

Valuation of R&D Sequential Exchange Options using Monte Carlo approach

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Abstract

This article describes a methodology for evaluating R&D investment projects using Monte Carlo methods. R&D projects generally involves multiple phases with or without overlapping. R&D investments are made often in a phased manner, with the commencement of subsequent phase being dependent on the successful completion of the preceding phase, it is known as sequential investment. Moreover, each stage creates an opportunity (option) for subsequent investment. Therefore, R&D projects can be considered as ‘Compound Options’ in which investments present uncertainty both in the gross project value and in costs. It is possible to use exchange options to value the R&D investment opportunities. In this paper, we propose to value the European and American Real Compound Exchange options through Monte Carlo simulation. We also provide a set of numerical experiments to provide evidence for the accuracy of the proposed methodology.

Key Words: Pseudo Compound American Exchange option; R&D; Monte Carlo Methods.

References

- [1] Armada, M.R., Kryzanowsky, L. & Pereira, P.J. 2007, *A Modified Finite-Lived American Exchange Option Methodology Applied to Real Options Valuation*, Global Finance Journal, Vol. 17, Issue 3, 419-438.

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- [2] Barraquand, J. and D. Martineau, 1995, *Numerical Valuation of High Dimensional Multivariate American Securities*, Journal of Financial and Quantitative Analysis, Vol. 30, Issue 3, 383-405.
- [3] Broadie, M. and P. Glasserman, 1997, *Pricing American-style securities using simulation*, Journal of Economic Dynamics and Control, Vol.21, 1323-1352.
- [4] Carr, P. 1988, *The Valuation of Sequential Exchange Opportunities*, The Journal of Finance, Vol 43, Issue 5, 1235-1256.
- [5] Carr, P. 1995, *The Valuation of American Exchange Options with Application to Real Options*. in: *Real Options in Capital Investment: Models, Strategies and Applications* ed. by Lenos Trigeorgis, Westport Connecticut, London, Praeger.
- [6] Copeland, T and J. Weiner, 1990, *Proactive management of uncertainty*, The McKinsey Quarterly, Vol. 10, Issue 4, 133-152.
- [7] Geske, R. and H. E. Johnson, 1984, *The American Put Option Valued Analytically*, The Journal of Finance, Vol 39, Issue 5, 1511-1524.
- [8] Hamilton, W and G. Mitchell, 1990, *What is your R&D worth?*, The McKinsey Quarterly, Vol.10, Issue 3, 150-161.
- [9] Margrabe, W. 1978, *The Value of an Exchange Option to Exchange One Asset for Another*, The Journal of Finance, Vol. 33, Issue 1, 177-186.
- [10] McDonald, R.L. and D.R. Siegel, 1985, *Investment and the Valuation of Firms When There is an Option to Shut Down*, International Economic Review, Vol. 28, Issue 2, 331-349.
- [11] Raymar, S. and M. Zwecher, *A Monte Carlo Valuation of American Call Options on the Maximum of Several Stocks*, J. Derivatives, Vol. 5, 7-23.
- [12] Tilley, J. 1993, *Valuing American Options in a Path Simulation Model*, Trans. Soc. Actuaries, Vol 45, 83-104.