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Real Options Theory

**Jeffrey J. Reuer and
Tony W. Tong**

REAL OPTIONS THEORY

ADVANCES IN STRATEGIC MANAGEMENT

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PART I:
INTRODUCTION

REAL OPTIONS IN STRATEGIC MANAGEMENT

Tony W. Tong and Jeffrey J. Reuer

A fundamental issue in the field of strategic management concerns firms' strategic choices and directions (Rumelt, Schendel, & Teece, 1994). Reflecting this central concern, a substantial amount of research in the field has examined the antecedents of a wide range of strategic decisions by firms as well as their performance implications. Whether strategic decisions involve internal investments in technology or external corporate development activities, they generally involve resource commitments to future initiatives under uncertainty. As a result, the role of uncertainty has received a great deal of attention in strategy research, and there has been recurrent interest in how firms might better manage strategic decision making under uncertainty.

Research has long recognized the key role that uncertainty plays in organizations and management (e.g., Cyert & March, 1963; Thompson, 1967), yet a recent and novel treatment of uncertainty comes from real options theory. In contrast to traditional views that managerial discretion is limited in the face of uncertainty or that organizational inertia dominates, real options theory maintains that firms can engage uncertainty and benefit by investing in options to respond to uncertain futures and by managing the investments in a sequential fashion as uncertainty is resolved (Kogut, 1991; Dixit & Pindyck, 1994; Kogut & Kulatilaka, 2001). Recent advances in strategy and finance have suggested that real options theory potentially offers a powerful valuation tool as well as a systematic strategy framework

to evaluate and structure resource investments under uncertainty, and that successful use of real options can lead to the benefits of downside risk reduction and upside potential enhancement (Bowman & Hurry, 1993; Kogut & Kulatilaka, 1994a; Trigeorgis, 1996; McGrath, 1997; Amram & Kulatilaka, 1999).

In undertaking this volume, our objectives are two-fold. First, as interest in real options theory continues to grow, there have also been questions on the greater promise of real options theory in strategy. While advocates believe that real options theory informs strategic decision making under uncertainty, others also see difficulties surrounding the theory's larger applicability to strategic management issues. We suggest that part of this dialogue reflects broader questions on how real options theory might link to the foundations of the strategy field, and we identify four fundamental questions for real options theory to advance in strategy. Second, the strategy literature on real options has developed rapidly, and research has examined diverse aspects of the theory. As such, our second objective is to catalog, synthesize, and critique the extant real options research in strategy. This effort can delineate the ways in which real options theory contributes to strategy, and it also can reveal certain avenues for future research on real options. The focused volume therefore can provide a forum for researchers to tackle key questions, discuss promising opportunities, and map out the future research agenda for real options theory in strategic management.

In the following section, we briefly review the origins of real options theory, trace its developments in strategic management, and outline three reasons why it has become important for the field. This review and assessment leads to an overarching framework that we also use to organize the remaining 17 chapters in this volume, and we highlight how these articles are built on the framework and contribute to our expanded knowledge. We conclude by offering four fundamental questions that we believe lie at the interface between real options and strategy and can help move forward real options research in strategy in important ways.

THE DEVELOPMENT OF REAL OPTIONS THEORY

The Origins of Real Options Theory

Real options theory begins by drawing an analogy between real options and financial options. A financial option is a derivative security whose value is

derived from the worth and characteristics of another financial security, or the so-called underlying asset. By definition, a financial option gives its holder the right, but not the obligation, to buy or sell the underlying asset at a specified price (i.e., the exercise price) on or before a given date (i.e., the expiration date). Financial economists Black and Scholes (1973) and Merton (1973) pioneered a formula for the valuation of a financial option, and their methodology has opened up the subsequent research on the pricing of financial assets and paved the way for the development of real options theory.

The notion of real options was developed from Myers' (1977) seminal idea that one can view firms' discretionary investment opportunities as a call option on real assets, in much the same way as a financial call option provides decision rights on financial assets. By way of analogy, a real option has as its underlying asset the gross project value of expected operating cash flows; its exercise price is the investment required to obtain this underlying asset; and the time to maturity is the period of time during which the decision maker can defer the investment before the investment opportunity expires (e.g., Myers, 1977; Trigeorgis, 1996). Formally stated, real options are investments in real assets, as opposed to financial assets, which confer the firm the right, but not the obligation, to undertake certain actions in the future (e.g., Trigeorgis, 1996; Amram & Kulatilaka, 1999). Comparisons of financial and real options can be found in standard textbooks (e.g., Brealey, Myers, & Allen, 2006).

Real options research in finance and economics has developed a taxonomy of common real options that are often embedded in an investment, including deferral options, options to stage investments, options to alter operating scale, abandonment options, switching options, and growth options. In addition, an investment frequently involves a combination of some of the common real options above, and their combined value often differs from the sum of the value of each option in isolation (Trigeorgis, 1993). Investments such as technology development or venture capital also may consist of sequential stages, and such multistage investments comprise compound options, whose underlying asset is not a real asset, but another option (Roberts & Weitzman, 1981; Trigeorgis, 1996). To the extent that an investor can hold a portfolio of options simultaneously (Merton, 1973), a firm undertaking multiple investments at a point in time may also experience option portfolio interactions, in that options embedded in one investment may shape the value of other options held by the firm and therefore the overall value of the option portfolio (e.g., Triantis & Hodder, 1990; Luehrman, 1998; Smit & Trigeorgis, 2004).

The real options literature in finance and economics tends to have an analytic focus, employing real options analysis to evaluate firms' investments under uncertainty and to model the optimal conditions for undertaking such investments. For example, earlier research in this literature has evaluated investments in natural resources and flexible manufacturing (e.g., Brennan & Schwartz, 1985; Triantis & Hodder, 1990), analyzed the optimal timing of investing in land development (e.g., Titman, 1985), and studied the relationship between options to alter operating scale and the value of the firm (e.g., McDonald & Siegel, 1985; Pindyck, 1988; Majd & Pindyck, 1989). Pindyck (1991) and Dixit (1992) reviewed the literature on investment under uncertainty, and Dixit and Pindyck (1994) provided extensive discussions of theoretical advances. Two recent developments relating to strategy are noteworthy, however. First, research has paid increasing attention to the competitive environment surrounding firms' investments and the strategic aspects of real options, which have important implications for competitive strategy (e.g., Kulatilaka & Perotti, 1998; Grenadier, 2000; Smit & Trigeorgis, 2004). Second, research has also used real options theory to analyze investments in building strategic resources such as R&D, as well as other corporate development activities such as acquisitions and diversification, in the broader context of corporate strategy (e.g., Childs & Triantis, 1999; Matsusaka, 2001; Bernardo & Chowdhry, 2002; Pacheco-de-Almeida & Zemsky, 2003).

Compared to the large amount of theoretical work in this literature, there have been relatively few large-scale empirical studies, a point lamented by Schwartz and Trigeorgis (2001) and others. The available empirical analyses of real options in finance and economics have largely continued the focus of analytic work in the areas of natural resource investments and real estate development (e.g., Paddock, Siegel, & Smith, 1988; Quigg, 1993; Moel & Tufano, 2002), and have also examined the implications of particular options for the value of the firm (e.g., Berger, Ofek, & Swary, 1996). Empirical work on investing in strategic resources and corporate development is lacking, however, and option implementation issues related to organization, incentives, and the like have yet to be probed in more depth (Trigeorgis, 1996).

The Development of Real Options Theory in Strategic Management

Initial interest in real options in the field of strategic management began to emerge in the early 1980s, when management researchers first expressed dissatisfaction with traditional financial techniques such as the net present

value (NPV) approach to resource allocation and strategic decision making (e.g., Hayes & Garvin, 1982). These techniques make it hard to account for follow-on investment opportunities often embedded in a corporate investment project, or to capture managers' flexibility in adapting their decisions to evolving market and technological uncertainty, a view also shared by financial economists such as Myers (1984) and Kester (1984).

Kogut was among the first to formally conceptualize and empirically test real options in strategic management. His seminal work started in the context of multinational corporations (MNCs) and the coordination of their operations across countries. In a series of articles, Kogut (1983, 1985, 1989) maintained that multinational operations confer the MNC a string of real options in order to capitalize on the high levels of uncertainty and heterogeneous opportunities present across countries. For instance, he suggested that international investment confers the MNC valuable growth options, and an initial investment in a foreign country often carries a large option value, since the investment can unlock opportunities for future expansion. Kogut also emphasized that the MNC holds a portfolio of switching options that offer operating flexibility by allowing the firm to shift value chain activities across geographically dispersed subsidiaries as uncertain environmental conditions evolve.

A number of studies have expanded Kogut's initial contributions in several concrete ways. Kogut and Kulatilaka (1994a), for example, developed a model that captures the option value of production switching between two country locations in the presence of volatile exchange rates. Kogut and Chang (1996) empirically tested the idea that an initial investment may serve as a platform for subsequent expansion, and they found that Japanese firms' direct investments in the U.S. were triggered by appreciation of the Japanese yen. Miller and Reuer (1998a, 1998b) studied U.S. MNCs' economic exposures to foreign exchange rate movements, and they showed that firms with greater FDI have lower exposures, and that such exposures also tend to be asymmetric, which is consistent with the presence of real options. Allen and Pantzalis (1996) and Tang and Tikoo (1999) provided evidence that the stock market values the breadth of MNCs' international operations, supporting the notion of switching options available to the firms. More recently, Reuer and colleagues couched the benefits of operating flexibility in terms of the downside risk reduction from multinational investments (Reuer & Leiblein, 2000; Tong & Reuer, 2007), and they suggested and found that the extent to which MNCs can benefit from geographically dispersed operations is tempered by certain organizational factors that increase coordination and switching costs.

Kogut's pioneering contributions also pertained to the areas of governance and organizational choice in the corporate strategy domain. He provided the first theoretical arguments and empirical evidence that joint ventures (JVs) provide firms real options to expand sequentially into new and uncertain markets (Kogut, 1991). By investing in a JV, a firm is able to limit its downside losses to an initial, limited commitment, while also positioning itself to expand, but only if future conditions turn out favorably. In line with the theory, he found that the firm undertakes expansion by exercising the option by buying out its partners when the JV experiences a positive demand shock, but the firm continues to hold onto its investments in the JV when negative demand signals materialize.

A significant amount of theoretical and empirical research that followed has sought to extend this paper by examining the firm's choice of particular governance modes and related governance design issues. First, using formal models, Chi and colleagues have examined the circumstances under which the option to acquire or sell out a JV provides positive economic value for partners, investigated the conditions under which firms may hold the option rights, and analyzed governance structure issues such as the allocation of equity stakes between the partners (Chi & McGuire, 1996; Chi, 2000). Reuer and colleagues studied the real options embedded in various types of JVs (Reuer & Tong, 2005, 2007; Tong, Reuer, & Peng, 2008), and their findings indicated that JVs enhance firms' growth option values, yet only under some well-defined conditions. Second, Folta (1998) studied firms' decisions to undertake JVs versus acquisitions by viewing JVs as providing deferral options and sequential commitments, and he found that firms are more likely to invest in JVs over acquisitions when facing high levels of uncertainty. Folta and Miller (2002) built on Kogut's (1991) focus on option exercise decisions, but went beyond JVs to investigate minority equity investments. Building on Dixit and Pindyck (1994) and continuing Folta's (1998) focus on deferral options, Folta and colleagues examined firms' market entry decisions and presented findings consistent with real options theory (Miller & Folta, 2002; Folta & O'Brien, 2004; Folta, Johnson, & O'Brien, 2006). Collectively, this set of empirical evidence has begun to develop toward a real options theory of market entry and organizational governance that can complement existing theories: market entry modes differ in their attributes and embedded options, and they respond to uncertainty in different ways, leading firms to use them discriminately to structure their investments.

Around the same time as Kogut's work, Bowman and Hurry (1987, 1993) were working to develop an option theory based perspective of strategic management. Bowman and Hurry (1993) proposed options as a strategy