

A QUANTITATIVE ASSESSMENT OF INTEREST RATE UNCERTAINTY IN REAL OPTION ANALYSIS

Luca Vincenzo Ballestra^{*}, Graziella Pacelli^{**},
Davide Radi^{***}

^{*} Department of Statistical Sciences, Alma Mater University of Bologna, Italy

^{**} Department of Management, Politecnica delle Marche University, Italy

^{***} Department of Economics and Management, University of Pisa, Italy



How to cite: Ballestra, L. V., Pacelli, G., & Radi, D. (2019). A quantitative assessment of interest rate uncertainty in real option analysis. *Corporate Governance: Search for the Advanced Practices*, 22-24. <https://doi.org/10.22495/cpr19a1>

Copyright © 2019 The Authors

This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0).

<https://creativecommons.org/licenses/by/4.0/>

Received: 23.11.2018

Accepted: 04.12.2018

JEL Classification: G3, C1

DOI: 10.22495/cpr19a1

Keywords: Real Option, Discounting Cash Flow, Interest Rate, Investment Projects

Abstract

The discounting cash flow (DCF) technique is the most popular approach for valuing firms' projects. Basically, it consists of discounting the values of the forecasted future cash flows by some interest rate, for example the so-called weighted average cost of capital (WACC), or an Enterprise's rate of return (measured by the annual growth of the firm's total assets), or, eventually, a required (desired) rate of return. DCF calculations have been widely criticized since they do not fully consider uncertainty. In particular, when a firm decides to undertake a project, if it is a complex project with a long time horizon, future revenues and costs are not exactly known. Then, during the project lifetime, depending on the realized economic and financial scenarios, managers have the option of making changes to the project, or even of abandoning it. The DCF approach does not allow one to consider such an option, which is instead accounted for by the so-called real option analysis (ROA). Specifically, due to its flexibility to cope with future uncertainty, ROA has become a very usual procedure for valuing firms' strategic projects, see, for example, Amram and Kulatilaka (1999), Baldi and Trigeorgis (2009), Cobb and Charnes (1994), Copeland and Antikarov (2003), Dixit and

Pindyck (1994), McDonald and Siegel (1986), Mun (2006), Schulmerich (2010).

The real option approach is almost always applied by considering flat interest rates. Nevertheless, if the time horizon of a firm's project is long (say several years), assuming that the interest rate remains constant over all the project's life does not seem very realistic. In particular, one could argue that, if the ROA is used in order to cope with unknown future scenarios, then the uncertainty of future interest rates should be taken into account as well.

A ROA approach that also takes into account stochastic interest rates has been pursued by Schulmerich (2010). However, the effect of the interest rate on the projects' evaluation is not completely explored.

In this work, we discuss the effect of the uncertainty of future interest rates on real option valuation. In particular, we assume that the interest rate follows the Vasicek model:

which may be regarded as the continuous version of the AR(1) time series:

$$r_{t+1} = \theta + \alpha(r_t - \theta) + \varepsilon_t \quad (1)$$

(for a suitable value of α).

Furthermore, the interest rate specification (1) is coupled with the common real option approach based on the famous Black-Scholes model (see Black and Scholes, 1973). By doing that it is possible to derive a simple analytical formula to evaluate firms' projects. Then, the ROA model with stochastic interest rates can be tested against a simpler ROA model with constant interest rate. The results obtained, some of which are contained in Ballestra et al. (2017), will be discussed in the talk.

References

1. Amram, M., & Kulatilaka, N. (1999). *Real options: Managing strategic investments in an uncertain world*. Boston: Harvard Business School Press.
2. Baldi, F., & Trigeorgis, L. (2009). A real options approach to valuing brand leveraging options: How much is Starbucks brand equity worth? Retrieved from: <https://69.175.2.130/~finman/Reno/Papers/StarbucksBrandValuation.pdf>
3. Ballestra, L. V., Pacelli, G., & Radi, D. (2017). Valuing investment projects under interest rate risk: Empirical evidence from European firms. *Applied Economics*, 49(56), 5662-5672. <https://doi.org/10.1080/0003684.6.2017.1327120>
4. Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy*, 81(3), 637-654. <https://doi.org/10.1086/260062>
5. Cobb, B. R., & Charnes, J. M. (1994). Real options volatility estimation with correlated inputs. *The Engineering Economist*, 49(2), 119-137. <https://doi.org/10.1080/00137910490453392>
6. Copeland, T., & Antikarov, V. (2003). *Real options, a practitioner's guide*. New York: Texere.
7. Dixit, A. K., & Pindyck, R. S. (1994). *Investment under uncertainty*. Princeton,

NJ: Princeton University Press.

8. Lewis, N. A., Eschenbach, T. G., & Hartman, J. C. (2009). Real options and the use of discrete and continuous interest rates. *American Society for Engineering Education*. Retrieved from: https://scholar.google.com/citations?user=or0uFhMAAAAJ&hl=en#d=gs_md_citad&u=%2Fcitations%3Fview_op%3Dview_citation%26hl%3Den%26user%3Dor0uFhMAAAAJ%26citation_for_view%3Dor0uFhMAAAAJ%3AY0pCki6q_DkC%26tzom%3D-120
9. McDonald, R., & Siegel, D. (1986). The value of waiting to invest. *The Quarterly Journal of Economics*, 101(4), 707-727. <https://doi.org/10.2307/1884175>
10. Mun, J. (2006). *Real options analysis: Tools and techniques for valuing strategic investments and decisions*. New Jersey: John Wiley & Sons, Hoboken.
11. Rabinovitch, R. (1989). Pricing stock and bond options when the default-free rate is stochastic. *Journal of Financial and Quantitative Analysis*, 24(4), 447-457. <https://doi.org/10.2307/2330978>
12. Schulmerich, M. (2010). *Real options valuation: The importance of interest rate modelling in theory and practice*. Berlin: Springer. <https://doi.org/10.1007/978-3-642-12662-8>
13. Vasicek, O. (1977). An equilibrium characterization of the term structure. *Journal of Financial Economics*, 5(2), 177-188. [https://doi.org/10.1016/0304-405X\(77\)90016-2](https://doi.org/10.1016/0304-405X(77)90016-2)