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Estimating risk-neutral density with parametric models in interest rate markets

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Abstract

The departure in modelling terms from the log-normal distribution for option pricing has been largely driven by empirical observations on skewness. In recent years, the Weibull and generalized beta distributions have been used to fit the risk-neutral density from option prices. In this article, we also propose the use of the generalized gamma distribution for recovering the risk-neutral density. In terms of complexity, this distribution, having three parameters, falls between the Weibull and generalized beta distributions. New option pricing formulas for European call and put options are derived under the generalized gamma distribution. The empirical evidence based on a set of interest rate derivatives data indicates that this distribution is capable of producing the same type of performance as the Weibull, generalized beta, and Burr3 distributions. In addition, we analyze the effect of July 2005 bombings in London on interest rate

markets under the best fitting distribution. Our results indicate that there was very little impact on the volatility of these markets.

Keywords:

Risk-neutral density | Real-world density | Power utility function | Generalized beta distribution | Generalized gamma distribution | Burr3 distribution | Caps and floors

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Notes

†Brunner and Hafner (2003) use the estimated RND to price a digital option.

†See for details Campa et al. (1997, 1998), Melick and Thomas (1997), Soderlind and Swensson (1997), Soderlind (2000), and Markose and Alentorn (2005).

‡For example, Ait-Sahalia and Lo (2000), Jackwerth (2000), Rosenberg and Engle (2002), and Giamouridis (2005).

§A review of this literature is beyond the scope of this paper. The reader is referred to the literature reviews provided in Jackwerth (1999, 2004) and Anagnou et al. (2005).

†Dutta and Babbel (2005) derive formulas for pricing these instruments but we believe that on page 850 there is an error in their derivation of formula (23).

†See, for example, Melick and Thomas (1997) and Markose and Alentorn (2005).

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