

REPLY

REAL OPTIONS AND REAL TRADEOFFS

RON ADNER
INSEAD

DANIEL A. LEVINTHAL
The Wharton School, University of Pennsylvania

The commentaries on our article fail to come to grips with the distinct challenges raised by a process of experimentation that leads to the discovery of new possible initiatives. These challenges differ from those posed by an investment that provides privileged access to a prespecified set of possible follow-on investments. By treating these challenges as simple problems of implementation, the commentaries ignore the strategic tradeoffs implied by efficient abandonment processes and, therefore, fail to clarify where the logic of real options is likely to be more (and less) helpful to strategy thinking.

To a man with a hammer, everything looks like a nail (attributed to Mark Twain).

We are glad to have the opportunity to reply to the responses to our article (Adner & Levinthal, 2004) regarding the boundaries of applicability of real options to business strategy. If the real options approach, as applied to strategy, represents a theoretical advance, it must offer new insights beyond those currently available from more general notions of path-dependent investment. Since path-dependent investments, in general, are characterized by incremental resource commitments and adaptive responses, the contribution of real options to strategy must extend beyond the observation that commitments need not be one-shot events and actually speak to the treatment and structure of resource reallocation over time.

A prominent characteristic of strategically interesting settings is that, having made an initial investment, firms can actively engage in follow-on activities that can influence outcomes and identify new possible actions and goals. While in established real options theory there is recognition that the option to make or forego follow-on investments is a source of value and that prior stage-setting investments may be a precondition for the exercise of these options, there is an assumption that the nature and quality of options are independent of the firms' interim activities. The implicit imagery is of a firm "buying a ticket" to engage in some prespecified

opportunity set, thus ignoring the potential for the firm to mold and enhance initiatives, learn about new opportunities, and discover new possible initiatives not conceived of at the time of the initial investment.

In our article we argue that, to extend the applicability of a real options logic to strategically interesting settings in which firms can act to affect the set of possible outcomes, a real options logic for initiating investments must be complemented by an organizational design that can abandon initiatives efficiently. We make the further point, however, that such organizational designs force strategic tradeoffs regarding the ways in which organizations can pursue opportunities. The greater the role of the organization in molding the possible course of an initiative after an initial investment, the greater the organizational challenges and the strategic tradeoffs associated with applying a real options logic. As a result, the less helpful the logic is for guiding strategy in such settings.

The three responses overlook the tradeoffs that a true real options approach imposes, each bypassing our concerns in its own way: McGrath, Ferrier, and Mendelow's (2004) by arguing that the abandonment issue is a matter of implementation and merely reflects an escalation of commitment bias; Kogut and Kulatilaka's (2004) by arguing that the abandonment problem is rooted in a status quo bias and that organizations, as adaptive learners, will eventually

converge on the proper compensating management techniques to overcome such difficulties; and Zardkoohi's (2004) by arguing that behavioral biases will be offset by the efficiency of internal and external governance mechanisms in for-profit firms, which render the problem of abandonment moot.

These arguments leave unaddressed the core challenge raised by the *endogenous* discovery of opportunity structures—a challenge quite distinct from the issue of behavioral biases. These arguments also ignore the strategic opportunity costs associated with their own organizational recommendations. In arguing for a seemingly limitless applicability of real options, the authors fail to address the question of “what is not a real option” or, more precisely, the question of where the logic of real options is likely to be more (and less) helpful to strategy thinking. Our original concerns remain unallayed.

FRIEND OR FOE OF REAL OPTIONS

We are not hostile to the notion of real options or to broader efforts at intentionally rational choice. The idea of real options is a powerful construct. To suggest that there are boundaries to the applicability of this particular analytical framework does not, in our minds, negate its power or merit. When it is possible to characterize a sequential decision problem as a real option, it is useful to view the choice as such. When such characterizations are illusionary, however, it is not self-evident that such a framing is useful. Our article is an attempt to provide some sense of the settings under which a real options framing is more or less likely to be of value.

Attempts to paint our discussion of the applicability of real options as a dichotomous exercise—neatly dividing the world between settings in which the application of options logic is warranted and those in which it is not—mischaracterize our arguments on two counts. First, we do not offer a black-and-white view of where options approaches hold and do not hold; rather, we consider how deviations from the key assumptions that underlie options logic affect its ability to contribute to strategy thinking, both in terms of formal correctness as well as in its ability to add new insight not already available

to the field.¹ Second, we do consider the process changes that organizations can make to extend the applicability of real options logic, but we also insist that the cost of such changes should not be overlooked when assessing the benefits of adopting real options logic in informing strategy.

We do not question the formal logic of real options. The formal logic, with its clear set of assumptions, is obviously correct when the underlying assumptions are met. Rather, we question the degree to which these critical assumptions hold in settings that are of interest to strategists. We argue that many of the intriguing applications offered for real options logic in the strategy literature, such as planning activities for radical technological change (e.g., McGrath, 1997) or investing in future capabilities (e.g., Kogut & Kulatilaka, 2001), strain these assumptions in important ways.

One can attempt to apply real options logic in all circumstances, as some would argue, especially as the formal logic is recast as a “heuristic for strategy.” However, we are concerned with the extent of the damage that can result from the misapplication of real options logic in settings to which it is not suited—either because it has not been complemented with the required organizational adaptations necessary for its implementation or because the tradeoffs associated with such organizational adaptations have not been considered.

CHALLENGES OF DISCOVERY, NOT OF INDIVIDUAL BIASES

The issues we raise are not artifacts of individual biases in decision making, such as the process of escalation of commitment (as suggested by McGrath et al. and by Zardkoohi) or status quo bias (as suggested by Kogut and Kulatilaka). Such deviations from rational choice accentuate the problems we raise but are not their root cause. Rather, as we argue in the original article, in a world in which the set of possible outcomes cannot be fully specified *ex ante*, in which firms can continue to act to affect outcomes, and in which firms can discover new

¹ For this reason, in our original article we discuss the *extent* (as opposed to *existence*) of applicability throughout the text and use dashed rather than solid lines in Figure 2 of the article.

possibilities for a given initiative through these actions, even well-motivated intentionally rational organizations will confront difficulties in the efficient abandonment of opportunities, and therefore in the application of real options.

We are not hostile to ideas of learning and adaptation, as McGrath et al. seem to suggest.² We simply argue that if one is to apply real options, then criteria need to be specified ex ante as to what outcomes merit continuation with the "option." Yes, the discovery of new possible avenues of approaches is an important outcome of experimentation. However, if a "Stage 2" initiative is something that was not even conceived of at the time of the initial investment, how can the initial investment be meaningfully characterized in terms of a real option? Such unstructured innovation journeys (Van de Ven, Polley, Garud, Venkataraman, 1999) are not real options.³ While both concepts are important, they are different.

² For further corroboration of this, one might consider some of our prior work (cf. Adner & Levinthal, 2002; Cohen & Levinthal, 1990).

³ Consider the extended example McGrath et al. give of the search down the river for a gold field. In the example the explorer operates according to the following search heuristic: continue on the current vector until you are forced to change (hitting land or a waterfall) and continue until gold is discovered. In what way does the process outlined relate to real options decision making?

It is important to distinguish good fortune from real options. The idea of real options implies that intentional investments are taken at some early stage so as to be able to exploit (exercise the option) those investments in a later stage. Michael Eisner's observation that the pre-existing library of Disney films is a valuable asset that can be more fully leveraged by selling more titles on video is not an example of real options reasoning. It is insight about a firm's existing resource. For this reason, we find the notion of shadow options (Bowman & Hurry, 1993) to be a problematic extension of the real options approach. We disagree with the suggestion that if an initiative creates possible future paths (creating "options" in the colloquial sense), such an initiative constitutes a real options investment. An initiative premised on real options logic requires ex ante intentionality regarding the specific possible future one is trying to create. In contrast, the discovery of how existing resources can be more fully exploited, while an important class of managerial insight, is a distinct sort of insight from real options reasoning. Not all acts of path creation constitute real options. While real options reasoning may provide an "economic justification for the behavioral process of investment" after the fact, such a characterization does not necessarily lend itself to insightful ex ante guidance or insightful ex post analysis.

WHY IS ABANDONMENT A CRITICAL PROBLEM FOR THE APPLICATION OF REAL OPTIONS WHEN FIRMS CAN AFFECT OUTCOMES?

We assess the applicability of options logic according to the degree to which uncertainty resolution is endogenous to firm action—the extent to which a firm can play an active role in affecting the value of an opportunity through its actions and, in particular, through the discovery of new possibilities. In settings where firms can attempt to modify outcomes in this manner, two organizational forces act to undermine the real options approach to decision making:

1. The fundamental appeal of the options approach stems from an ability to reduce downside risk while maintaining upside risk (opportunity). By sequencing investments such that new resources are committed only if and when positive outcomes emerge, the firm is able to benefit from positive outcomes through continued investment and to avoid negative outcomes by stopping investment. *Stopping investment is a key to limiting downside risk.* We highlight the importance of abandonment because maintaining the option of participating in emerging technologies, emerging markets, and other strategically interesting opportunities requires active investment and involvement; project teams need to maintain their development activities both to push forward the resolution of uncertainty (outcomes will not reveal themselves without further development or market exploration) and to maintain the ability (absorptive capacity, operational capability, etc.) to participate should such action prove desirable. In settings where firms need to act to resolve uncertainty, search is costly; in settings where firms can act to change outcome possibilities, search is unbounded. In these latter settings, the ability and willingness to stop investments in the face of negative information are hampered by the organizational dynamics we discuss in our article. Absent efficient abandonment processes, the downside risk of the option will be much greater than characterized ex ante.
2. Formal options logic dictates that as outcomes become more uncertain, the rational scope for organizational inaction (i.e., the band of hysteresis) becomes larger. In many strategically interesting settings, the greater the firms' scope to affect possible outcomes, the greater the potential variance in outcomes. When exploration activities increase choices, creating "options on options" rather

than reducing uncertainty, we have a circular trap: the logic states that firms should be more willing to invest in initiatives the higher their option value; however, the more they are willing to invest in search and development, the more variance there is in potential outcomes and, hence, the greater the project's option value. With sufficient endogeneity of the possible outcomes, if a firm is willing to invest initially in the option, it will continue to discover reasons to believe that subsequent investment will be worthwhile, since success will always seem to be "around the corner."

Combining the implications of these two forces suggests that, under conditions of endogenous uncertainty resolution, organizational dynamics are likely to hamper the efficient abandonment of opportunity and real options approaches are likely to overestimate the value of an opportunity. Thus, it is when firms can act to affect and create new outcomes—the setting of greatest interest to strategists—that the exercise of options logic is most suspect, overestimating the potential for gains and underestimating the potential for losses.

The above points highlight some important constraints, but these can be addressed by more rigorous discipline in project management. In our article we remind readers of some of the tools available for managing processes of project drift, and McGrath et al. similarly point out that such tools are available. We would note, however, the remarkably light treatment of such considerations in the vast majority of published discussions of real options and strategy (see Garud, Kumaraswamy, & Nayyar, 1998, and Coff & Laverly, 2001, for notable exceptions). The efficient management of abandonment, however, itself imposes strategic constraints on the organization whose costs must not be overlooked.

WHY IS ABANDONMENT A STRATEGIC ISSUE, NOT SIMPLY A MATTER OF IMPLEMENTATION?

In our article we focus considerable attention on how organizations can be structured to increase the scope of applicability of real options, with a special focus on the question of how projects are maintained and abandoned. Our critics interpret this narrowly—as simply a matter of correct strategy implementation and project management. In doing so they ignore the

strategic tradeoffs that come from organizing for real options.

In looking back on the past forty years of work in the innovation, creativity, and learning literature, we note that significant value has been attributed to autonomous and loosely monitored search processes in organizations whose goal is to find opportunities where they may, and whose mandate is to capitalize on serendipity.

This sort of unstructured, adaptive search runs contrary to the disciplined project abandonment procedures implicit in a real options approach. We do not believe, or claim, that one approach dominates the other; rather, they represent distinct strategic choices regarding approaches to exploiting opportunity. We do, however, emphasize the need for consistency between the logic used to initiate investments in path-dependent activities and the logic used to determine whether such activities should be continued or abandoned. The choice of tradeoffs is a matter of strategy, not implementation. It reflects a strategic choice regarding the balance between making errors of commission (type I) and errors of omission (type II). Part of our concern about the use of real options to guide strategic thinking stems from implementation recommendations, such as those outlined in the three responses, that are proffered without accounting for their broader strategic impact.⁴

Claiming the benefits of disciplined options management while at the same time advocating the merits of unstructured innovation journeys, as the authors of the responses seem to do, strikes us as a contradiction. As managerial advice, this contradiction is likely to lead to inefficient resource allocation; as research agenda, this contradiction is likely to lead to incomplete and potentially misleading analysis.

⁴ Consider, for example, Kogut and Kulatilaka's recommendation that firms review projects more frequently. Embracing such a recommendation, without considering and weighing the tradeoffs it implies for the ways in which projects are selected (e.g., in terms of ambition and time horizons) and managed (e.g., in terms of administration and dedication), is likely to lead to inconsistent policies, which, in turn, may induce exactly the sort of near-term focus the real options approach is intended to remedy.

FORMAL LOGIC, HEURISTICS, AND PLATITUDES

In seeking to extend the use of options in strategy thinking, many authors have advocated adopting an "options heuristic," in recognition that the formal logic may be unwieldy (or indefensible) in settings of greatest interest to strategists—settings where many of the key assumptions required to arrive at an option value are stretched and the input values are vague at best. A heuristic is a decision rule that simplifies a more complex decision-making logic. As such, a real options heuristic may mitigate the unwieldiness of the formal tool. However, while applying such a heuristic may reduce the technical challenge of applying a logic, it does not change the fact that, when applied in settings that are increasingly distant from its underlying assumptions, the guidance given by the logic is also subject to increasing degradation.⁵

As criteria for guidance are made less stringent, the insights offered by the heuristic become less precise and less differentiable from existing insights on path-dependent processes. In our article we note that many of the recommendations that fall out of the real options heuristic do not seem substantially different from what is, by now, conventional wisdom in the field: the arguments derived from resource-based perspectives, evolutionary economics, innovation management, and dynamic capabilities. That is, as the options logic is expanded and extended, the subset of path-dependent activities to which it applies does indeed potentially grow, as McGrath et al. argue, to the point of encapsulating all path-dependent processes. At such a point, however, any unique insight that may have been attributable to the real options approach disappears.

⁵ In this regard, a superficial response to our critique might be that real options models in the finance literature are now able to accommodate such complications as compound options, foregone dividends, and options with no expiration dates. This formal work might be presented in support of the generalizability of a real options heuristic to strategy. In response, we would note that the added complexity and restrictiveness of the assumptions required to get results in these formulations only serve to magnify our concerns about their applicability in settings where these assumptions are clearly violated, such as when firms can act to affect the set of possible outcomes.

Distancing a heuristic from its underlying logic risks leaving adopters blind to its limits and fostering its misapplication in settings where faith in its effectiveness may do more harm than good. Recall that much of the impetus behind the adoption of real options was the observation that net present value (NPV) analysis overlooks the value of flexibility inherent in sequential investment structures and, thus, leads to a systematic underinvestment under uncertainty. Real options were a way to overcome the short-term, single-quarter investment perspective that troubled scholars in the 1980s (e.g., Bowman & Hurry, 1993; Mitchell & Hamilton, 1988). When applied in situations that stretch their underlying assumptions, however, real options can lead to significant overinvestment in opportunity, which can be no less damaging than underinvestment (e.g., consider the recent stock market bubble, fueled by optimistic beliefs about possible futures on the part of investors and firms alike).⁶

FORMALISM, LEGITIMACY, AND STRATEGIC INSIGHT

It seems to us that at least some of the excitement behind real options in the strategy field stems from the respectability that it brings through its roots in formalism and finance. The rush to import formal logics into our field should be tempered, however, by the realization (and perhaps the pride) that the context of strategy, in which financial, organizational, operational, and competitive forces intersect, tends to present a much richer and more complex setting than that assumed in much formalism derived

⁶ We note that part of the recent excitement surrounding real options in finance came from the ability to rationalize market valuations of technology-based firms at the height of what has come to be viewed as a technology bubble. For scholars and analysts who took the assumption of market efficiency as inviolable, an attractive way to explain the gap between CAPM valuations and observed prices came from "the value of flexibility" that option value captured:

Internet companies that lose money but attract more market capital than larger, profitable rivals expose the irrelevance of discounted cash flow. Viewed as options on a future that has not yet revealed itself, sky-high price/earnings ratios seem a little more palatable, if not more rational (Mintz, 1999: 57).

Such sentiments illustrate the danger of embracing "an economic logic for behavioral decisions" that may serve to justify, rather than guide, investment choices.

outside the field. To be clear, we are supportive of efforts to bring formal logic to strategy (and have participated in such exercises ourselves), but we argue that much customization is required before ready solutions from other fields can add real insight to our own.

Relying on support from formal financial models to rebut our concerns is somewhat specious. For example, the suggestion in McGrath et al.—that Dixit and Pindyck's (1994) accommodation of "technical uncertainty" in their models extends the validity of real options as a heuristic to settings with endogenous uncertainty resolution of the type with which we are concerned (e.g., the example presented in their response regarding Bluetooth wireless networks)—is an overextension of the formal logic. As Dixit and Pindyck characterize it: technical uncertainty "can only be resolved by undertaking and completing the project. One then observes actual costs (and construction time) unfold as the project proceeds" (1991: 47–48). The assumption is of one unique possible history; the only question is how far down this single road the firm wishes to travel.⁷ Our interest, however, is precisely with situations in which firms can act to change possible outcomes (e.g., activities in emerging settings, such as wireless technology). The potential to recast initiatives in ways that affect costs, performance, and target markets has implications for the management of the project, the management of the organization, and the broader strategy choices that govern them both.

While we are respectful of the power and value of the notion of real options, we are uncomfortable with the sanguine view offered by our critics. Contrary to the suggestion of Zardkoohi, for-profit enterprises are not immune to making nonoptimal decisions. The applicability of real options can be extended if organizations compensate for endogeneity through changes to organization design and control systems. Such compensating changes, however, entail signifi-

cant opportunity costs, particularly in terms of unanticipated discoveries that will not be pursued. Our modest proposition is simply that these costs and tradeoffs must be considered in evaluating the value of a real options approach in different settings.

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⁷ Note that the simulation model presented by Kogut and Kulatilaka similarly treats firms as passively observing outcomes and, thus, skirts the challenges posed by endogenous uncertainty resolution and ex post alternative generation, which are our core concerns.

examines the impact of the demand environment on technology evolution and competition, as well as the organizational challenges that confront firms competing in heterogeneous demand environments.

Daniel A. Levinthal is the Julian Aresty Professor of Management and Economics at The Wharton School, University of Pennsylvania. He received his Ph.D. from the Graduate School of Business, Stanford University. His research interests focus on issues of organizational adaptation and industry evolution, particularly in the context of technological change.

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