nature biotechnology

Letters may be edited for space and clarity. They should be addressed to:
Correspondence
Nature Biotechnology
345 Park Avenue South
New York, NY 10010-1707, USA
or sent by e-mail to biotech@natureny.com
Please include your telephone and fax numbers.

Real options for biotechnology valuation

To the editor:

Fair value is the foundation of an equitable arrangement between a biotechnology company and its investors. An article in the September issue (*Nat. Biotechnol.* 19, 813–817, 2001) proposes a risk-adjusted net present value (rNPV) model, which takes revenues, risks, and costs into account as an improved valuation tool. We believe the rNPV model has two shortcomings that can put a biotechnology venture at a disadvantage in funding negotiations. First, it does not take into consideration the fact that at every step of the development process, a biotechnology company has the option to modify a project on the basis of improved information and diminishing uncertainty. Second, it uses point estimates of future revenues and market share, variables that are best seen as having an estimable probability distribution.

A potentially more useful valuation method is real option analysis, which takes flexibility into account at each stage of product development¹. Using this approach, the rNPV example would be seen as a compound rainbow option, with each development stage representing a component of the option-pricing model. Applying real options in pharmaceutical project evaluation captures the value of flexibility and also takes account of the real-life complexity of managing choices that are not mutually exclusive².

Although a biotechnology venture may be able to make a strong case concerning the science that it aims to commercialize, projected revenue streams are often regarded as speculative. A clear step-wise model of future options provides a more robust foundation for assessing the value of a project. Such modeling techniques as real options

mathematically having to claim implausibly high positive project NPVs as a negotiating strategy. Real options also permit a realistic assessment of marginal projects and could enhance their attractiveness for funding.

Taking these points into account, real options and simulations provide improved valuation models to assist companies and investors in achieving a fairer valuation of the opportunities and uncertainties in biotechnology ventures.

Michael Harrison and Leonard Lerer,
INSEAD,
Healthcare Management Initiative,
Boulevard de Constance,
Fontainebleau,
77350, France
(leonard.lerer@insead.edu)

1. Luehrman, T. *Harvard Bus. Rev.* May/June 132–142 (1997).
2. Copeland, T. & Antikarov, V. *Real options: a practitioners guide*. (Texere Publishing, New York; 2001).

Jeffrey J. Stewart responds:

The shortcomings that Harrison and Lerer perceive in rNPV methods of valuing biotechnologies are more theoretical than practical. To cure the perceived ills in rNPV, Harrison and Lerer suggest taking into account two additional parameters: first, an increasing certainty in market size as research and development (R&D) proceeds; and second, a distribution of possible market returns. We must ask, however,

whether there are any realistic scenarios where such parameters come into play.

Let me first address increasing market certainty. There are obviously only two situations in which “increasing certainty in market size” could affect a biotechnology valuation—either the market is greater or it is smaller than initially estimated. Should the market be lower than projected, a biotechnology company must meet four conditions if it is to change the initial valuation. It must: (i) recognize and (ii) admit to its shareholders that, after considerable R&D expense, the hoped-for market now is thought to be on the small side. Furthermore, the company must (iii) project a market that is so miniscule that any further investment would be throwing bad money after good. Finally, having realized that it is wasting investors’ money, the company must then (iv) shut down late-stage clinical trials or the drug approval process to gain any benefit whatsoever

from their new market projection. I find myself doubting, as have others¹, that management would have such fiscal discipline.

In theory, the “increasing certainty in market size” could have an effect if a market is later projected to be larger than first anticipated. For instance, consider a biotechnology project that initially appeared to be worthless (negative rNPV), but for which a significant market later developed. In this case, the project did have latent positive value, and real options analysis is an appropriate means of pricing this special case of an “option to expand.” In practical terms, however, so many projects with positive rNPVs are available for investment that marginal (worthless) projects justifiably remain off the radar of most investors. Moreover, patent expiration severely limits the potential benefits of delaying investment in R&D until a company’s finance department can turn in a solid market projection.

In summary, increasing certainty of the future market size for a product has no impact on a biotechnology valuation. This is because neither “option” can be exercised in practice.

Having addressed market size, I turn to the second parameter, market distribution. Harrison and Lerer also mark as a shortcoming of the rNPV method the fact that market projections can be highly speculative. In this case, these authors are correct. However, rNPV and real options analyses are equally at the mercy of market projections, speculative or otherwise. I therefore remain unconvinced that their second parameter—a market distribution (for example, high/medium/low)—cures this source of inaccuracy or, indeed, fundamentally changes anything. One trivial solution would be to calculate multiple rNPVs based on different market projections.

Real options analysis views drug development as a set of “call options” (the right, but not the requirement, to invest in the future at a predetermined price). As Harrison and Lerer suggest, if the two additional parameters are carefully chosen in real options analyses, the practitioner can arrive at valuations that are more favorable to the “sell side.” For the “buy side,” there are complementary advantages to a less “parameter-rich” model so that the buyer is less easily confused by the worthy opposition. Whereas real options valuations include many parameters that are in the company’s favor, these analyses tend to ignore offsetting options that other parties will have on the biotechnology company. Chief among these is potential legal liability from adverse events (such as drug-related fatalities). It is misleading to increase