Seminarios de Macroeconomía y Finanzas

Sieve Estimation of Options Implied State Price Density

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Los Seminarios de Macroeconomía y Finanzas tienen como objetivo difundir investigación académica y aplicada de investigaciones del Banco y externos.

Abstract

This paper proposes a nonparametric estimator for the state price density implied by a single cross-section of European options with different strikes and the same maturity. The proposed estimator has two distinctive features. First, it extracts information from both call and put options, as opposed to only call options. Second, it does not require estimating any second-order derivative. Instead, it is obtained as the solution to a constrained and penalized linear regression. The technical analysis faces two challenges because the density is defined by the Fredholm integral equation of the first kind with an unbounded support, and the kernel functions are unbounded and non-differentiable. We address these challenges by exploiting the structure of the option pricing problem. After establishing the consistency and the convergence rate of the estimator, we apply it to uncover the state price density implied by S&P500 index options and that implied by the VIX options. The sample period includes the recent financial crisis and the Great Recession, during which the turbulent market conditions impose substantial challenges on the estimation. We show that the procedure can work with both daily and high-frequency observations. We also study whether various features of this density can predict future asset returns and obtain positive findings. Finally, we apply the method to examine the causal effects of monetary policy announcements on the market using high-frequency data.