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VALUATION

# Real-Options Valuation for a Biotechnology Company

David Kellogg & John M. Charnes

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## Abstract

Many companies in the biotechnology industry have significant valuations despite having no product revenue because their products are in early stages of development. In the past 10–15 years, investors have bid up the stock prices of companies showing promise of developing a blockbuster drug. We explain the decision-tree method and binomial-lattice method (which adds a growth option) and use them to value a biotechnology company, Agouron Pharmaceuticals, as the sum of the values of its drug-development projects. The growth option was added because the development of an initial new molecular entity (NME) is similar to purchasing a call option on the value of a subsequent NME. We compare our computed values of Agouron with actual market values at selected points in time during the development of Agouron's Viracept, a drug used to treat HIV-positive patients.

Many companies in the biotechnology industry have significant valuations despite having no product revenue because their products are in the early stages of

development. In the past 10–15 years, investors have bid up the stock prices of companies that show promise of developing a blockbuster drug. This phenomenon is similar to the more recent rise in stock prices of Internet start-up companies, most of which have shown losses throughout their existence.

Methods used in real-options valuation can be used to assess the value investors place on companies with promise but no current revenue. The value of the company is derived from the expected profits of the company's current products and services together with the potential for growth of the company into one with many profitable products and services. Real-options valuation methods can be applied to estimate the value of individual projects, but the problem addressed in our article is how to use real-options valuation models to assess the value of a company when it is viewed as a portfolio of projects.

We explain decision-tree and binomial-lattice methods and use them to compute the value of a biotechnology company, Agouron Pharmaceutical, as the sum of the values of its current projects. We find each project's real-options value by using the two real-options valuation methods. We then compare our computed values of Agouron with the actual market values at selected points in time during the development of the company's Viracept product, a drug used to treat HIV-positive patients.

Our intention is to illustrate how real-options valuation methods can be used for financial analysis. Because in our analysis we used data based on results from prior studies (primarily, industry averages), the results reflect the value of Agouron under the assumption that its situation matches that of a typical research-intensive pharmaceutical company in the 1980s and early 1990s. We discuss some of the ways in which Agouron's situation differed from that assumed by the models, which a securities analyst would no doubt understand. We found that the methods used here worked best to find the value investors were placing on Agouron when all its drugs were in early stages of development. As a drug's market potential becomes clearer in the later stages of development, securities analysts with access to more specific information than we had could improve the results of using these methods. As projects progress and new information becomes available, a financial analyst who is

following a particular stock closely is likely to have better estimates of the important inputs.

The real-options approach outlined here can be a powerful addition to a security analyst's toolbox. In addition, financial analysts in pharmaceutical companies can use the methods to value projects at their companies and compare the projects' relative worth for capital-budgeting purposes. Executive managers of pharmaceutical companies can use these methods to increase their understanding of the value of their projects and convey that value to investors. Finally, for academic readers, this case study provides empirical evidence of the usefulness of real-options valuation methodologies.

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