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1. Untangling the Pricing Kernel Puzzle: The Impact from Macroeconomic States (Job Market Paper)

This paper addresses the long-standing puzzle related to pricing kernels—the empirical finding of upward or U-shaped patterns in empirically estimated stochastic discount factors (SDFs), which is consistent with risk-love behavior. I introduce a GARCH-MIDAS model that includes low-frequency macroeconomic variables such as industrial production, term-spread volatility, and inflation uncertainty in the conditional variance of daily equity returns. This inclusion aligns the econometrician's information set with that of agents in the marketplace, thus allowing the physical measure to account for both high-frequency shocks as well as broader macroeconomic trends. Using daily S&P 500 returns (1990–2022) and options data (2003–2022), I estimate the physical measure parameters and calibrate the risk-neutral measure through option prices. The resulting pricing kernels are monotonic and downward-sloping, even during crises such as 2008 and 2020. In comparison with conventional GARCH models, GARCH-MIDAS model reduces implied-volatility RMSE 46% in-sample as well as 53% out-of-sample, replicates the VIX index with greater accuracy, and provides Euler-equation errors that are statistically indistinguishable from zero. Robustness testing employing a nonparametric risk-neutral density yields consistent conclusions. In total, the paper establishes that adding macroeconomic conditions to volatility dynamics eliminates its pricing kernel puzzle as well as enhances accuracy in option valuation.

2. Individual Stock Option Pricing with a Bivariate GARCH Mixture Model (with Lars Stentoft and Jeroen V.K. Rombouts)

Pricing options has been a critical part of financial econometrics for several decades, and the recent literature shows the importance of non-normality and correlation between stock and market index returns in pricing options. This paper contributes to the fast growing literature of using GARCH model for option pricing by using a mixture of Normals multivariate BEKK GARCH model for pricing individual stock options. We use the model for pricing American options written on 25 stocks from the U.S. stock market. To compare our model with the current models in the literature, we also consider 3 restricted models. Our results are very promising and the mixture of Normals BEKK GARCH model prices options for all assets significantly better than the other models. We demonstrate that the power of our model compared to the other models comes from the ability of this model to estimate the implied volatility (IV). Our IV estimation shows a dramatic difference between the root mean square IV error estimation between our model and the restricted alternatives.

3. Option Pricing with a GARCH-MIDAS Framework

This research aims to construct an option-pricing model that explicitly integrates macroeconomic variables into the volatility mechanism via a GARCH-MIDAS framework, augmented by a mixture of Normals innovations. The risk-neutral parameters are systematically obtained from the physical measure, thereby maintaining coherence between the two probability spaces. An empirical assessment using S&P 500 returns, options data, and U.S. macroeconomic indicators demonstrates that incorporating macroeconomic conditions and non-normal shocks significantly improves option-pricing efficacy in comparison to conventional single-component models.