

# Estimating Portfolio Risk using GARCH-EVT-Copula Model: An Empirical Study on Currency Exchange Rate Market

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## Abstract

This paper utilizes the GARCH-EVT-Copula model in financial applications to study the portfolio risk of exchange rates. The first step consists of extracting filtered standardized residuals for each return series by an asymmetric GJG-Runkle Generalized Autoregressive conditional Heteroscedastic (GJR-GARCH) model. The marginal distributions of filtered residuals are fitted with a semi-parametric cumulative distribution function using Generalized Pareto Distribution (GPD) for tails. Multivariate Copulas including Gaussian Copula, Student's-t Copula and Clayton Copula, Gumbel Copula, Frank Copula and Joe Copula are used to describe the dependence structure and extend the analysis from bivariate to any  $n$ -dimension. The out-of-sample forecasting accuracy of the GARCH-EVT-Copula model is compared to a number of conventional parametric models in estimating VaR in four major currency exchange rates. The effectiveness of using copula-extreme-value based semi-parametric approach in estimating currency portfolio risk is assessed. Backtesting results of the Monte Carlo VaR simulation demonstrate that the Student's-t copula-EVT has the best performance regardless of the return distributions, and in general the copulas with the EVT perform better in estimation of VaR than the conventional GARCH models.

**Keywords:** Backtesting, Copulas, dependencies, GARCH-EVT-Copula model, Exchange rate, Portfolio risk, Value-at-Risk (VaR).