



# Gold and exchange rates: Downside risk and hedging at different investment horizons



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## ABSTRACT

This paper assesses the hedging and downside risk benefits of using gold for currency risk management at different investment horizons. Using wavelet multi-resolution analysis, we characterized market interdependence between gold and exchange rates for different time scales, finding positive dependence between gold and US dollar depreciation against a wide set of currencies for all time scales for the period January 2000 to March 2013. The analysis for mixed gold–currency portfolios confirms the usefulness of gold in currency hedging and downside risk management at different investment horizons, even though the size of the benefits varies through investment horizons, with benefits circumscribed to specific kind of portfolios, namely, those whose weights are optimally determined.

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## 1. Introduction

The coupling between the US dollar (USD) value and gold prices has long fascinated financial media, investors and researchers in equal measure. For many years, gold has been gaining credibility as a special financial asset that provides diversification benefits against currency swings and preserves portfolio value against extreme currency movements. The fact that gold preserves its value in times of a weak dollar feeds into investor interests in using gold as an asset in portfolio risk management. The aim of this paper is to study whether gold provides diversification and downside risk benefits to currency investors considering different investment horizons.

The potential of gold to serve as hedge or safe-haven asset against exchange rate risk was noted early on in the literature.<sup>1</sup> Beckers and Soenen (1984) provided evidence on gold's hedging benefits for investors, finding asymmetric risk diversification for gold's

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<sup>1</sup> Another strand of the literature has investigated the benefit of using gold to hedge against inflation risk (see, e.g., Chua & Woodward, 1982; Jaffe, 1989; Ghosh, Levin, Macmillan, & Wright, 2004; Worthington & Pahlavani, 2007; Blose, 2010; Wang, Lee, & Thi, 2011) and gold's hedge and safe-haven status with respect to oil price changes (Reboredo, 2013a) and stock market movements (Baur & Lucey, 2010; Baur & McDermott, 2010; Miyazaki, Toyoshima, & Hamori, 2012). Other studies have analysed the relationship between gold, oil and exchange rates (see, e.g., Ewing & Malik, 2013; Kim & Dilts, 2011; Malliaris & Malliaris, 2013; Sari, Hammoudeh, & Soytas, 2010), between these variables and interest rates (Wang & Chueh, 2013) and the forecasting ability and efficiency of gold markets (see, e.g., Apergis, 2014; Pierdzioch, Risse, & Rohloff, 2014).

holding positions for US and non-US investors. Sjasstad and Scacciavillani (1996) and Sjasstad (2008) confirmed that dollar appreciation or depreciation had strong effects on the price of gold. Similarly, Capie, Mills, and Wood (2005) reported a positive relationship between USD depreciation and the price of gold that confers gold with hedging power against the USD. According to Pukthuanthong and Roll (2011), the price of gold is also associated with currency depreciation in all countries. Likewise, Joy (2011) studied the role of gold as a hedge or an investment safe haven, reporting that gold was a poor safe haven and a successful hedge against the USD. Wang and Lee (2011) studied the hedge effect of gold for the yen, finding that this effect depended on the size of yen depreciation. More recently, Zagaglia and Marzo (2013) documented that co-movements between gold and the USD remained unaffected by the recent financial crisis, so its hedging abilities were left unaltered. Finally, Reboredo (2013b) characterized average and extreme market dependence between gold and the USD using copulas, finding evidence of average and symmetric tail dependence between gold prices and USD depreciation. This has positive implications in terms of diversification benefits and downside risk reduction and confirms the usefulness of gold for currency portfolio risk management.

This paper contributes to the current literature by exploring whether gold provides hedging and downside risk benefits against currency movements at different investment horizons. Investors in exchange rate markets are heterogeneous and have different term objectives, so a proper understanding of gold–currency dependency at different time scales is a fundamental concern for investors seeking to use gold to hedge currencies or reduce downside risk. In contrast to the above-mentioned studies considering the gold–currency relationship at only one or at most two time scales (the short and the long run), we study this relationship at different time scales using wavelet multi-resolution analysis. The wavelet approach is model-free and permits a timeseries to be decomposed into different frequency components without losing time information: lower time scales capture higher frequency time series components which occur over very short periods of time, whilst higher time scales capture lower frequency components occurring over very long periods of time. Thus, the use of wavelets avoids the problem of reduced data over longer horizons, allowing term relationships between gold and currencies to be disclosed that are difficult to uncover using other econometric techniques. Wavelets have been used to model the relationship between different economic variables, like expenditure and income (Ramsey & Lampart, 1998) and stock returns and inflation (Kim & In, 2005), and have also been used to model co-movement between energy commodities (see, e.g., Vacha & Barunik, 2012), between oil and stock returns (see, e.g., Jammazi, 2012; Reboredo & Rivera-Castro, 2014) and between oil prices and exchange rates (see, e.g., Benhmad, 2012; Reboredo & Rivera-Castro, 2013). However, no study has as yet used wavelets to analyse dependence between gold and currency and the implications for risk management at different investment horizons.

Our empirical research on gold's ability to hedge and reduce downside currency risk contributes to the literature in two ways. First, for the period January 2000 to March 2013, for both the time and frequency domains, we studied market interdependence between gold and the USD exchange rate for a wide set of currencies and a USD exchange rate index by analysing wavelet variances and correlations along different time horizons. This is of relevance for investors with different investment horizons. Second, we address the hedging and downside risk benefits of gold by considering different kinds of portfolios for different maturities, evaluating the importance of gold in a currency portfolio by comparing the risk for gold–currency portfolios to the risk for a currency-only portfolio; furthermore, by studying value-at-risk (VaR), expected shortfall (ES), semivariance and regret performance, we evaluate whether investors exposed to currency risk could achieve downside risk gains from including gold in their portfolio. Our empirical results indicating that gold and USD depreciation have positive dependence that is robust across different time scales extend previous empirical evidence on the gold–USD depreciation relationship (see, e.g., Pukthuanthong & Roll, 2011) by considering different time scales. Moreover, we found that hedge, risk minimization and equally weighted gold–currency portfolios experienced downside risk gains that varied across different investment horizons and portfolio compositions, with downside benefits occurring for the hedge and risk minimization portfolios but not for the equally weighted portfolios. Hence, our evidence extends existing results on the diversification benefits of commodities (see, e.g., Cheung & Miu, 2010; Erb & Harvey, 2006; Jensen, Johnson, & Mercer, 2000) by confirming the usefulness of gold in risk management of a currency portfolio, even though this usefulness varies for different investment horizons and portfolio compositions.

The rest of the paper is laid out as follows: in Section 2 we outline wavelet methodology and wavelet variance and dependence at different time scales. In Sections 3 and 4 we present data and results regarding the implications of gold–currency dependence at different time scales in terms of portfolio risk management. Finally, Section 5 concludes the paper.

## 2. Methodology

### 2.1. Wavelets

Wavelets, a powerful statistical technique, are capable of decomposing time series into different components associated with different scales of resolution.<sup>2</sup> Wavelet analysis relies on two basic functions: (a) father wavelets,  $\phi$ , which enhance the representation of the trending or low frequencies for a signal with an integral equal to 1, and (b) mother wavelets,  $\psi$ , which are useful in describing

<sup>2</sup> For a thorough review of wavelet analysis see, Percival & Walden (2000); Serroukh et al. (2000), Whitcher et al. (2000), Gençay et al. (2002) and Gençay et al. (2005).

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