Valuing Alternative Market Entry Strategies as "Real-Options"

Darryl G. Waldron
Professor of Business Administration
Trinity University

Abstract

The creation of shareholder value has become the standard by which companies worldwide are now being judged and for global companies the value creating process is largely a matter of constructing an optimal portfolio of businesses, products, and markets. No element of this process is more important than the choices firms make with respect to what markets to enter and what market entry strategies to employ. Correspondingly, few investment decisions are as difficult to value or are characterized by more uncertainty and, consequently, more risk, than the market entry decision. The valuation process is made even more difficult when expected cash-flows are contingent on downstream events that do not lend themselves to evaluation using conventional discounted cash-flow (DCF) analysis. However, as this paper suggests, real-options analysis provides management with a way of dealing with multi-stage sequential investments like those so commonly encountered in employing one strategy or another to enter foreign markets. This paper demonstrates how financial market discipline can be brought to bear on the evaluation of market entry strategies where flexibility and dexterity are major determinants of future value. An example is developed using a licensing agreement that contains an imbedded FDI real-option.

Introduction

The decision to enter a foreign market is one of the most daunting strategic challenges a manager must face. What makes this so is the magnitude of the financial commitment the firm must assume and the degree of complexity and, correspondingly, the uncertainty that attaches to most efforts to enter foreign markets. The argument posited here, however, is that the uncertainty associated with the decision to enter a foreign market is in fact a potential source of value, and that firms able to effectively price such uncertainty can expect to realize above market rates of return. The ability to consistently leverage discontinuities and imperfections across markets in a way that contributes to the creation of shareholder value is, after all, a characteristic that tends to distinguish more successful companies.

Real-options analysis allows a firm to price uncertainty by aligning project related risk with the only reliable index for achieving a proper valuation, capital market risk. The analytical approach being advocated in this paper constitutes a "middle-way" between what might be characterized as the two real-options camps; one championed by Sharp (1991) and the other by Amram and Lulatilaka (1999). Sharp (1991) argues that: "well-informed, experienced managerial judgment is an excellent, practical substitute for exact option valuation." Amram and Lulatilaka (1999) argue that real option valuation "is based on objective inputs and a precise list of which inputs are needed and which are not." This paper argues for a "ball-park approach" founded on well-informed managerial judgment but employing "fuzzy" mathematical modeling to derive something less than precise valuations but something more than purely subjective hunches. This more forgiving approach recognizes that mathematical modeling for business purposes must accommodate for the imprecision inherent in business and economic data.

Models that take on a life of their own can result in valuations driven by the numbers and not by critical thinking. The *Long Term Capital Management* fiasco is a wonderful example of just this sort of thing happening. Trying to anticipate your options before entering a foreign market makes sense, as does deriving a "ball-park" estimate of the value that is likely to be created by the entry strategy. On the other hand, trying to quantify those options on anything other than a "close is good enough" basis could best be described as a fool's errand.

Application of real-options analysis to the market entry problem requires that one make the transition from the world of financial assets to the world of real assets. While many managers, particularly those lacking strong backgrounds in finance, might view such a journey as daunting, this need not be the case. One objective of this paper is to take real-options analysis from the realm of the arcane and put it squarely in the realm of more broadly utilized, practical, easily understood analytical techniques. And although to some it may seem almost counter intuitive, it is the Black-Scholes options pricing model, a complex mathematical algorithm designed for pricing financial options, that will make this transition possible. The Black-Scholes model lets one move from simply thinking about a firm's market entry strategy as a real-option to actually being able to measure the contribution a particular market entry strategy is likely to make to the creation of shareholder value. Furthermore, it is unnecessary for one to understand differential calculus in order to understand the anatomy and application of the Black-Scholes model. In fact, as this paper demonstrates, the Black-Scholes model is easy to understand, easy to apply, and it focuses on a set of inputs that managers are broadly familiar with.

In addition to providing a framework for actually valuing a market entry strategy, real-options analysis encourages what some have described as a new way of thinking about strategic investment. In this regard, Amran and Kulatilaka (1999) argue that:

> The current set of valuation and decision-making tools just doesn't work for the new business realities: strategic investments with lots of uncertainty and huge capital requirements; projects that must adapt to evolving conditions; complex asset structures through partnerships, licenses, and joint ventures; and the relentless pressure from the financial markets for value-creating strategy. Real-options is an important way of thinking about valuation and strategic decision making, and the power of this approach is starting to change the economic 'equation' of many industries (p. 3).

The truth of the matter is that managers and investors have been exercising the kind of thinking real-options advocates are calling "new" and "innovative" at least since the days of the East India Company (for evidence of this see: John Keay (1991). *The Honourable Company: a History of the English East India Company*). However, new or not, a real - options way of thinking is essential for managers who must formulate and successfully implement a firm's market entry strategy. This is true because in a majority of cases the real-option value of a market entry strategy will be greater than the present value of the measurable cash-flows that are initially generated. The challenge, of course, is to fully articulate the options that are likely to exist and to "ball-park" the conditions that are likely to obtain.

Arriving at Go

Operationalizing a real-options analysis of possible market entry strategies begins with the determination of whether such an approach is even necessary. In some instances, the firm will have no options, or there may be options but very little uncertainty. A real-options approach should be used under the following conditions:

> When the market entry strategy brings on contingent investment decisions.
>
> When the initial level of uncertainty is high, the investment is irreversible, and waiting will significantly reduce the opportunity cost of a wrong guess.
>
> When the present value of expected future growth options that attach to a particular market entry strategy exceed the present value of the cash-flows from simply entering the market.
>
> When uncertainty is large enough to make the present value of expected flexibility options greater than the present value of the cash-flows from market entry.
>
> When market entry will lead to project/investment updates, downstream innovation, and meaningful changes in strategy (Amram and Kulatilaka, 1991, p.24).

Both Luehrman (1998) and Sharp (1991) describe the real-options available to managers in broad but similar terms. One broad category is options that are incremental in nature. *Incremental options* provide the firm with downstream investment opportunities that build on the initial market entry investment. The other type is options that enhance a firm's flexibility. *Flexibility options* leverage existing investment by providing the firm with a broader range of investment alternatives than would otherwise obtain. In addition to incremental and flexibility options, Amram and Kulatilaka (1999) describe: *growth options*, which come as a consequence of entry investments that position the firm to take advantage of future growth opportunities if the initial project goes well; *waiting-to-invest-options*, which weigh the value of waiting for additional information that will significantly reduce or eliminate losses associated with being a first-mover; *exit options*, which value the opportunity to walk away from an investment and thereby increase the value of an investment; and *learning options*, where information gained at successive stages provide additional information that significantly enhance the value of the overall investment, making it worthwhile.

Options that attach to various market entry strategies are a function of how the firm chooses to enter a market initially. For example, if a firm enters a foreign market through a management agreement, its downstream options are likely to be quite different from those of a firm that initially enters a foreign market through exporting. The following elaboration of market entry alternatives draws on the work of Ball and McCulloch (1999), although the literature is replete with coverage of this topic:

Exporting on either a direct (in-house) or indirect (export agent) basis.

Direct investment (FDI) through a wholly owned subsidiary.

Joint venture (JV) structured around an equity investment.

Strategic (SA) structured around an alliance agreement.

Franchising agreement

Licensing agreement

Management agreement (MA)

Contract manufacturing agreement (CMA)

Build-operate-transfer (BOT) agreement

Internet investment

In addition to these alternative market entry strategies, management may employ a combination approach and there are subtle variations on some of these broad themes. For example, a technology development agreement might be structured into a licensing agreement or made part of a strategic alliance. To make a real-options approach to the valuation of market entry strategies manageable, the analysis must be structured in a way that allows for a disciplined assessment of multi-stage sequential investments. Exhibit 1 integrates the market entry strategies a firm might employ with the real-options that are likely to result.

Exhibit 1
Market Entry Strategies and Resulting Real-Options

	Incremental	Flexibility	Growth	Wait-to-see	Exit	Learning
Exporting	Yes	Yes	Yes	Yes	Yes	Yes
FDI	Yes	Yes	Yes	No	No	No
JV	Yes	Yes	Yes	Yes	No	Yes
SA	Yes	Yes	Yes	Yes	Yes	Yes
Franchising	Yes	Yes	Yes	Yes	No	Yes
Licensing	Yes	Yes	Yes	Yes	Yes	Yes
MA	Yes	Yes	Yes	Yes	Yes	Yes
CMA	No	No	No	No	Yes	Yes
BOT	No	No	No	No	No	Yes
Internet	Yes	Yes	Yes	Yes	Yes	Yes

Exhibit 1 also underscores the importance of looking beyond the value likely to be created by the initial market entry strategy. In many instances the value of imbedded downstream options will greatly exceed the value created by the initial market entry strategy. Exhibit 1 also highlights the importance of an orderly and disciplined evaluation of the options that might be created by a proposed market entry strategy. By failing to consider all of the options created, too great an emphasis may be placed on simply valuing the initial cash-flows, thereby producing a sub-optimal solution to the market entry problem.

Drawing It All Together

Understanding the basics of the Black-Scholes options pricing model is essential to being able to work with real-options. However, as suggested earlier, understanding the basics is relatively easy, in fact, both the inputs needed and the model itself are straight forward and logical. In this regard, Luehrman (1998) successfully eliminates the mystery surrounding development of real-option inputs in his discussion of "mapping" a real-option. Hopefully, what follows is equally effective in eliminating any mystery surrounding the application of the Black-Scholes model to real-options. Here the explanation is developed within the context of the market entry problem.

While derivation of the Black-Scholes model relies on a complex mathematical process, use of the model to price options on financial assets or to price real-options is relatively simple. The basic Black-Scholes option-pricing model calculates the price of a European call option as follows:

$$C = (S)[N(d_1)] - (X)(e^{-r_f t})[N(d_2)] \qquad (1)$$

where:

C = price of the call, or the call premium

S = price of the underlying asset

X = exercise or strike price of the call

r_f = continuously compounded annual risk-free rate of return

t = time to the option's expiration

e = approximately 2.7183

$N(d_1)$ *and* $N(d_2)$ = values for d_1 and d_2 are used to derive probabilities $N(d_1)$ and $N(d_2)$ of the asset being at a certain price relative to its price at the time the option is created.

Clearly, the difference between the price (value) of the asset and the exercise price (cost) is critical in determining what an option is worth. At maturity the price of the call option will be zero if the asset's price is at or below the exercise price or the price will be equal to the difference between the asset's price and the exercise price. Since the objective is to price the call option before expiration, it is necessary to derive an estimate of the present value of the exercise price and this continuous discounting process is accomplished by $e^{-r_f t}$. Because the asset price is a random variable, a probability distribution is employed to adjust the option price for the uncertainty involved. Here d_1 and d_2 are used to calculate the probability that the asset's price at expiration will be a specific number of standard deviations above or below the standardized mean of zero, and d_1 and d_2 are derived as follows:

$$d_1 = \frac{\ln(S/X) + (r_f + .5\sigma^2)t}{\sigma\sqrt{t}} \quad (2)$$

and:

$$d_2 = d_1 - \sigma\sqrt{t} \quad (3)$$

As this brief overview of the Black-Scholes model suggests, the price (C) of a European call option is driven by (1) the price or value of the asset (S), (2) the exercise price or price at which the asset can be purchased (X), (3) volatility of returns (σ), (4) time to expiration (t), and (5) the risk-free rate of return (r_f). Table 1 describes the underlying relationships between an option's price and these five "value drivers."

Table 1
Option Value Drivers

Increase:	**Change:**
Asset (stock) price	Increase
Exercise price	Decrease
Time to expiration	Increase
Volatility of returns	Increase
Risk-free rate of return	Increase

From equation (1), the price of a European call option at expiration is a function of the expected value of the underlying asset, *S*, (i.e., (S)[N(d_1)]) where $S > X$, the probability of $S > X$ at expiration (i.e., [N(d_2)]), and the present value of the cost of the investment, *X*, (i.e., $(X)(e^{-r_f t})$). What one must know to value either a financial or a real-option is (1) the current price of the underlying asset, (2) the time to the expiration of the option, (3) the exercise price, (4) the risk-free rate of return, (5) the volatility of returns on the underlying asset, and (6) the value of any cash payouts or noncapital gains on the underlying asset during the holding period. And while it may seem counter intuitive, the present value of a real-option goes up as the volatility of expected returns and the time to expiration increase. This opportunity to leverage uncertainty and the flexibility that additional time provides makes it imperative that management carefully assess any market entry strategy for imbedded real-options.

To make the transition from financial to real-options management must first understand the correspondence between financial and real-option inputs. As mentioned earlier, Luehrman (1998) addresses this process in his discussion of “mapping” real investment opportunities to fit the Black-Scholes model. Table 2 specifies the correspondence between inputs for a financial call option and inputs for a real-option, and puts the correspondence on a cash-flow basis. A cash-flow perspective makes better sense than continuing to think in terms of investing in assets because it is expected cash-flows (ECF) that will ultimately determine the economic value of any strategy. The economic value of a real-option on a market entry strategy will be higher where: (1) the difference between the present value of the expected cash-flows resulting from successful implementation of the strategy (S) and the cost of implementing the strategy (X) is maximized, (2) implementation can be deferred for a longer period of time, (3) the time value of money is higher, and (4) the volatility of the strategy’s ECFs is greater.

Table 2
Mapping a Real Investment into a Call Option

Investment opportunity	**Variable**	**Call option**
Present value of ECFs to be acquired	S	Stock price
Expenditure needed to acquire the ECFs	X	Exercise price
Length of time the decision may be deferred	t	Time to expiration
Time value of money	r_f	Risk-free rate of return
Riskiness of the investment’s ECFs	σ^2	Variance of stock returns

Table 2 not only articulates the correspondence between financial and real-options, it provides a basis for better understanding the variables that define the Black-Scholes financial options model and these “same” variables as they appear in real-options. With financial options we have variables that are more readily observable and whose values are a reflection of the collective wisdom of broad and deep financial markets. These are not forecasted values and we are not talking about the need to use “synthesized” or “derived” values as proxies for what are readily observable measures of performance. On the other hand, real-options rely more heavily on values derived from forecasts and the judgment of management.

More specifically, the price or value of a financial option derives from the present value of the underlying asset’s expected cash-flows, a valuation that reflects the consensus of what is generally viewed as a reasonably efficient market. Stock prices adjust quickly to account for new information and they are readily observable. The present value of the ECFs produced by a particular market entry strategy is derived from a forecast that is presumed to be the byproduct of a thorough analysis. This value does not reflect a market consensus, nor is it a readily observable value. It reflects management’s thinking and it is obscure. The price of a financial asset such as a share of stock is clearly specified (not negotiated) and readily observable. The investment necessary to implement a successful market entry strategy is likely to be less clearly specified and subject to considerable negotiation and uncertainty, and it is an obscure value. The time to expiration of a financial option is more clearly specified and readily observable, while the expiration period for a real-option on a market entry strategy may be quite arbitrary and a majority of the time, obscure. The time value of money is more clearly specified for financial options (i.e., the yield to maturity on U.S. Treasury bills) and readily observable. The time value of money for a real-option on a market entry strategy would be both firm and market specific, and relatively obscure. Finally, the variance of returns (capital appreciation and dividends) for individual stocks or for the market (a class of assets) is easy to calculate and broadly observable. The variance of ECFs from the successful implementation of a particular market entry strategy must be estimated and is likely to be firm and market specific, as well as obscure.

In reality, none of these differences compromise the appropriateness or applicability of real-options analysis for the market entry problem. They simply reflect the differences that exist between financial and real assets, and the cash-flow characteristics that attach to each. Not having market based values to work with certainly makes the job of conducting a real-options analysis more difficult in terms of specifying the inputs. And forecasting clearly makes for a more subjective analysis. But some forecasting is needed in all valuation models and it is something that managers are called on to do every day. Furthermore, a higher level of subjectivity is inherent in real-options analysis and, as a consequence, should not be viewed as determinant in judging the efficacy of the approach. An analysis structured around a real-option captures the essence of a market entry strategy with downstream investment alternatives far better than a straight discounted cash-flow analysis or a decision-tree analysis ever could. Regarding the issue of efficacy, Coy (1999) arrives at a similar conclusion in his assessment of the practicality of real-options analysis:

> What's hot now is the extension of real-options beyond commodities-into biotechnology, pharmaceuticals, software, computer chips, and similar fields. This requires some innovation. The underlying asset of the option is no longer a traded product such as oil, whose going price can be plugged easily into a formula. Now, the asset that you get with the call option is something that's not traded-for example, a factory that hasn't even been constructed yet. Its present value must be estimated from projections of its future cash-flows. That's not a simple calculation, to be sure, but it gives better answers than the methods that most companies use today to make major investment decisions (p. 122).

The one value managers are likely to be unaccustomed to estimating is the cumulative volatility ($\sigma\sqrt{t}$) of ECFs for a market entry strategy. Luehrman (1998) recommends three possible approaches for deriving an estimate of σ, the standard deviation of expected returns and an important part of the cumulative volatility estimate. One possibility is an educated guess based on historical precedent-generally a range of 30 to 60 percent per-year is about right. A second possibility is to develop an *implied volatility measure* using historical data on investment returns in the same or a related industry. Finally, a *Monte Carlo* simulation can be used to synthesize a probability distribution and, correspondingly, an estimate of variance for expected returns.

The following example provides a real-option valuation of a market entry strategy where a licensing agreement is used to create a foreign direct investment (FDI) option. While the example uses a hypothetical company, it is representative of the kind of investment choices firms make every day in association with the decision to enter new markets.

The Market Entry Problem as a Real-Option: An Example

Precision Instruments (PI), a manufacturer of high quality optical measurement devices, has established a broad international presence using exporting, licensing agreements, foreign direct investment, and strategic alliances where PI has provided technology, managerial expertise, and, in some instances, financing. Here, PI is considering entering the Brazilian optical measurement device market through a licensing agreement with an established Brazilian firm, Andoz, which manufactures and distributes similar equipment throughout Latin America. The licensing agreement will give PI access to Mercosur, something PI does not currently enjoy, and it will allow management to learn more about doing business in Latin America. It will also provide PI with the option of creating its own manufacturing and distribution system anytime after three years. PI must furnish working capital, technical assistance, and equipment to bring Andoz' systems and processes up to ISO 9002 standards. There is no real danger that Andoz might subsequently compete with PI because Andoz lacks the R&D capability. Following are the earnings and cash-flow projections for the licensing agreement.

Exhibit 2
Cash-Flow Projections for Precision Instrument's Licensing Agreement

Year	**0**	**1**	**2**	**3**
Cash-flow projections (000s)				
revenue		83.5	102.0	146.4
-operation expenses[1]		20.5	24.8	36.0
=operating profit from licensing		63.0	77.2	110.4
-taxes		22.0	27.0	38.5
+depreciation		3.4	4.1	6.0
-increase in NWC	180.0	8.0	2.3	5.8
-increase in capital expenditures	342.0	12.5	2.9	7.5
=operating cash-flow from licensing	**-522.0**	**26.9**	**49.1**	**64.6**
+residual value (perpetuity with g=.03)				**354.0**
Present value @ discount rate of .25				
discount multiple	1.00	.800	.640	.512
present value of ECFs-PV if investment	**-162.8**	**21.5**	**31.4**	**214.3**

(1) Cost of goods sold is accounted for by Andoz

As the results from Exhibit 2 suggest, when viewed as a straight licensing agreement, the market entry strategy would destroy the equivalent of $86.4 million in shareholder value and, presumably, management would not approve the investment. What this discounted cash-flow analysis fails to value, however, is the option to build a factory and marketing system created by the licensing agreement. After all, the licensing agreement will give PI access to Mercosur and, presumably, will contribute in a significant way to PI's better understanding of what it takes to do business in Latin America. The only way to properly value the direct investment alternative is as a real-option.

The real-option PI would create by entering the market through a licensing agreement combines an *incremental option* with a *wait-and-see* (*wait-to-invest*) option (see Exhibit 1). The licensing agreement will allow PI to minimize its initial investment in the face of great uncertainty, put off an irreversible decision, and reduce the opportunity cost of a wrong guess. Most important of all, the strategy lets PI acquire valuable experience and develop business relationships in Latin America, a region with incredible growth potential, but a region characterized by very high levels of business, financial, and political risk. To exercise its option, PI must build a factory in Brazil, create a marketing and distribution system, staff the organization, and provide adequate working capital. Exhibit 3 shows the cash-flow projections for the FDI option that is imbedded in the strategy to initially enter the market through a licensing agreement.

Exhibit 3
Cash-flow Projections for Precision Instrument's FDI Real-Option

Year	**4**	**5**	**6**	**7**
Cash-flow projections (000s)				
operating cash-flow from direct investment[1]	25.0	85.0	180.0	335.0
residual value (perpetuity with g=.08)				2500.0
-investment in working capital	-285.0			
-capital expenditures	-735.0			
total investment **(X)**	**-1020.0**			
Present value @ discount rate of .20				
discount multiple	.482	.402	.355	.279
present value of ECFs **(S)**	**901.3**	**34.2**	**64.0**	**791.0**

(1) Operating cash-flow is fully specified in Exhibit 2. For a complete discussion of operating cash-flow see: Rappaport, Alfred (1998). *Creating Shareholder Value*, New York: The Free Press.

The risk free rate (r_f) is estimated to be 13 percent, the yield to maturity on a three-year U.S. Treasury bond plus the premium on Brazilian government debt. The option will expire in three years (t = 3), and the volatility of returns, expressed as the standard deviation of the real-option's ECFs, is estimated to be 40 percent ($\sigma = .40$). With the variables fully specified, it is a relatively simple task to use the Black-Scholes options pricing model (see Equation 1) to value the direct investment strategy as an imbedded real-option. The value of PI's direct investment real-option, $335.25 million, was derived as follows:

$(C) = \$901.3(.7673) – \$1020.0(.6770)(.5160) = \underline{\$335.25 \text{ million}}$

where:

C = value of the FDI real-option = \$335.25 million

S = present value of ECFs from foreign direct investment = \$901.3 million

X = investment necessary to exercise the option = \$1.020 billion

r_f = the continuously compounded annual risk-free rate of return = .13

t = time to the option's expiration = 3 years

e = approximately 2.7183

$N(d_1)$ and $N(d_2)$= the values for d_1 and d_2 are used to derive (from a cumulative standard normal distribution) probabilities $N(d_1)$ and $N(d_2)$ of the asset (ECFs) being at a certain price or value relative to the price or value at the time the real option is created. d_1 and d_2 were derived as follows:

$d_1 = \mathit{ln}(901.3/1020.0) + [.13 + .5(.4^2)3/(.4)\sqrt{3} = .7308$

and: $N(d_1) = .7673$

$d_2 = .7308 – (.4)\sqrt{3} = .038$

and: $N(d_2) = .5160$

Properly structured, valuation of PI's strategy to enter the Brazilian market for optical measurement devices through a licensing agreement with an imbedded direct investment real-option should be viewed as a two-step process. The licensing agreement must be valued first on a discounted cash-flow basis, followed by the direct investment opportunity valued as a real-option. Taken alone, the present value of the licensing agreement (-\$162.8 million) would argue against PI entering the Brazilian market. However, when combined with the present value of the direct investment real-option imbedded in the licensing agreement (\$335.25 million), an aggregate \$172.45 million (i.e., \$335.25 – \$162.8 million) in shareholder value is created. The above analysis suggests that PI's optimal strategy would be to sign the licensing agreement with Andoz and at the end of three years exercise its option to build a factory and establish a marketing system to serve the Brazilian market on a direct basis. One additional observation, multi-stage sequential investment problems can not be solved by simply adding together DCFs for each stage. In this case, for example, such an approach would overstate the value created by approximately \$75 million.

Summary

Real-options analysis is a useful methodology for evaluating multi-stage sequential investments where downstream opportunities to create additional value make a straight discounted cash-flow analysis inappropriate. The decision to enter a new market, particularly a foreign market, can require a significant commitment of cash and be fraught with uncertainty. Correspondingly, the market entry strategy a firm employs can subsequently lead to the creation of a variety of follow-up investment opportunities that can only be properly valued as real-options. However, as Busby and Pitts (1997) suggest, to date, real-options analysis is not being broadly utilized by decision-makers:

> Few firms had procedures either to identify or to evaluate most types of real-options, although a third did require that rescaling options were assessed during the appraisal process. Generally, such procedures as firms did use were labeled 'risk and 'risk mitigation,' or 'risks and opportunities' rather than in terms of flexibility or options. Many firms use tools like sensitivity analysis to understand where their projects are most susceptible to uncertainties, although it seems that few take the further step of identifying and evaluating any options which they could exercise if needed…. Very few decision-makers had heard of the terms 'real-options,' 'growth-options' or 'operating-options' in the sense used in the research literature and management periodicals; however two firms were in the process of assessing the usefulness of real-option theory in the investment appraisal process (p. 184).

The very nature of the market entry decision involves so much uncertainty and can create so many downstream opportunities to leverage the risk that tends to naturally occur, that a firm simply must employ a disciplined and orderly evaluation process that explicitly considers any imbedded options that are created. This study demonstrates the importance of viewing a firm's choice of a market entry strategy as a real-option problem. And, contrary to what many would suggest, real-options analysis does not rely on arcane mathematical modeling, nor does it focus on value drivers that are unfamiliar to managers. Simply put, management must derive estimates of (1) the cash-flow the strategy is expected to generate, (2) the investment required to successfully implement the strategy, (3) the option's expiration date, (4) the risk-free rate of return, and (5) the expected volatility of returns. Treating the market entry strategy as a real-option forces management to carefully think through the opportunities that are likely to be created and to explicitly evaluate the strategy's value drivers.

The example developed as part of this study demonstrated the importance of management looking beyond the initial market entry strategy and resulting cash-flows, to consider as well any imbedded real-options. Had the market entry strategy in the example been judged entirely in terms of the value likely to be created by the licensing agreement, Precision Instruments would not have entered the Brazilian market for optical measurement devices. However, when the direct investment opportunity was valued as an imbedded real-option, nearly $175 million in shareholder value was created.

Clearly, a formal decision making process that explicitly accounts for and effectively values uncertainty and volatility should be used to evaluate investments that are apt to result in follow-up investment opportunities. In many instances an assessment incorporating only a discounted cash-flow analysis will lead management to make the wrong decision. However, used in conjunction with discounted cash-flow analysis, real-options analysis introduces a degree of flexibility that allows management to more accurately account for the present value of projects consisting of a bundle of multi-stage investment opportunities. The resulting valuation will be a more robust measure and one that more fully accounts for the value enhancing potential of uncertainty, volatility, and flexibility.

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