

# Bitcoin or Gold? Risk Assessment Based on Continuous Wavelet Transform

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In this paper, the risk reduction and downside risk reduction of Value at Risk and Expected shortfall are calculated using variance and covariance derived from wavelet analysis. By comparing bitcoin to currency (stock) portfolios and gold to currency (stock) portfolios in the time-frequency domain, we find strong evidence that the portfolios containing bitcoin effectively reduce investment risk than the portfolios containing gold after 2019 and especially after 2020. Furthermore, in this paper, the results of risk reduction and downside risk reduction are made in the form of a heat map by extending VaR and ES to the time-frequency domain so that the study results can be observed more intuitively. Notable that although our risk reduction and downside risk reduction findings both suggest that bitcoin has a more pronounced risk reduction effect on investments compared to gold, because the value of risk reduction and downside risk reduction change over time and frequency, investors should be cautious whether they are investing in bitcoin as a hedge asset or gold, especially when investing for the long-term.