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Business Appraisers

Valuation updates | Insights into real options
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This thought leadership paper provides insights on real option valuations.

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Introduction to real options

Traditional approaches to capital budgeting, such as discounted cash-flows (DCF), cannot capture entirely the project value, for various reasons: it is assumed that investment decision are irreversible, interactions between today decisions and future decisions are not considered, and investment in assets seems to be a passive one (management doesn't interfere during the life of the project).

Managerial flexibility generates supplementary value for an investment opportunity because of managerial capacity to respond when new information arises, while the project is operated. Investment in real assets includes a set of real options that management can exercise to increase investment's value (under favorable circumstances) or limit loses (under unfavorable situations).

From this perspective, a project has a standard value, determined through traditional techniques like DCF, but also a supplementary value, coming from operational and strategic real options held by an active management.

Real options valuation

Real option analysis applies option pricing techniques to capital budgeting decisions. Real options do not refer to a derivative financial instrument, but to actual choices or opportunities of which a business may take advantage or realize. For example, investing in a new manufacturing facility may provide a company with real options of producing new products, consolidating operations or making other adjustments to changing market conditions. Another non-business example would be giving up a job to attend graduate school.

The scope of this discussion will be confined to capital budgeting decisions i.e. investments. There are three types of options embedded in investments: The option to delay, expand or abandon.

A pertinent point to keep in mind is that not all investment decisions exhibit characteristics of real options. There are certain criteria which must be tested before treating an investment decision as a real option.

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Valuation of real options

What are the key tests for real options?

Key tests		Example
Is there an option embedded in the asset/decision?	Can you identify the underlying asset?	If the company has a patent to manufacture a product, does it have the choice to hold the patent in its name without using the patent to manufacture?
	Can you specify the contingency under which you will get pay off?	
Is there exclusivity?	If yes, there is option value	It needs to be assessed whether is it only your company or other companies as well that have a right to manufacture a similar product.
	If no, there is none	
	If in between, you have to scale value	
Can you use option pricing model to value the real option?	Is the underlying asset traded?	Assess whether you can assign values to the inputs in the option pricing models pertaining to the underlying asset.
	Can the option be bought or sold?	
	Is the cost of exercising the option known and clear?	

Input estimation in real option valuation

The challenge in real option valuation is the application of an option pricing model designed for valuing financial instruments to a capital budgeting decision. There is plenty of estimation involved as one has to assign a proxy to each of the inputs of the purely mathematical formula. The table below discusses such estimation:

Input	Estimation
Value of underlying asset	• Present value of cash inflows from taking project now
Strike price on the option	• Option is exercised when investment is made; • Cost of making investment on the project; assumed to be constant in present value dollars
Variance in cash flows of underlying asset	• Variance in cash flows of similar assets or firms or; • Variance in present value from capital budgeting simulation
Dividend yield	• Cost to delay • Each year of delay translates into one year less of value-creating cash flows Annual cost of delay = 1/n
Expiration of the option	Life of the patent

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Illustration

Biogen, a bio-technology firm, has a patent on Avonex, a drug to treat multiple sclerosis, for the next 17 years, and it plans to produce and sell the drug by itself. The key inputs on the drug are as follows:

PV of cash flows from introducing drug now ("S")	$ 3.422 billion (a)
PV of cost of developing drug for commercial use ("K")	$ 2.875 billion (b)
Patent life ("t")	17 years
Risk-free rate ("r")	6.7% (17-year T-bond rate)
Variance in expected present value ("σ2")	0.224 (Industry average firm variance for bio-tech firms)
Expected cost of delay ("y")	1/17 or 5.89%
Value of Avonex based on traditional DCF	$ 547 million (a-b)

Interpretation

Biogen has an exclusive patent to develop the drug Avonex. This patent can be viewed as a call option and the drug as the underlying asset. To analyze whether producing the drug would be profitable or not and if yes, what would be the optimal time to exercise the patent during its entire life, option pricing analysis can be used.

Computation:

d_1	1.1362
$N(d_1)$	0.8720
d_2	-0.8512
$N(d_2)$	0.2076
Call value	$ 907 million

Source: Aswath Damodaran: Valuation: Real Options, Acquisition Valuation and Value Enhancement"

Implication

The value of Avonex using DCF was around $547 million. This is simply the difference between the present value cash inflows from commercializing the product now and cost of developing the patent. However the present value of the patent at the same time based on option pricing is $907 million. This implies that the patent i.e. without commercializing the product is valued at $907 million vis-à-vis the product being valued at $ 547 million i.e. the NPV of the project. As the option pricing analysis is performed every year with the term and cost of delay changing, the option to wait continues to be more valuable than the option of exercising the option i.e. beginning commercial production. Such option continues to be profitable upto the point in time the value of the patent is above $547 million. Thus commercial production should begin when the value of the patent is equal to the value of the product i.e. $ 547 million.

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