

Letter from the Editors

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Put the Sonic and Call the Cruiser

Placing even the most simple capital budgeting decisions in a real options framework offers managers important insight into the problem they are facing. It may make the difference between accepting value enhancing projects rather than rejecting them. We concoct an example to flush out the point that incorporating real options into traditional capital budgeting methodology is worthwhile. We simply illustrate that ignoring real options will lead to the under estimation of a project's value. Consider the following problem faced by the manager of a heating oil delivery service. (The Company).

The Company is currently preparing to bid on a service contract being offered by a large residential and commercial developer. One of the variables that the committee responsible for awarding the contract will examine is the previous year service record of the competing firms. A manager at one of the firms is deciding whether to purchase a new heating oil tanker truck one year before the bid must be tendered in order to improve his firm's performance. If the firm buys the tanker there are two possible market outcomes.

If the firm wins the new contract, outcome (1), demand for the firm's services increases at the expense of the competition. If the firm loses the bid, outcome (2), the tanker will remain idle for much of the time.

The manager must decide if purchasing the new tanker is a valuable investment. He has decided that with the purchase of the tanker the firm will have a 50% chance of winning the new service contract. We consider four series of cash flows across the two outcomes. Series 1 and 2 ignore real options. Series 3 includes the exercise of a put option at time 1. Series 4 includes a call option on an additional truck at time 1. We compute the expected net present value of three separate scenarios. Scenario (A) gives no credit to real options. Scenario (B) incorporates the put option, the managers have the right to sell the tanker in the secondary market after the firm loses the bid on the service contract. Scenario (C) incorporates the put option and the call option. The call option is the manager's right to purchase an additional tanker to support the new

business generated by the new contract and the supplemental gain in market share that comes at the expense of firms that did not win and have become weaker competitors. We use a discount rate of 10% in the example. Our results are presented in exhibit 2.

What we have done is to place the intrinsic value of the call and put options embedded in the investment opportunity into the project cash flows. Our example assumes that both the put option and the call option are in the money at the end of the first period and that managers exercise the options. We have not valued the options *ex ante*. The volatility of the cash flows and the duration of the project would effect the value of the options. As with financial options higher volatility of the underlying assets increases the value of the option on the asset. A more volatile demand for heating oil delivery services or heating oil prices would increase the value of both the put and call options. These volatility estimates would be used as inputs in the option pricing model.

If cash flows are simulated there will be runs when the options are out of the money. This is the scenario that excludes options, scenario (A) in our example. Managers would not exercise out of the money options, this is why accounting for real options in the capital budgeting process will only increase a project's value, never decrease it. The caveat is that inaccurate option valuation will bias errors towards accepting value decreasing projects. The purpose of this note is to illustrate that including the accurate value of real options into the capital budgeting analysis increases the value of real investments.

In our stylized example, disregarding real options would lead managers to reject the investment in the new tanker. The net present value of scenario A is negative \$8,247. When the put option is factored in (scenario B) the net present value increases to positive \$8,914. When both the put and call options are factored in (scenario C) the net present value increases to positive \$10,755.

Real options analysis may not be worth while for simple short term projects. Rather than try to price the options managers may decide to use a hybrid analysis as we have

Exhibit 1. Cash Flow Series With and Without Embedded Options

Time	OUTCOME 1. Cash flows when market share is increased.	OUTCOME 2 Cash flows when market share declines.	OUTCOME 2 (Put option incorporated) Cash flows when market share declines and put option is exercised.	OUTCOME 1 (Call option incorporated) Cash flows when market share increases and call option is exercised.
1	-\$100,000	-\$100,000	-\$100,000	-\$100,000
2	\$50,000	\$5,000	\$5,000+\$75,000 =\$80,000 (\$75,000=value of truck in secondary market)	\$50,000+\$20,000- \$75,000= -\$5,000 (\$75,000 = price of competitor's tanker, \$20,000 - business taken from competitor)
3	\$50,000	\$5,000	0	\$50,000+\$20,000
4	\$50,000+30,000 =80,000 (\$30,000=residual value)	\$35,000 (\$30,000=residual value)	0	\$50,000+\$60,000+ \$20,000= \$130,000 (\$60,000 = the sum of the market value of two trucks)
Net Present Value @ 10 %	\$42,620	-\$59,115	-\$24,793	\$46,342

done in which the important real options are identified and cash flows are simulated across various values of the relevant inputs in a manner that captures the intrinsic value of the options at various points in time. For longer term projects with high research and development costs or high phased and uncertain investment outlays, foregoing real options analysis may lead managers to reject valuable projects. Inaccurate option valuation may cause managers to accept a project that should have been rejected.

Developing an aircraft for commercialization is a complex long term project. Without assigning value to the abandonment option, managers would be giving too much weight to scenarios where the costs of the project are too high or assets are yielding too little. Having the option to liquidate or reallocate resources tied up in the project once development is underway is valuable. Without this put option the likelihood that managers would exclude the development of the aircraft from the capital budget is much higher. If Boeing executives had to commit the de-

velopment costs of a new airplane according to an inflexible schedule that could not be altered as the state of the aircraft market, the financial markets, and the macro economy became more certain we would all still be flying in the Boeing Strato Cruiser. The estimated costs of developing the Sonic Cruiser were \$12 billion

“The major focus of commercial aircraft development activities over the past three years has been the 737 Next-Generation-900 model, the 747-400ER, the 747-400ERF, the 767-400ER, the 777-200LR, the 777-300ER, and a Sonic Cruiser airplane. The initial delivery of the 737-900, the largest member of the 737 Next-Generation family, occurred in the second quarter of 2001. Initial delivery of the 767-400ER, a stretched version of the 767-300ER capable of carrying over 300 passengers in a two-class configuration, occurred in the third quarter of 2000. Certification and first delivery of the 747-400ER and 747-400ERF occurred during the fourth quarter of 2002. Certification and first delivery of the 777-300ER and 777-

Exhibit 2. Expected Net Present Values

SCENARIO (A) Expected Net Present Value when both put and call options are ignored	SCENARIO (B) Expected net present value when put option is recognized and call option is ignored	SCENARIO (C) Expected net present value when both call and put options are recognized
-\$8,247	\$8,914	\$10,775

200LR is scheduled for 2004 and 2006, respectively.” (Boeing Inc. 2002, 10-K)

By December of 2002 Boeing executives had decided not to exercise their option to continue the development of the Sonic Cruiser. This implies that the option premium—in the case of real options, the investment required to bring the project to the next stage—exceeded the value of developing the Sonic Cruiser. Rather than allocate more resources to a project (call assets away from other projects within Boeing or from the market) that was not expected to add value to the firm, managers decided to shelve the Sonic Cruiser and put both hard and intellectual assets tied up in the project into the development of a more efficient but also more traditional aircraft, the 7E7.

From 1999-2000 when the Sonic Cruiser concept was being discussed with airlines through March of 2001 when the design for the plane was unveiled to the public and into the end of 2002 when the Sonic Cruiser project was cancelled, the market for aircraft changed dramatically. Recession, terrorism, war and the development of the Airbus 380 all lowered the value of Boeing’s Sonic Cruiser.¹

“In the fourth quarter of 2002, the Company announced that it would focus its product development efforts on the development of an efficient 200- to 250-seat

airplane that will fly 7,000 to 8,000 nautical miles with 15 to 20 percent lower fuel usage at the top end of today’s commercial jet speeds. The market potential for a new airplane of this size is forecasted at up to 3,000 units over the next 20 years. The Company expects to formally offer the new airplane to customers in early 2004, with entry into service targeted for 2008.” (Boeing 2002, Annual Report)

This new “efficient 200- to 250-seat airplane” is the Boeing 7E7.

We would like to invite financial engineers to contribute work to *The Financier* that analyzes how real option analysis should be or is integrated into aircraft development decisions at Boeing and Airbus.

We are privileged to have this opportunity to publish “*Real Option Approach to R&D Project Valuation: Case Study at Serono International S.A.*” by Olena Borissouk and Janos Peli. Their work offers valuable insight to financial managers and engineers on how they can use real option analysis to enrich the capital budgeting process.

END NOTES

¹ See news releases at WWW.Boeing.com for information regarding the Sonic Cruiser and the 7E7 program. Also for a good summary of the Sonic Cruiser program see the FLUG REVUE Aircraft Gallery at WWW.FLUG-REVUE.com. Read “Boeing’s Amazing Sonic Cruiser It was Supposed to change the way the world flies. Instead the world changed.” by Alex Taylor III in Fortune Magazine, Tuesday, December 3, 2002

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