

## **An Analytic Approximation of the Implied Risk-neutral Density of American Multi-asset Options**

J. C. ARISMENDI(ICMA Centre, Henley Business School, Univ. of Reading - UK) and MARCEL PROKOPCZUK (Chair of Empirical Finance & Econometrics, Zeppelin Univ. Germany)

Abstract:

The price of a European option can be computed as the expected value of the payoff function under the risk neutral measure. For American options and path-dependent options in general, this principle cannot be applied. In this paper, we derive a model-free analytical formula for the implied risk-neutral density under which the expected value will be the price of the equivalent payoff with the American exercise condition. The risk-neutral density is semi-parametric as it is the result of applying the multivariate generalized Edgeworth expansion (MGEE), where the moments of the American density are obtained by a reverse engineering application of the Longstaff and Schwartz (2001) least-squares method (LSM). The theory of multivariate truncated moments is employed for approximating the option price, with important consequences for the hedging of variance, skewness, and kurtosis swaps.

Key Words: Multi-asset Risk-neutral Density, American Multi-asset Options, Higher-order Moments