financialization of Commodities." *Financial Analysts Journal* 68.6(2012): 54-74.

Tufano, P. "The Determinants of Stock Price Exposure: Financial Engineering and the Gold Mining Industry." *Journal of Finance* 53.3(1998): 1015-1052.

Urquhart, A., J.A. Batten, B.M. Lucey, F. McGroarty, and M. Peat. "Does Technical Analysis Beat the Market?–Evidence from High Frequency Trading in Gold and Silver." Working paper, August 28, 2015. Social Science Research Network (http://ssrn.com/abstract=2652637).

World Gold Council. "Gold Investor: Risk Management and Capital Preservation." New York: World Gold Council, April 2013.

World Gold Council. "Gold: Hedging against Tail Risk." New York: World Gold Council, October 2010

TABLE 1

Portfolio Performance with and without Gold during Normal Market Conditions and in High Volatility Scenario.

Allocations to gold range from 3% to 9%. Source: World Gold Council (2010) and AIS Investment Guide (September 30, 2012).

	Average Risk Scenario		High Risk Scenario	
	w/o gold	with gold	w/o gold	with gold
Gold weight	-	3%	-	9%
Expected annual return (%)	6.6	6.5	7.9	7.7
Annual volatility	3.2	3.1	11.0	10.4
2.5% VaR ($)	76,000	71,000	318,000	301,000
Gain/loss by including gold (%)	-	6.4%		5.5%
1.0% VaR ($)	108,000	96,000	443,000	429,000
Gain/loss by including gold (%)	-	11.3	-	3.3

TABLE 2

Pearson Correlation Coefficients between Gold, SPDR Gold ETF, Arca Gold Miner's Index and Fama-French Benchmark Factors.

*, **, *** indicate significance at 15%, 10% and 5% confidence level, respectively.

		Gold	Rm-Rf	SmB	HmL
Pearson Correlation	Gold	1.000	0.0109	0.0384	0.0237
	Rm-Rf		1.000	0.1762	0.4299
	SmB			1.000	-0.0254
	HmL				1.000
		SPDR Gold ETF	Rm-Rf	SmB	HmL
Pearson Correlation	SPDR Gold ETF	1.000	-.013	.042	-.051
	Rm-Rf		1.000	.470	.482
	SmB			1.000	.351
	HmL				1.000
		Arca Gold Miners	Rm-Rf	SmB	HmL
Pearson Correlation	Arca Gold Miners	1.000	.396***	.041*	.068***
	Rm-Rf		1.000	.176	.430
	SmB			1.000	-.025
	HmL				1.000

TABLE 3

Results of the Gold Return Regression on Fama and French (1993) Benchmark Factors.

In specification (1) monthly gold returns are computed from the end-of-month prices from February 1970 to August 2012. In specification (2) daily gold returns are computed from closing daily data from November 2004 to August 2012. *, **, *** indicate significance at 15%, 10% and 5% confidence level, respectively.

Dependent Variable: Gold Returns	OLS with Monthly Returns	GARCH (1,1) with Daily Returns
	(1)	(2)
Constant	0.952**	0.000550
Rm–Rf	-0.012	0.000521*
SmB	0.035	0.000382
HmL	-0.082	0.000681
Sample size	511 monthly returns	2100 daily returns
Model significance	R-square = 0.003	Log likelihood = 6397.604 Prob> Chi-square = 0.0008

TABLE 4

Results of the SPDR Gold ETF Return Regression on Fama and French (1993) Benchmark Factors.

In specification (1) monthly returns are computed from the end-of-month prices from November 2004 to August 2012. In specification (2) daily returns are computed from daily closing prices for the same time period.
*, **, *** indicate significance at 15%, 10% and 5% confidence level, respectively.

Dependent Variable: SPDR Gold ETF	OLS with Monthly Returns	GARCH (1,1) with Daily Returns
	(1)	(2)
Constant	1.599**	0.000474
Rm–Rf	-0.016	0.001304***
SmB	0.170	0.000255
HmL	-0.108	0.000526
Sample size	93 monthly returns	2100 daily returns
Model significance	R-square = 0.007	Log likelihood = 6395.506 Prob> Chi-square = 0.0000

TABLE 5

Results of the NYSE Arca Gold Miners Index Return Regression on Fama and French (1993) Benchmark Factors.

Daily returns are computed from the end-of-month prices from November 2004 to August 2012.
*, **, *** indicate significance at 15%, 10% and 5% confidence level, respectively.

Dependent Variable: Arca Gold Miners Returns	OLS with Daily Returns	GARCH (1,1) with Daily Returns
	(1)	(2)
Constant	0.000	0.0001158
Rm – Rf	0.009***	0.0078743***
SmB	-0.002*	0.001194
HmL	-0.006***	-0.000469
Sample size	2100 daily returns	2100 daily returns
Model significance	R-square = 0.171	Log likelihood = 5094.06 Prob > Chi-square = 0.0000

TABLE 6

A Matrix of Possible Gold Response to Market Instability and Market Downfall.

	Turmoil	
Volatility	Equity Index returns are two st.dev. above the market average (Turmoil =0)	Equity Index returns fall two st.dev below the market average (Turmoil =1)
Low - below two st.dev. of the mean market volatility; (Volatility=0)	a	$a + \gamma$
High - above two st.dev. of the mean market volatility; (Volatility=1)	$a + \tau$	$a + \gamma + \tau$

TABLE 7

Results of the Gold, ETF and Miners Returns GARCH(1,1) Regression on Volatility and Turmoil Indicators.

Daily gold returns are computed from closing daily data from November 2004 to August 2012. All regressions are using GARCH(1,1) model. *, **, *** indicate significance at 15%, 10% and 5% confidence level, respectively.

	Gold Returns	ETF Returns	Arca Gold Miners Index Returns
	(1)	(2)	(3)
Constant	0.000547**	0.0003806	0.0000479
Rm-Rf	0.000787**	0.0020891***	0.0091492***
SmB	0.0003385	0.0000809	0.0011318
HmL	0.0008541*	0.0009226	0.0001869
Turmoil	0.0000747	-0.0013294***	-0.0007564
Volatility	-0.000771**	-0.0014891***	-0.0029558***
Sample size	2100	2100	2100
Model significance	Log likelihood = 6399.194 Prob> chi-square test = 0.000	Log likelihood = 6405.723 Prob> chi-square test = 0.0000	Log likelihood = 5100.537 Prob> chi-square test = 0.0000

FIGURE 1

Gold Prices and S&P500 over the Period of 1970-2012.

Source: American Investment Services. "Is Gold a Safe Haven?" *Investment Guide* 34.9(2012): 66-68.