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The price of shelter - Downside risk reduction with precious metals

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ABSTRACT

Investor aversion to extreme losses may motivate them to seek out investments perceived to function as a safe haven during times of crisis. In this study, we consider the potential for precious metals to mitigate downside risk when combined with equities, and evaluate the impact on portfolio risk-adjusted returns. Each of gold, silver and platinum are found to contribute to downside risk reduction at short horizons, but diversification into silver and platinum may result in increased long horizon portfolio risk. The price of sheltering an equity portfolio from downside risk is a relative reduction in portfolio risk-adjusted returns. Variance and kurtosis properties of precious metals are identified as marginal contributors to downside risk reduction. Futures markets on precious metals are also shown to present an interesting and viable diversification alternative to physical metals.

1. Introduction

The aversion of investors to extreme downside risk has been heavily documented.[1] In particular, aversion to acute losses may lead investors to seek a risk premium for bearing extreme downside risk, (Bali, Demirtas, & Levy, 2009; Ang, Chen, & Xing, 2006), and also impact their optimal allocation strategy, (Jarrow & Zhao, 2006; Liu, Longstaff, & Pan, 2003). Recent literature has considered the safe-haven properties of precious metals, and gold in particular, illustrating the capacity of gold to act as a strong short-run hedge for traditional assets during times of extreme market turbulence (Baur & Lucey, 2010; Baur & McDermott, 2010).[2] Gold has also been considered as a hedge against inflation, (Beckmann & Czudaj, 2013; Gorton & Rouwenhorst, 2006), and as a currency safe-haven (Reboredo, 2013; Capie, Mills, & Wood, 2005).

Our paper first examines the ability of three precious metals, gold, silver and platinum, to reduce portfolio downside risk when held together with equities. While investors require a risk premium to bear extreme downside risk, (Bali et al., 2009; Ang et al., 2006), they may also be willing to cede expected returns in order to negate such risks. In this light, we also explore the price of diversifying a traditional portfolio with precious metals. Specifically, we examine the change in the risk-return profile of an equity portfolio with a proportional allocation to precious metals, relative to an equity-only portfolio. In contrast to previous studies, focussed predominantly on the unadjusted reward-to-risk ratio (for example, Hillier, Draper, and Faff (2006)), we consider both the relative Sharpe ratio and relative modified Sharpe ratio as performance metrics, explicitly accounting for the risk-free rate. The latter point is noteworthy, as any relationship, positive or negative, between gold and interest rates might alter the investment implications.[3] This analysis helps to reconcile conflicting previous evidence regarding the performance implications of portfolio diversification using precious metals.

This paper adopts a methodology appropriate for understanding infrequent but dangerous tail events. Downside risk measures are concerned with quantifying only the potential losses that a portfolio might be exposed to.[4] In measuring the downside risk of an investment it is vital to consider higher-order moments of the distribution for two reasons; first, financial returns are extensively shown to be non-normal, implying that variance alone is not a suitable measure of risk. Second, investors have preferences over higher-order moments of returns such as skewness and kurtosis (Dittmar, 2002; Kraus & Litzenberger, 1976). In this paper, risk is characterized

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1 A large body of theoretical work proposes that investors trade-off between risk and skewness, in an attempt to avoid situations with potential for extreme downside losses (see, for example, Chiu (2005), Keenan and Snow (2002) and Menezes, Geiss, and Tressler (1980)). Moreover, experimental evidence also suggests that investors consider potential for extreme losses when making investment decisions (Unser, 2000; Olsen, 1997).

2 A detailed review of the role of gold as an investment asset may be found in Batten, Baur, Lucey, and O'Connor (2015).

3 Various arguments have been put forward regarding the perceived relationship between gold and interest rates (Erb & Harvey, 2013).

4 A variety of measures to quantify downside have been proposed, including semivariance, lower partial moments and value-at-risk. In this study, we focus on the latter as it facilitates the quantification of the level of extreme losses to which an investor might be exposed.

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using a four-moment downside risk measure, accounting for the skewness and kurtosis of the empirical distribution. These higher-order moments are captured by way of the Cornish-Fisher expansion (Favre & Galeano, 2002). This methodology offers new insights relative to previous safe haven analysis, including facilitating analysis of any potential trade-off between moments of a portfolio when holding precious metals.

Our paper incorporates a number of innovations. In contrast to previous studies which have examined the hedging and safe-haven potential of gold, our paper is the first known study to explicitly examine the downside risk reduction possibilities from a portfolio perspective. Given the extent of non-normality in asset returns (see Cont (2001) and Pagan (1996), for example), only an evaluation taking account of higher-order moments can provide an accurate assessment of the risk reduction opportunities. Second, while a growing literature examines the safe-haven properties of gold, little attention has been paid to the downside risk reduction properties of silver and platinum. We examine both silver and platinum, and contrast their risk reduction potential with that of gold. Third, taking account of higher-order moments enables identification of the individual contributions from distributional moments on risk reduction. This issue has also not been considered previously in the literature.

Next, the level of risk reduction achievable may vary across different return intervals, in keeping with previous findings for risk (Bandi & Perron, 2008; Gençay, Selcuk, & Whitcher, 2005), hedging (Conlon & Cotter, 2012, 2013) and risk management (Rua & Nunes, 2009). We build upon previous papers examining the temporal dimension of risk reduction, (Bredin, Conlon, & Potì, 2015; Baur & McDermott, 2010; Baur & Lucey, 2010; Lucey, Potì, & Tully, 2006), providing a detailed analysis of the risk-return relationship at each horizon. Fifth, investors are unlikely to consider an investment in precious metals for downside risk reduction purposes in isolation. Instead, they will consider the tradeoff between risk (or downside risk) and return in their allocation decision. In this paper, we determine the price of investing in precious metals, by examining relative risk-adjusted returns. Our findings shed new light on the benefits of precious metals as an investment asset, as results are based upon a more appropriate performance metric over a longer sample than previously considered. Finally, building on previous studies focussed almost exclusively on physical gold, we examine the diversification potential of precious metal futures and exchange traded funds (ETF's).

Our results indicate that the risk reduction opportunities from gold are, in fact, larger than previously indicated by the literature, but only for short investment horizons (less than 15 days). Similar findings are also reported for silver and platinum, although not consistently as substantial as those for gold. At longer horizons, gold retains some downside risk-reduction properties, while those for silver and platinum are attenuated. These findings imply that an investor concerned with short horizon risk can achieve downside risk reduction benefits from precious metals, but the choice of precious metal is of first order importance for those seeking longer term diversification.

Building on this, we find that find that investors must pay a price to achieve downside risk reduction, contrary to much previous research.[5] An investor must surrender some proportion of their risk-adjusted returns to mitigate negative returns in traditional assets. This is in keeping with the notion that downside risk has an associated risk-premium (Bali et al., 2009; Ang et al., 2006). Instead of earning a risk-premium for bearing downside risk, investors must pay a risk-premium to negate downside risk.

Our identification approach illustrates that precious metal kurtosis is a key contributor to portfolio downside risk reduction, while the skewness properties of precious metals do not help in mitigating such risks. Again, this result is specific to short horizons. The benefits from kurtosis are suggested to be a consequence of low co-kurtosis between precious metals and equities, a consequence of non-coincident tail risks. When the analysis is extended to both futures and exchange traded funds (ETF's) relating to precious metals, we also find evidence of downside risk reduction properties. In particular, we find that the proportion of risk-adjusted returns surrendered to achieve downside risk reduction is lower for futures markets. The source of this additional performance is increased returns, rather than risk reduction and is attributed to roll yield from futures markets.

The paper is organized as follows: Section 2 describes the measurement of downside risk reduction, while Section 3 details the data examined in the study. Empirical results are reported in Section 4 and Section 5 concludes.

2. Downside risk reduction

2.1. Downside risk measurement

Two-moment value-at-risk (VaR) may be employed to measure the level of tail- or downside risk associated with an asset, provided that the asset's returns are normally distributed. For a given confidence level, two-moment VaR is defined as the maximum expected loss on a portfolio over a given time interval or horizon (τ) and is given by

$$VaR_p\,(1-\alpha,\tau) = \mu_p - \sigma_p z(\alpha) \tag{1}$$

where $z(\alpha)$ is the α quantile of the standardized distribution. The time interval, τ, is the horizon over which we are interested in measuring risk, while μ_p and σ_p are the mean and standard deviation of portfolio returns respectively. When the empirical distribution of returns is normal, the VaR of an asset is simply a constant multiple of the standard deviation of asset returns.

Financial asset returns have been heavily documented as not following a normal distribution, making it likely that two moment VaR will not accurately capture the risk associated with potentially large non-normal returns. In order to understand the downside risk of a portfolio consisting of traditional assets and precious metals, we employ the four-moment *modified VaR*, first documented by Favre and Galeano (2002) in the case of hedge funds. The four-moment modified VaR is derived from the Cornish-Fisher expansion, which adjusts the quantiles of a distribution to account for the higher-order moments of skewness and kurtosis. The Cornish-Fisher expansion approximates the quantile of the distribution as,

$$\hat{Z}\,(\alpha,S_p,K_p) = z(\alpha) + \frac{1}{6}\left(z(\alpha)^2-1\right)S_p + \ldots \frac{1}{24}\left(z(\alpha)^3-3z(\alpha)\right)K_p - \frac{1}{36}\left(2z(\alpha)^3-5z(\alpha)\right)S_p^2 \tag{2}$$

where μ_p, σ_p, S_p and K_p are the first four moments of portfolio P, K_p is the excess kurtosis and $z(\alpha)$ is the α quantile of the standard normal distribution. The modified four-moment VaR is then given by

$$MVaR_p\,(1-\alpha,\tau) = \mu_p - \sigma_p\hat{Z}\,(\alpha,S_p,K_p)\,, \tag{3}$$

[5] Chua, Sick, and Woodward (1990) and Jaffe (1989) indicate increased portfolio returns and corresponding decrease in portfolio risk upon the addition of gold. Hillier et al. (2006) also detail a relative improvement in the reward-to-risk ratio for equity portfolios with a proportional allocation to gold, silver or platinum. Only Emmrich and McGroarty (2013) cite decreasing risk-adjusted returns for a portfolio incorporating gold after 2001.