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On the characteristics of dynamic correlations between asset pairs☆

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ABSTRACT

Recent research provides considerable evidence that correlations between assets change significantly over time and diversification benefits of correlations may vary substantially based on the time-varying measure of correlation used for different asset types. Our study evaluates and compares alternative time-series correlation modeling techniques according to both statistical and economic metrics, focusing specifically on individual asset pairs. We identify the moving correlation structure that best tracks the dynamic conditional correlation estimates using a large set of different financial time series encompassing 467 asset pairs in nine different asset classes. Results from our direct, statistical loss function based, and indirect, portfolio mean-variance based, forecast evaluations provide optimal window-length ranges for 36 asset-class pairs which should help in portfolio construction as well as risk management. Furthermore for robustness tests, we implement the model confidence set approach which, without a benchmark specification,

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produces a set of models constructed to contain the best models with a given level of confidence among competing forecast evaluations.

1. Introduction

Modeling the second moments of time series, volatilities, and correlations is important to the theory and practice of finance. Their accurate measurement and estimation are essential to portfolio management, asset pricing (including complex derivative instruments), and risk management.[2] The fundamentals of portfolio theory establish the role of correlation among assets as well as the role of volatility within early option pricing models.

Advances in econometrics have improved the accuracy of models that describe the time-varying dynamics of volatility such as the generalized autoregressive conditional heteroskedasticity (GARCH/ARCH) and stochastic volatility models. The modeling of the time-varying dynamics of correlations following such techniques is far newer. Historically the *moving window correlation* (MWC) technique has been the most prevalent, while there has been little consensus on the optimal window length for different asset pairs. Building upon the literature on multivariate GARCH models, Engle and Sheppard (2001) and Engle (2002) develop a new class of multivariate *dynamic conditional correlation* (DCC) models. They show that these models have the flexibility of univariate GARCH models, coupled with parsimonious parametric models for the correlations.

Our objective is to compare the MWC and the DCC approaches to estimating time-varying pairwise correlations, according to both statistical and economic metrics on a large set of different financial time series, identifying which MWC moving window length best tracks the DCC across tests and asset-class pairs. Recent research has highlighted the considerable evidence that correlations between assets change significantly over time; due to this time-varying nature of correlations, diversification benefits are also time-varying.[3] Our research aims to identify the characteristics of optimal window lengths for the historically popular MWC method using the DCC estimation as a benchmark, specifically for individual asset pairs. For robustness tests, we use the model confidence set (MCS) methodology, developed by Hansen et al. (2011), which produces a set of models constructed to contain the best models with a given level of confidence among competing forecast evaluations.

In recent years, advanced models of volatility have been augmented to simultaneously take into account the time-varying dynamics of correlations between assets in order to improve portfolio performance, and to enhance risk management methods. In addition, time-varying correlation modeling is fundamental to forecasting and pricing correlation risk which helps investors manage the risk that arises from changes in correlations between assets. Driessen et al. (2009), by focusing on index options, and Krishnan et al. (2009), by using equity portfolios, investigate the pricing of correlation risk in financial markets.

The purpose of our research is first, to statistically compare the historically popular and relatively simple to calculate time-varying correlation modeling technique of MWC to the DCC estimation which is an extension of time-varying volatility models, and second, to evaluate the economic effectiveness of different moving window lengths, using a broad time-series database across a wide range of asset classes. Our particular focus is pairwise asset correlations among a large set of assets in order to identify the time-varying dynamics of relationships between individual asset pairs within various classes of investment alternatives. Given the importance of correlation modeling and the historical prevalence of the MWC method, our study generates empirical results by analyzing the performance of MWC with different estimation windows against a benchmark, i.e. DCC estimates. This involves, in addition

[2] Patton and Sheppard (2009) indicate that volatility and covariance forecasts are fundamental inputs into many decisions in financial economics.

[3] Campbell et al. (2008), Driessen et al. (2009) and Krishnan et al. (2009).