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Can gold hedge and preserve value when the US dollar depreciates?

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ABSTRACT

This paper examines gold's hedging and value-preserving properties against fluctuations in the US dollar. We propose a likelihood ratio test that draws a distinction between hedging and safe-haven characteristics on the basis of the conditional dependence structure under different market conditions. Our evidence, based on an analysis of data for US dollar exchange rates with a broad set of currencies, indicates that gold can serve as a hedge against US dollar depreciation but is a weak safe haven against extreme US dollar movements. These results have implications for risk management and hedging strategies.

1. Introduction

Financial media and investors have long noted that the price of gold and the value of the US dollar (USD) have tended to move in opposite directions. Gold is linked to the USD because it is priced in USD; hence, when the USD loses value the nominal price of gold rises, thereby preserving gold's real value and providing an exchange-rate hedge for investors with USD holdings. As a result, gold has attracted investors' attention for many decades and has been gaining a reputation as a financial asset that provides diversification benefits against currency movements and that could act as a safe haven against extreme currency movements. The aim of this research was to test whether gold provides diversification and downside risk benefits against USD fluctuations for currency investors.

The potential role of gold as a hedge or investment safe haven against USD depreciation has been examined in several studies.[1] Beckers and Soenen (1984) analyzed gold's hedging benefits for investors, finding asymmetric risk diversification for gold's holding positions for US and non-US investors. Sjasstad and Scacciavillani (1996) and Sjasstad (2008) provide evidence on the effects of USD appreciation or depreciation on the price of gold. The positive relationship between USD depreciation and the price of gold, and thus the hedging power of gold against the USD, was confirmed by Capie et al. (2005). According to Pukthuanthong and Roll (2011), the price of gold is also associated with currency depreciation in all countries. Likewise, the empirical evidence reported by Joy (2011) indicates that gold is a weak safe haven and a successful hedge against the USD. Wang and Lee (2011) studied the hedging effect of gold for the yen, finding that this effect depended on the extent of yen depreciation. More recently, Zagaglia and Marzo (2013) documented the fact that co-movements between gold and the USD were unaffected by the current financial crisis, leaving its hedging abilities unaltered. Finally, using copulas to characterize average and tail dependence, Reboredo (2013b) reported evidence of average and symmetric tail dependence between gold prices and USD depreciation, with the positive implications in terms of diversification benefits and downside risk reduction confirming the usefulness of gold for currency portfolio risk management.

The distinguishing feature of gold as a hedge or safe-haven asset is the dependence structure between gold and exchange rates, specifically, average and extreme market dependence (see, e.g., Baur and Lucey, 2010; Baur and McDermott, 2010; Kaul and Sapp, 2006). Gold acts as

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[1] Other studies have examined the role of gold as a hedging device against inflation (see, e.g., (Chua and Woodward, 1982; Jaffe, 1989; Ghosh et al., 2004; Worthington and Pahlavani, 2007; Blose, 2010; Wang et al., 2011)) and gold's hedge and safe-haven status with respect to oil price changes (Reboredo, 2013a) and stock market movements (Baur and Lucey, 2010; Baur and McDermott, 2010; Miyazaki et al., 2012).

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a hedge when disjointed or opposite movements in gold and the USD value are observed only on average and not in a specific region of their joint distribution (e.g., the tails). Gold is a safe haven when gold and USD depreciation exhibit tail dependence; thus, when the USD experiences sharp depreciation, gold increases greatly in value, and vice versa.

In the empirical literature, the dependence structure of gold with exchange rates and stock returns has been examined by considering the behavior of the gold–USD exchange rate correlation coefficient (see, e.g., Joy, 2011) or by considering the marginal impact of stock returns on gold returns using a threshold regression model, with the threshold given by a specific quantile of the stock return distribution (see, e.g., Baur and Lucey, 2010; Baur and McDermott, 2010; Ciner et al., 2013; Wang and Lee, 2011). However, when the joint distribution of gold and exchange rates is far from the elliptical distribution, the correlation coefficient is insufficient to describe the dependence structure (see Embrechts et al., 2003), especially for extreme market dependence; meanwhile, the marginal effects captured by the threshold regression model do not fully account for conditional joint extreme market movements (Reboredo, 2013b).

In this paper, we contribute to the empirical literature by testing gold's hedging and safe haven characteristics, using a methodological approach based on the abovementioned notions of tail dependence and average dependence. This approach involves two steps. First, to analyze tail dependence, extreme values have to be identified, in particular extreme losses for the USD exchange rate and gold price. Following Reboredo et al. (2013), we used the extreme value theory to classify extreme returns as those that exceed a specific threshold. In the literature (see, e.g., Baur and McDermott, 2010; Joy, 2011; Ranaldo and Söderlind, 2010) extreme market conditions were exogenously identified as a specific quantile (90%, 95%, etc.) of the return distribution or as a specific time period. Second, once gold and USD returns have been identified as extreme and non-extreme, we test for tail and average conditional dependence between gold and USD exchange rates using a likelihood ratio test of conditional dependence that draws a distinction between hedge and safe-haven asset characteristics in terms of conditional dependence under different market circumstances. Specifically, we consider the conditional probability that gold returns at time t lie in a specific region of their return classification, given that exchange rates belong to a specific region at time $t-1$. We then formulate different dependence hypotheses in accordance with the implications of a hedge or safe haven for dependence. Gold acts as a hedge when, given non-extreme USD depreciation, the conditional probability that gold returns are in a non-extreme state is greater than when this probability is conditional on extreme USD depreciation. Similarly, gold serves as a safe-haven asset when the conditional probability that the value of gold remains as a normal or extreme positive value is greater than the probability that gold takes an extreme downward value conditioned on the fact that the USD also experiences extreme depreciation.

Our empirical study of the hedge and safe-haven properties of gold against the USD exchange rate covered the period January 2000 to September 2012 and involved the USD exchange rate with respect to a broad set of currencies and a USD exchange rate index. The evidence provided by the likelihood ratio test indicates that gold serves as a hedge and as a weak safe-haven asset against exchange rate fluctuations. These results, which confirm the claim in the financial media that gold can hedge and preserve value against USD rate fluctuations, have portfolio and risk management implications, given their usefulness regarding portfolio design, particularly in relation to downside risk.

The rest of the paper is laid out as follows: in Section 2 we outline the methodology and test the hedge and safe-haven hypotheses. In Sections 3 and 4 we present data and results, respectively. Finally, Section 5 concludes the paper.

2. Empirical methodology

According to the definitional approach described in Kaul and Sapp (2006), Baur and Lucey (2010) and Baur and McDermott (2010), the distinctive features of an asset as a hedge or safe haven are as follows:

- Hedge: an asset is a hedge if it is uncorrelated or negatively correlated with another asset or portfolio on average.
- Safe haven: an asset is a safe haven if it is uncorrelated or negatively correlated with another asset or portfolio in times of extreme market movements.

Thus, the distinguishing feature of gold as a safe haven or as a hedge against exchange rate fluctuations is the shape of the gold and exchange rate dependence structure. If gold has safe haven properties, then its value is not (negatively) affected by extreme downward USD movements, implying a specific form of tail dependence. If gold has hedging properties, however, disjointed or opposite movements in gold and the USD value are required only on average and not in a specific region of their joint distribution (e.g., the tails).

We tested for the hedging and safe haven characteristics of gold using the above notions of tail and average dependence. This approach involved two steps: first, analyzing tail dependence by identifying extreme losses for the USD exchange rate and gold price using the extreme value theory to classify extreme returns as those that exceed a threshold u; and second, once gold and USD returns were identified as extreme and non-extreme, testing for tail and average conditional dependence between gold and USD exchange rates using a likelihood ratio test of conditional dependence.

2.1. Identifying extreme values

As in Reboredo et al. (2013), we used the peaks-over-threshold (POT) approach to identify extreme gold and USD exchange rate values as those exceeding a specific threshold u. To select this threshold we used a non-parametric approach called the Hill estimator, applicable to distributions that belong to the maximum domain of attraction (MDA) for the Fréchet distribution. The Hill estimator is applied directly to the return series $\{r_t\}_{t=1}^{T}$, so there is no need to consider subsamples in order to obtain information on extreme returns. Given the order statistics of the return sample:

$$r_{(1)} \leq r_{(2)} \leq \ldots \leq r_{(T)},$$

the Hill estimator for a positive integer k is defined as:

$$\xi_{Hill}(k) = \frac{1}{k}\sum_{i=1}^{k}\left[ln\left(r_{(T-i+1)}\right) - ln\left(r_{(T-k)}\right)\right], \quad (1)$$

where k emphasizes that the estimator depends on k. In practice, to find the correct value of k, the Hill estimator is plotted against it in order to find the value k for which the estimator appears to be stable (Tsay, 2010). In this plot the Hill estimator is associated with different thresholds. The following ordered pairs are graphed:

$$\left\{\left(k, \alpha_{k,T}^{Hill}\right) : k = 2, 3, \ldots, n\right\} \quad (2)$$

where $\alpha = \frac{1}{\xi_{Hill}(k)}$ is the estimated tail index.

The Hill estimator $\xi_{Hill}(k)$ converges in probability to ξ as $k \to \infty$. It is asymptotically normally distributed, with asymptotic variance given by ξ^2/k.

2.2. Testing for conditional dependence

The Hill estimator identifies upper and lower thresholds for gold and USD depreciation return series, with returns classified as extremely positive, extremely negative or non-extreme. From this