Theme of the Lecture: Financial derivatives and their risk management

Introduction

Financial derivatives are indispensable securities in the modern financial market. Although derivatives are seemingly created for the purpose of hedging and risk management, they also generate additional risk and become the source of recent financial crisis. This lecture aims to provide audiences with basic knowledge of derivatives pricing, their risk management and the pro-crisis regulatory implication for their prices. The lecture consists of five parts. The first part introduces the concepts of risk-neutral valuation, change of measure, and simulation methods. We use lattice approach and continuous-time stochastic processes to illustrate how the aforementioned concepts are applied to standard options. When the Black-Scholes model is assumed, we also introduce some exotic derivatives such as accumulators and range accrual notes. The second part explains the differences and usages between estimation and calibration (mark-to-market) approaches toward derivatives pricing. The key message is that a financial model could have at least two different implementation methods for derivative pricing purpose. The choice depends on the data availability and the business objective. For example, we demonstrate the estimation approach to option pricing with the GARCH model, the calibration approach with the stochastic volatility model, and the calibration to the interest rate yield curve. The third part details the application to derivatives on different asset classes including equity, foreign exchange (FX) rates, interest rates and credits. The focus would be the practical use of change of measure techniques, and numerical methods. For instance, we show the linkage of risk-neutral measures between two economies through the FX rate, and the simulation with forward measures within the LIBOR market model. In the forth part, we present some cases studies on derivatives related to financial crisis. Specifically, we empirically price the Australian dollar accumulator using the data during the 2008 financial crisis period. CITIC Pacific reported a mark-to-market loss of HK$1.5 billion in late 2008 as a result of an Australian dollar accumulator. We also introduce credit default swaps (CDS), collateralized debt obligation (CDO) and CDO on CDO (CDO^2), where the last one is regarded as the source of the sub-prime mortgage crisis of 2008. Finally, we discuss how the pro-crisis regulations affect the implementation and modeling for derivative pricing and share industrial opportunities in Hong Kong.