

Simultaneous Forecasting of Yield Curves for Multiple Zero-Coupon Bonds Using Heath-Jarrow-Morton Model

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Abstract

Market diversification is an investment strategy according to which a company seeks growth by adding products and markets that are in a certain sense “uncorrelated” with its existing products and markets. Bonds play a major role in the well-balanced diversified portfolio because of their low correlation to other asset classes. While correlations may vary widely over time, bonds are typically not highly correlated with any other asset classes. Even in the simplest diversified portfolio, bonds can reduce volatility due to their low or negative correlation with stocks. Because investment funds can create robust diversified portfolios with bonds, it is imperative that different bonds are studied simultaneously so that portfolios can be created in a coherent manner. This can facilitate optimal investment allocations. In fact, many economic studies indicate that geographical diversification is more efficient at reducing portfolio risk than many other investment strategies. We discuss the well-known Heath-Jarrow-Morton (HJM) model which describes the evolution of the entire yield curve by modeling term structure dynamics in continuous time under no-arbitrage conditions. Further, we extend the classical HJM model to the multi-bond case to study multiple zero-coupon bonds simultaneously. We provide tools to estimate the correlation structure that may or may not be strongly pronounced. We first assess the predictive power of the HJM model by applying it to AAA-rated Euro bonds which allow for negative yields. We also extend the same scheme to the multi-bond case by simultaneously analyzing AAA-rated Euro bonds and US treasuries with the evolution of short rates following a multivariate Vasicek model. We perform statistical estimation and inference for our proposed multi-bond extension of the classical HJM model and discuss predictive performance.

Keywords: Heath-Jarrow-Morton model; zero-coupon bonds; forward rates; multivariate Vasicek model; SPDE; arbitrage-free.