North American Journal of Economics and Finance 25 (2013) 318–334

Contents lists available at SciVerse ScienceDirect

North American Journal of Economics and Finance

Downside risk management and VaR-based optimal portfolios for precious metals, oil and stocks

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ARTICLE INFO

JEL classification:
G1

Keywords:
Key assets
Value-at-Risk
Optimal portfolios
Efficient frontiers
Risk management

ABSTRACT

Value-at-Risk (VaR) is used to analyze the market downside risk associated with investments in six key individual assets including four precious metals, oil and the S&P 500 index, and three diversified portfolios. Using combinations of these assets, three optimal portfolios and their efficient frontiers within a VaR framework are constructed and the returns and downside risks for these portfolios are also analyzed. One-day-ahead VaR forecasts are computed with nine risk models including calibrated RiskMetrics, asymmetric GARCH type models, the filtered Historical Simulation approach, methodologies from statistics of extremes and a risk management strategy involving combinations of models. These risk models are evaluated and compared based on the unconditional coverage, independence and conditional coverage criteria. The economic importance of the results is also highlighted by assessing the daily capital charges under the Basel Accord rule. The best approaches for estimating the VaR for the individual assets under study and for the three VaR-based optimal portfolios and efficient frontiers are discussed. The VaR-based performance measure ranks the most diversified optimal portfolio (Portfolio #2) as the most efficient and the pure precious metals (Portfolio #1) as the least efficient.

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http://dx.doi.org/10.1016/j.najef.2012.06.012

1. Introduction

In this high risk and volatile environment, the time is right to examine the downside risk/return profiles for major commodities and stocks. In particular, the downside risk pertains well to the four major precious metals – gold, silver, platinum and palladium – which have risen significantly in terms of global trading and portfolio investments in the recent years, as well as to oil and stocks. The financial and commodity markets had undergone a severe financial crisis in 2007/2008, which turned into a Great Recession, fostering risk aversion and preferences toward safe havens. Despite the ensuing recovery, the mounting risk and uncertainty have confounded investors, portfolio managers and policy-makers. In such an environment, it will be valuable and useful to examine asset behaviors that are not only volatile but also characterized by extreme events like the 2007/2008 financial crisis that affected essentially all asset markets.

Standing as hedges and safe havens against risk and during uncertainty, commodities like the precious metals and oil have experienced extraordinary surges in prices and returns in the last few years, which have elevated the potential downside risk and subjected them to black swan-types of events. These assets have therefore become important elements of diversified portfolios. Additionally, stocks have also become very volatile on both sides of the return aisle and had underdone severe extreme events; with high and opposing wild swings being part of their daily trading. Under such circumstances, significant and extreme drops in prices and returns of these assets have become more probable, with potentially damaging consequences on portfolios of individuals and institutions. These circumstances have also made risk management strategies for these high flying commodities and highly volatile stocks more challenging, particularly as the percentages of violations of confidence targets have compounded.

The quantification of the potential size of losses and assessing risk levels for individual precious metals, oil, stocks and portfolios composed of them is fundamental in designing prudent risk management and portfolio strategies. Value-at-Risk (VaR) models have become an important instrument within the financial markets for quantifying and assessing market downside risks associated with financial and commodity asset price fluctuations. They determine the maximum expected loss an asset or a portfolio can generate over a certain holding period, with a pre-determined probability value. Thus, a VaR model can be used to evaluate the performance of portfolio managers by providing downside risk quantification, together with asset and portfolio returns. It can also help investors and portfolio managers to determine the most effective risk management strategy for a given situation. Moreover, quantification of the extreme losses in asset markets is important in the current market environment. Extreme value theory (EVT) provides a comprehensive theoretical forum through which statistical models describing extreme scenarios can be developed.

There is a cost of inaccurate estimation of the VaR in financial markets which affects efficiency and accuracy of risk assessments. Surprisingly, despite the increasing importance of precious metals and the diversified portfolios that include them as well as other assets and their highly volatile nature, to our knowledge there is only one study that analyzes the VaR for precious metals (Hammoudeh, Malik, & McAleer, 2011), while there are several studies that have worked on oil and stocks' VaRs. Hammoudeh et al. (2011) concentrate on the four major precious metals only, use relatively older VaR techniques and do not deal with VaR-based optimal portfolio constructions and efficient VaR frontiers. These authors do not distinguish between the risk associated with positive and negative returns which usually display asymmetric behavior. Their study also does not deal directly with volatility clustering. Moreover, it does not include EVT methods which provide quantification of the stochastic behavior of a process at unusually large or small levels. On the contrary, our current study expands the spectrum of asset diversification and deals with events that are more extreme than any others that have been previously observed. Most importantly, it constructs VaR-based optimal portfolios and efficient VaR frontiers of different degrees of diversification and examines their characteristics and performances. It also ranks those optimal portfolios using a VaR-based risk performance measure.

The broad objective of this paper is to fill this void in the financial risk management and modern portfolio analysis literature by using more up-to-date techniques and designing optimal diversified portfolios that take into account volatility asymmetry and clustering, with relatively strong emphasis on precious metals which have not been researched adequately despite their potential to provide