© Academy of Management Review
1999, Vol. 24, No. 1, 13–30.

FALLING FORWARD: REAL OPTIONS REASONING AND ENTREPRENEURIAL FAILURE

RITA GUNTHER MCGRATH
Columbia University

Although failure in entrepreneurship is pervasive, theory often reflects an equally pervasive antifailure bias. Here, I use real options reasoning to develop a more balanced perspective on the role of entrepreneurial failure in wealth creation, which emphasizes managing uncertainty by pursuing high-variance outcomes but investing only if conditions are favorable. This can increase profit potential while containing costs. I also offer propositions that suggest how gains from entrepreneurship may be maximized and losses mitigated.

Schumpeter linked wealth creation directly to the entrepreneurial process, through which "new combinations" of factors of production are introduced into an economic system (1950: 83). Entrepreneurship creates new processes, puts underutilized resources to new uses, initiates the formation of new industries, and otherwise unleashes "gales of creative destruction" (Schumpeter, 1950: 83). It has been linked to creation of employment, increases in productivity, and improvement of living standards, and to economic growth in general (Baumol, 1993; Birch, 1979). Consequently, scholars often regard entrepreneurship as quite a good thing (see Birley, 1986, and Lumpkin & Dess, 1996). Embracing entrepreneurship, however, implies accepting all that goes with it, particularly the recognition of a priori irreducible uncertainty (Venkataraman, 1997). One manifestation of uncertainty is highly variable—or risky—returns (Lubatkin & Chatterjee, 1994: 110). Risk can become manifest in failure (Miller & Reuer, 1996).

Comments from Eric Abrahamson, Edward H. Bowman, Joel Brockner, Melissa Cardon, Ian C. MacMillan, S. Venkataraman, and four anonymous *AMR* reviewers were extremely helpful in developing the ideas presented here. This research was partially funded by the proceeds from an award for Best Conceptual Paper, bestowed by *Entrepreneurship, Theory & Practice* at the 1996 annual meeting of the Academy of Management, and by the ECLIPSE (Entrepreneurial Careers, Learning and Investment Patterns) project at the Columbia University Graduate School of Business. I am also grateful for the support of the Sol C. Snider Entrepreneurial Center at The Wharton School.

The popular (and sometimes the scholarly) enthusiasm for risk taking in the entrepreneurial process wanes considerably at the prospect of failure (Baker, Aldrich, Langton, & Cliff, 1997). Researchers mourn the cost of new business failure, attempt to root out its causes, and seek to determine how it can be avoided (e.g., Kets de Vries, 1985; Reynolds, 1987, Romanelli, 1989; Statistics Canada, 1997). Social norms can render "losing" shameful (Tezuka, 1997), and expensive public policies help new firms avoid failing by providing them with resources. In short, a tendency to view failure negatively introduces a pervasive bias in entrepreneurship theory and research. As March and Shapira observe, "Society values risk taking, but not gambling, and what is meant by gambling is risk taking that turns out badly" (1987: 1413).

My objective is to offer ideas that might help redirect the theoretical focus in entrepreneurship from a preoccupation with achieving success and avoiding failure to a more integrated view of how the two phenomena are related (see also Aldrich & Fiol, 1994). I begin by characterizing entrepreneurial initiatives not as variations, random mutations, or bold new adventures but as *real options*, whose value is fundamentally influenced by uncertainty. I show how an options lens can reveal the conditions under which an antifailure bias can hinder understanding of the systemic relationship between success and failure, leading to unintended negative consequences. Real options reasoning, moreover, allows more of failure's possible benefits to be captured and the most egregious of its costs to be contained. I apply these ideas at the economy and firm levels.

A REAL OPTIONS PERSPECTIVE ON ENTREPRENEURIAL FAILURE

I define the entrepreneurial process here as the set of activities through which innovations change existing combinations of factors of production, in both the manufacturing and the service sectors. The most widely recognized sources of inspiration for entrepreneurship are market inefficiencies (Kirzner, 1979) and technological progress (Schumpeter, 1950; see also Shane, 1996). An entrepreneurial initiative, thus, is a specific effort by an existing firm or new entrant to introduce a new combination of resources. An initiative can be said to have failed when it is terminated as a consequence of actual or anticipated performance below a critical threshold (see Gimeno, Folta, Cooper, & Woo, 1997). In other words, failure is the termination of an initiative that has fallen short of its goals.

Those goals are idiosyncratic. Consistent with behavioral decision theory (Cyert & March, 1963) and theories of individual decision making (Kahneman & Tversky, 1979), failure thresholds involve subjective assessments of alternatives. Hence, an entrepreneur might disband an economically profitable business if other activities appear more lucrative or interesting, if his or her interests change, or if it seems that long-run growth is limited. That is, adverse opportunity costs deter continuation of the current initiative (Gimeno et al., 1997). In contrast, as Meyer and Zucker (1989) argue, organizations whose performance is economically poor may be sustained by self-interested stakeholders, resulting in "permanently failing," underachieving organizations. It is the idiosyncratic judgment of what constitutes failure that makes real options reasoning attractive.

Entrepreneurial Initiatives As Real Options

Real options theory concerns classes of investments in real assets that are similar to financial options in structure (Bowman & Hurry, 1993; Dixit & Pindyck, 1994). Just as the purchase of an option contract conveys the right but not the obligation to purchase the underlying asset on which the contract is written, investment in a real option conveys the opportunity to continue investment. If investments are staged so that expenditures end under poor conditions, losses can be contained. The cost of failure, in other words, is limited to the cost of creating the real option, less any remaining option value (Dixit & Pindyck, 1994; Mitchell & Hamilton, 1988; Roberts & Weitzman, 1981). Should conditions prove favorable, further investments may be made, which is referred to as exercising the option.

Scholars applying a real options framework have emphasized its advantages over conventional approaches (such as net present value calculations) under conditions of uncertainty (Dixit & Pindyck, 1994; Hurry, Miller, & Bowman, 1992; Kogut, 1991; Kogut & Kulatilaka, 1994; Trigeorgis, 1996). It has also been described as a useful lens for viewing entrepreneurship (McGrath, 1996).

In financial options theory, increased volatility of the underlying asset increases the value of the option, because the potential gains are greater while the costs to access them remain the same. The upside becomes greater, but potential losses become no worse (Fama & Miller, 1972). So, too, is the case with real options, for which potential variance of expected returns is akin to volatility (McGrath, 1997). Ex ante uncertainty, thus, is an important driver of option value. If their present value is held constant, projects with greater variance of potential outcome have higher option value.

In this model failure is related directly to uncertainty, from which the value of the entrepreneurial option is derived (Knight, 1921). Entrepreneurial rents (Rumelt, 1987) can be earned by those who take out real options on opportunities that are not obvious to others and that, therefore, are undervalued.

Real Options in Bundles

Understanding what leads to the success or failure of a specific initiative, however, tells us only a small part of the story of entrepreneurial wealth creation, which is a combinative process of interrelated advances and setbacks (see Venkataraman, Van de Ven, Buckeye, & Hudson, 1990). Because of spillover and learning effects, it is often more useful to evaluate the collective contribution of entrepreneurial initiatives to wealth creation than to assess each initiative on its own. The initiative that fails may still improve knowledge or methods of production. Consider Osborne's introduction of the first portable (some said "luggable") personal computer with bundled software—both innovations that were

imitated by later entrants. The benefits remain long after the demise of the company that pioneered them.

On a larger scale, failed first movers are associated with the emergence of entirely new industries (Aldrich & Fiol, 1994). Speech recognition technology is a current example. Technological development is being driven by well-known research laboratories (including those at Carnegie Mellon University, the Massachusetts Institute of Technology, Stanford Engineering, SRI International, and Lucent Technologies' Bell Labs) and a clutch of startups (with names such as Dragon Systems, Nuance Communications, and Applied Language Technologies). Should speech recognition systems become ubiquitous, pundits argue that profits will flow to those who make products and deliver services—not to the startups developing the technology (Gross, Judge, Port, & Wildstrom, 1998). The startups, however, will have played an important role in a process expected to fundamentally alter the way people transmit information, use computers, and offer services. Even if the startups eventually fail, their contribution will have been profound (Garud & Van de Ven, 1992).

Entrepreneurial Initiatives and Wealth Creation

Entrepreneurship attracts scholarly attention because it is strongly associated with growth for an economy and with prosperity for individual firms, as illustrated above.

Economy-level impacts. The technical and other advances generated by entrepreneurial activity long have been associated with economic growth, because they allow increasing—not diminishing—returns to the deployment of capital (Knight, 1944; Romer, 1987). In what Barro (1997) terms "endogenous" growth theories, entrepreneurial initiatives are seen as experiments in which hypotheses about the utility of a new combination of resources relative to existing combinations and relative to other new alternatives are tested (Starr & MacMillan, 1990). This hypothesis testing generates improvements in technologies and increases economic resilience (Hayek, 1945).

Governments can influence the process of endogenous growth through "taxation, maintenance of law and order, provision of infrastructure services, protection of intellectual property rights, and regulation of international trade, financial markets, and other aspects of the economy" (Barro, 1997: 6). In options terms, government policies can have a significant influence on which options are taken out, which are exercised, and which are abandoned, as well as by whom.

Firm-level impacts. At the level of the firm, entrepreneurial orientation (Lumpkin & Dess, 1996) is the propensity of the firm to sponsor initiatives that reconfigure and renew its resource base. Much of the real options literature to date has focused on firm-level initiatives, often calling them "ventures," "projects," or "proposed investments" (Dixit & Pindyck, 1994; McGrath, 1997; Stewart, 1991).

With financial options, uncertainty regarding the price of the underlying stock eventually is resolved by the passage of time. The value of the underlying asset accessed through the acquisition of a real option, however, is not as easy to ascertain, since real options generally are not easy to trade, nor do they have defined expiration dates. Moreover, real options also cannot always be valued on their own. The investment made in one real option may pay off by resolving issues surrounding other real options, even if the first was a failure.

Thus, a complete accounting of a real option's worth requires an understanding of the other options in play. For instance, Maidique and Zirger (1985) show that new product failures like the Edsel and the IBM Stretch computer dramatically and idiosyncratically reduced technical and market uncertainties in ways that led to spectacularly successful subsequent product launches, such as Ford's Mustang and IBM's System 360. Initiatives may be pursued with the explicit recognition that they are likely to fail (Lynn, Morone, & Paulson, 1997) or may be viewed as part of an entire portfolio of new business development activities (Collins & Porras, 1994: 140–168). What matters is that they enhance the firm's accumulated resource and knowledge base by reducing uncertainty, increasing variety, and expanding the search for opportunity (March, 1991).

Just as national policies influence the structure of payoffs to entrepreneurs at a societal level, business policies influence the rewards and sanctions for entrepreneurship within a firm. Senior executives influence entrepreneurial effort through their policies, including pro-

motion, pay, and recognition, as well as through their disposition of firm-controlled assets, such as physical facilities and capital (Hambrick & Mason, 1984).

Implications of using real options reasoning. Four observations regarding a real options approach apply across both the societal and the firm levels of analysis. First, options are best valued as part of a "bundle." Second, uncertainty—and hence potential variance—is key to the value of an option. Third, failures can have positive consequences. Fourth, preventing failure can mean sacrificing opportunity. If one understands these commonalities, one can use real options reasoning to develop a more balanced theoretical perspective on failure.

Note that I do not mean to suggest that failure is desirable in and of itself. It can be painful and costly, can generate vicious cycles of discouragement and decline, and can obviously be mismanaged. These well-known drawbacks tend, however, to distort how failure is conceived. The consequent antifailure bias can lead to the loss of many of failure's most important lessons and to unanticipated negative consequences.

ADDRESSING ANTIFAILURE BIASES THROUGH REAL OPTIONS REASONING

Real options reasoning suggests that the key issue is not avoiding failure but managing the cost of failure by limiting exposure to the downside while preserving access to attractive opportunities and maximizing gains. A high failure rate can even be positive, *provided that the cost of failing is bounded.* For instance, "churn" (high rates of business founding and exiting) is associated with economic vibrancy (Birch, 1979).

Changing one's perception of failure can require adjusting fundamental assumptions regarding performance. As March and Shapira (1987) observe, failure as manifested in risk taking that goes badly is considered undesirable. Therefore, people seek success and avoid failure, and those efforts can introduce errors in learning and interpretation processes. Paradoxically, such errors often make failure more likely or more expensive than it need have been (see Levinthal & March, 1993). Errors fall into three broad categories: (1) errors caused by extrapolating to the future from past success, (2) errors owing to cognitive bias, and (3) errors introduced through interventions to avoid the occurrence or appearance of failure. Table 1 provides a summary.

Unintended Negative Consequences of an Antifailure Bias

Extrapolating to the future from past success. Economic systems are like others in that they oversample success and undersample failure (Levinthal & March, 1993: 110). Hence, generalizing from observation can be a poor guide for future action (see Sitkin, 1992: 255). Further, since routines are used for most ongoing operations, those not associated with failure are likely to be retained. These are then applied to new situations, whether or not they are appropriate (Nelson & Winter, 1982). A related phenomenon is the competence trap. Unless management deliberately takes countermeasures, success in the application of one routine or technology tends to decrease an organization's willingness and capacity to adopt a new one, even if the new one offers long-term performance benefits (Levitt & March, 1988). The sad fate of incumbents confronting innovations introduced by newcomers illustrates this point (Tushman & Anderson, 1986). In short, a major unintended consequence of seeking success and avoiding failure is a tendency to bring into the future not only the valuable lessons learned from the past but also the distortions of those lessons.

Cognitive biases. Well-known psychological phenomena, such as the confirmation bias (see Kahneman, Slovic, & Tversky, 1982), systematically lead people to reject information that might indicate that their current assumptions are incorrect. When making decisions, individuals may see information with negative connotations as less vivid, plausible, visible, or available, whereas they readily accept information with positive connotations (Kiesler & Sproull, 1982). By implication, many judgments on costs, revenues, opportunities, and outcome distributions are likely to be wrong. Furthermore, entrants in a new area often behave like lemmings. If they conclude that growing markets are attractive, they may overlook the fact that many other players may be making an identical evaluation. One inadvertent result is an increase in the probability of failure for any given entrant. For example, in the early days of the Winchester disk drive industry, over a hundred

TABLE 1
Examples of the Unintended Consequences of an Antifailure Bias

Antecedent	Effect	Potential Biases Introduced	Potential Unintended Consequences	Examples from the Entrepreneurial Process
Extrapolating to the future from past success				
Oversampling success and undersampling failure (Levinthal & March, 1993).	Successes are more widely represented in survivor samples than failures are. Samples are left censored (Aldrich & Fiol, 1994).	Incorrect inferences when generalizing from observed behavior. Success is seen as more likely than it really is; failures are seen as less likely than they really are; factors that powerfully predict performance are seen as weaker than they really are.	Misspecification of causal relations, as in superstitious learning based on spurious correlations or downward bias in factors that actually do drive performance.	Gimeno et al.'s (1997) study, in which spurious correlations from biased survivor samples make it seem that intrinsically motivated entrepreneurs have lower performance. The correct interpretation, they argue, is that those who are intrinsically motivated are willing to accept lower performance.
Routinization, in which practices perceived to be associated with adequate performance are retained and repeated, whereas practices perceived to be associated with inadequate performance (failure) are avoided.	Responses to the environment are selected from a narrow range of path-dependently acquired routines—not from all possible choices. These, further, have many tacit elements, rendering their functioning difficult to understand and replicate.	New situations are approached the way previous ones were, regardless of the causal structure that underlay the old routine (Nelson & Winter, 1982).	Routines that were effective in a known context fail when applied to a new one or are continued to the point at which they generate what Starr and Bygrave term the "liabilities of staleness, sameness, priciness, and costliness" (1992: 353).	Blockbuster Video's venture into Germany, in which established practices that work in the United States proved not to appeal to sufficient numbers of German consumers. For instance, Blockbuster stocks only family entertainment and movie classics, whereas one-third of Germany's $510 million rental market is composed of movies with sexual or violent themes. Blockbuster withdrew from the German market in November 1997.
Improvement and imitation. Like routinization, these processes decrease the variety of routines available (Levinthal & March, 1993; Levitt & March, 1988; Meyer, 1997).	Increasing competence at achieving known results; development of specialized routines and cospecialized assets.	Decreased variety and absorptive capacity; greater "simplicity" (Ashby, 1956; Miller, 1993). Existing levels of competence become the standard; alternatives that may represent a better long-run solution are rejected in the short run.	Competence traps and "core rigidities," in which success at the application of an inferior technology inhibits the adoption of a superior one (Levitt & March, 1988) or creates inertia (Leonard-Barton, 1992). Increased vulnerability of the system to a change in conditions.	A tendency for those who enter early into an arena to lose out to later entrants (Aldrich & Fiol, 1994). This is common in the case of "competence-destroying" innovations (Tushman & Anderson, 1986).

TABLE 1
(Continued)

Antecedent	Effect	Potential Biases Introduced	Potential Unintended Consequences	Examples from the Entrepreneurial Process
Cognitive biases				
Cognitive biases, such as the confirmation bias (in which disconfirming evidence is rejected), which tend to make information associated with potential failure less vivid, plausible, visible, or available and factors associated with success the opposite.	Decisions are based on distorted intelligence, and available information is misinterpreted.	Judgments of opportunities or risks are systematically distorted (Kahneman, Slovic, & Tversky, 1982).	People make bad judgments, as when multiple entrants chase the same (perceived to be successful) opportunity or course of action, or multiple players avoid the same (perceived to be failing) course of action. Reduced incentive to take action (Kiesler & Sproull, 1982).	The frenzied entry into the emerging Winchester disk drive business, followed by a shakeout and massive exit from that business (Sahlman & Stevenson, 1985). Starbuck and Milliken (1988) suggest that part of the cause of the Challenger space shuttle disaster was that evidence that might have suggested a future problem was not heeded because doing so would have meant disconfirming previous beliefs.
Misattribution of success to one's own actions and failure to exogenous unlucky circumstances.	Spurious correlations between actions taken and results achieved; difficulty differentiating between luck and causality (Barney, 1986).	Actors associated with previous success are perceived as more competent than they are; actors associated with previous failures are perceived as less competent than they are.	Overconfidence in one's own ability to determine performance, as in the "illusion of control" (Langer, 1975), and a tendency of others to defer to the "superstar," who then is able to capture more resources and behave with less discipline than would be possible without such a bias (Starr & Bygrave, 1992).	Millions of dollars in investment were behind Steve Jobs' approach to the startup of NeXT Corporation on the assumption that Jobs could repeat the success that he had with Apple. Results never quite met expectations, and NeXT was recently acquired by Apple.
Negative perceptions of events associated with failure, whether or not they were actually related to the failure and whether or not they would lead to the same results under other circumstances.	Pessimistic ex post judgment of behaviors and events.	Ideas and behaviors are rejected, even though they might prove useful under other circumstances or in a different application.	Defensive routines (Argyris, 1978), and the "We'll never try that again" phenomenon.	Citibank is known for being an innovator, but many of the new combinations it has introduced have failed in their initial trial and been abandoned. Several of these (point-of-sale information systems and computerized banking by phone, for instance) have now become business successes for other companies.

TABLE 1
(Continued)

Antecedent	Effect	Potential Biases Introduced	Potential Unintended Consequences	Examples from the Entrepreneurial Process
Negative retrospective recollection of events associated with failure.	Events associated with a past failure are suppressed, not talked about, or avoided.	Firms and individuals fail to learn from their experiences and may repeat the same mistakes over and over.	Negative feedback depresses estimates of organizational performance and personal effectiveness (March & Sutton, 1997: 701).	The Swiss watch industry repeated the same strategy of moving to successively higher-quality, higher-priced watches in the face of the introduction of digital technology. It lost the bulk of its market and only regained a strong position in watches with a completely different approach—the Swatch watch.
Direct interventions				
Manipulation of metrics to produce measures that reflect success, regardless of actual results (Meyer, 1997).	The correlation between measures and outcomes weakens; measures themselves lose variance.	Distortion of the original meaning or value of measures; self-serving or unethical manipulation of information to avoid the appearance of failure.	Inability to adequately assess outcomes or their relationship to aspirations. Markets become less efficient.	Intentionally misinforming investors and other stakeholders (see Cable & Shane, 1997).
Diversion of resources to support underperforming initiatives for noneconomic reasons (Meyer & Zucker, 1989; Watson & Everett, 1996).	Delays or prevents exit (Gimeno et al., 1997); delays or prevents other kinds of unpleasant but potentially necessary actions.	Distorts information; weakens the relationship among aspirations, slack, and performance, which can distort incentives for search and improvement (Cyert & March, 1963). Can create a false sense of confidence.	Destroys economic value from the shareholder's perspective (Meyer & Zucker, 1989); encourages riskier behavior owing to protection from its costs; creates opportunity costs as valuable resources and talents are trapped; limits search for better alternatives.	Practices of the Korean *chaebol,* in which funds are diverted to underperforming units to mask performance problems (*The Economist,* 1998); practices of governments and other assistance programs that help small firms and bail out large ones.
Asymmetric allocation of the penalties of failing.	Those who try and fail bear all the costs; those who fail to try escape unscathed.	Uninvolved actors can benefit from information generated by a failed attempt while incurring none of its risks.	Creates a disincentive for taking initiative; free riding and opportunism problems can become pervasive (March & Shapira, 1987).	The often-cited situation in large Japanese companies, in which the perception is that taking initiative is not going to be rewarded (Tezuka, 1997).

new entrants developed the same optimistic scenarios and entered en masse. Few remained after a nasty shakeout (Sahlman & Stevenson, 1985).

A second cognitive bias is the tendency to attribute success to one's own actions and failure to bad luck (Staw, McKechnie, & Puffer, 1983). This results from difficulty distinguishing be-

tween luck and causality (Barney, 1986). Consequences include overconfidence in one's own efficacy (Langer, 1975) and a tendency on the part of others to assume that previous success implies superior ability. Entrepreneurs who have attained superstar status may not only believe themselves to be more gifted than they actually are, but they may also draw investment and attention that they do not merit. For instance, consider the substantial backing that flowed into Steve Jobs' NeXT software on the basis of his previous substantial success at Apple. As Starr and Bygrave (1992) argue, success-seeking supporters are unlikely to impose discipline or offer constructive criticism, ironically rendering disappointment more likely. Disney Corporation's foray into Europe demonstrates a similar phenomenon at the firm level.

The flip side of this bias is the perception that everything associated with a failure is bad, whether causally related to the failure or not. Firms in the grips of this perception gain nothing from their failed attempts. One example is Citibank's venture into point-of-sale data recording. Citibank pioneered the use of an electronic card to identify, by household, what brands of goods were being purchased in supermarkets. Unfortunately, the bank did not opt for a gradual launch in some test markets, as real options reasoning might have suggested would make sense. Instead, they launched nationally, making an investment of over $100 million. When the market did not materialize as quickly as expected, Citibank terminated the venture. Real options reasoning suggests that the bankers should have redirected the effort to make use of the reduction of uncertainty that the launch allowed. Finally, because Citibank terminated the people and sold off the assets deployed in the initiative, instead of recycling them, the bank was less able to capture benefits by reducing the uncertainty its other ventures faced. Ironically, the lessons were not lost on Citibank's rivals, many of which have since entered what is now seen as a profitable, high-growth business.

Direct manipulation. Distaste for failure also can lead to behavior that seeks to avoid failure unscrupulously. Metrics can be manipulated. Meyer (1997) uses as his example teachers who train students to take tests (because good test scores are a measure of success), which reduces the power of the test to indicate how much students actually have learned. Populations from which metrics are drawn also can be skewed. For example, business schools can reject students with low Graduate Management Aptitude Test (GMAT) scores to bolster their average reported GMAT. Less benign manipulations of metrics occur when entrepreneurs want to provide incorrect or misleading information, as Cable and Shane (1997) observe may plausibly be the case when entrepreneurs deal with venture capitalists.

Another form of failure avoidance occurs when resources are diverted to support initiatives that might otherwise be cancelled or closed down. Important stakeholders may value the survival of the firm more than economic returns to shareholders, therefore causing it to survive (Meyer & Zucker, 1989). Some businesses are valued for reasons that are intrinsic or psychological, as when they represent a family tradition; are an extension of an enjoyable activity (e.g., a hobby); or reflect personal values, such as independence, held by the entrepreneur (Gimeno et al., 1997). Governments divert resources to bolster poorly performing businesses for a variety of reasons: to preserve or protect competition in an industry (e.g., when the government rescued Chrysler Corporation), to sustain employment (Storey, 1997), or to redress formerly disadvantaged groups. Companies, too, sometimes use cash flows from high-performing businesses to support poorly performing ones. The Korean *chaebol* have been criticized for taking this to such an extreme as to make their financial statements meaningless (*The Economist,* 1998).

Finally, the systemic desire to avoid failure sometimes is manifested by individuals or firms allocating all the penalties for failure to those judged to be responsible. This allows the uninvolved to benefit in two ways: (1) they avoid the cost of failing, and (2) they can potentially benefit from the new knowledge and insight created by the failed attempt. Such an asymmetric allocation of costs reduces the incentive to engage in entrepreneurship; can deter future entrepreneurial efforts; and (when those who fail exit) can cause loss of organizational memory, exacerbating cognitive biases (March & Shapira, 1987). Free riding and opportunism are related issues. A system in which it is better not to fail than to succeed has been blamed for a lack of

innovation in large Japanese companies (Tezuka, 1997).

An antifailure bias can, in short, have counterintuitive negative effects. It can interfere significantly with people's ability to make sense out of experience. This, in turn, means that failures are not (to borrow Sitkin's [1992] phrase) "intelligent." I hope to show that theory based on real options reasoning can foster a more balanced view of the relationship between failure and wealth creation. The resulting policies should (1) generate increased variance, (2) allow options with poor prospects and little value to be terminated, and (3) make action more attractive than passivity, despite the possibility of failure.

Avoiding Unintentional Bias by Increasing Variance

When people seek success in order to avoid the downsides, they look for opportunities to lower variance. The somewhat counterintuitive effect is to decrease option value, because variance is to a real option what volatility is to a financial one (McGrath, 1997). The question is, how can entrepreneurial processes increase variance in the face of powerful forces that seek to reduce it?

According to conventional thought, motivation to pursue high-variance opportunities is a function of the availability of resources, or slack (March & Simon, 1963: 146), and the perception of a gap between current performance and some higher aspiration (see March & Sutton, 1997: 701). Availability of slack, meaning resources not yet committed to other firm efforts, permits experimentation to occur, while performance not yet at aspiration levels induces search. Performance gaps can stem either from recent poor performance (threatening failure) or from the perception of opportunity. In either case the availability of slack, coupled with the motivation for search, will intensify the search for variance, because in this condition experimentation with new combinations of resources is possible and searching in new, higher-variance directions is perceived as desirable.

> *Proposition 1: Other things being equal, at the industry and firm levels, the higher the motivation for search and the more slack available, the greater the variance in returns that will be sought and the higher the resulting option value will be.*

Where, however, does slack come from?

Industry level. Aldrich and Fiol (1994) observe that established institutional forces (such as the behavior of incumbents, rules set up by standards bodies, acceptance of dominant designs, government regulations, and so forth) dictate which factors of production used in which combinations will be considered legal and legitimate. These limits establish boundary conditions of variance for an industry. Other things being equal, and assuming reasonably efficient capital markets, in an established industry the amount of slack in the form of capital available for investment in new initiatives is likely to remain within a range consistent with the expected value and variance of returns in the industry (Stewart, 1991). Further, new initiatives are apt to enter the industry near its mean performance level.

Disrupt established industry boundaries, however, and the pattern of risk and reward is disrupted as well. This gives options-oriented investors (Schumpeter's [1934] "capitalists") the incentive to increase available slack in the form of investment funds in the pursuit of higher returns, and it gives entrepreneurs the incentive to use the capital for search in the altered industry space. Consider the current frenzy of entry into Internet-based businesses, into telecommunications, and into such formerly moribund industry spaces as the recently deregulated electric utilities industry. The perception of high-variance opportunity has caused enormous diversion of resources into these industries, permitting the formation of thousands of new firms. This growth has dramatically increased the variance in returns within each industry and, consequently, their option value.

As the examples suggest, although disruption of industry boundaries is sometimes a function of relatively exogenous Schumpeterian processes at the industry level, governments and other institutional actors often play a significant role. When these actors restrict potential change in the industry, potential variance of opportunities is limited, and the option value of the entire industry is reduced. Aldrich and Fiol, for example, observe that state regulation of the funeral home business suppressed founding rates and

"almost totally" suppressed the emergence of competing industries (1994: 646). The important point for our purposes is that, often, such variance-restricting behavior is a function of the desire of incumbents and their supporters to avoid challenges (and concomitant potential failure).[1]

Firm level. If high-revenue opportunities are sparsely scattered, policies that encourage search over a wide area will tend to be more likely to discover them than policies that focus on a circumscribed area. Unlike capital markets, however, which can rely to some extent on an invisible-hand approach to the allocation of slack to high-variance opportunities, firms usually depend on managerial policy to accomplish this. Only managerial policy is likely to overcome internal competition from lower-variance, more powerful, and often more immediately profitable existing businesses and to allocate slack to new initiatives (see Block & MacMillan, 1993). Moreover, the pursuit of success often initiates a process of organizational simplification (Miller, 1993) that makes sustained pursuit of variance difficult.

Monsanto's entry into agricultural biotechnology highlights these problems. Beginning in the late 1960s, a high-variance-seeking initiative into biology was undertaken by a few scientists seeking to depart from the Agricultural Products group's focus on chemicals. Throughout the course of the next three decades, the biology program consumed over $2 billion. It risked termination dozens of times, faced vicious competition from other Monsanto programs, and was haunted by the possibility that government officials would be leery of permitting genetically altered plants to be farmed outdoors. According to company documents, only strong support for the program on the part of senior executives enabled it to continue (Rogers, 1998). Ironically, although the biotechnology program has been judged a major success, management plans to split the firm into a chemicals company and a life sciences company, thereby decreasing the pursuit of high variance that the entry into biotechnology made possible in the first place.

As this example suggests, increasing the search for high variance within a firm is not a trivial problem. One solution, long proposed in the corporate venturing and innovation literature, is structural separation of variance-increasing subunits from variance-reducing ones (see, for instance, Tushman & O'Reilly, 1997). This has the effect of increasing the number of choices the firm may make, in that it is far easier to instill separate budgeting, control, and administrative processes for different units.

One effect of such structural separation is to create more environments in which the liabilities of failure avoidance may be escaped. The parent organization, for instance, may be able to avoid applying existing routines to new problems and may create conditions in which unexpected results can yield valuable reduction of uncertainty. When Citibank entered the consumer credit card industry, for instance, the initial idea was to cross-market credit cards to branch banking customers. Disappointing results led to an organizational move out of the branches into a separately funded and managed initiative designed specifically to pursue new business opportunities in nonbranch consumer markets. The initiative that eventually became a spectacular success differed in significant ways from retail branch banking (e.g., the ideal credit card customer is not a saver but a borrower).

The point is that, absent high motivation, which was generated by a combination of strong corporate emphasis on innovation and a willingness to allocate available slack to a new structure, early poor results could easily have terminated the venture. In short, as Bowman and Hurry (1993) observe, organizational structures that facilitate the opening and exercising of individual options through the existence of differentiated subunits have the potential to generate greater potential variance in outcomes for a firm (see also Bowman & Moskowitz, 1998). This implies that large firms, in particular, should pursue multiple options in many subunits, rather than only a limited number of large opportunities.

Proposition 2: Given motivation for search for high-variance opportunities and allocation of slack at firm level, a

[1] This is one of the problems with the deliberate creation of entry barriers in traditional competitive strategy (Porter, 1980). To the extent that entry barriers limit potential variance within an industry, the option value of that industry is reduced, slack is likely to flow elsewhere, and the entire system can come to be increasingly vulnerable to invasion by another industry.

portfolio of options structured so that independent decisions can be made to support or withdraw from individual entrepreneurial initiatives will have greater upside potential than a portfolio in which one choice affects multiple entrepreneurial initiatives.

This brings us to the question of the cost of failure. So far, I have addressed the first implication of real options reasoning—namely, that there are benefits to be gained from the pursuit of high-variance opportunities, even if that pursuit increases the potential for failure. But what of a second consideration in real options reasoning, which is to contain the downside cost of those failures that occur? Next, I consider the implications both for parsimony in the creation of new options and discipline in closing them.

Parsimony in the Pursuit of an Options Strategy

One of the key implications of real options reasoning is that investments should be made sequentially so that major commitments are made only if circumstances are favorable (McGrath, 1997). This has strategic implications. First, initiatives that promise high upside variance in potential profits are likely to have higher option value by constraining *levels* of cost. Consider, for instance, Block and Subba-Narasimha's conclusion with respect to corporate ventures that "overall firm performance in venturing is most likely determined by the size of the losses in the losers, rather than percentage of ventures that are profitable" (working paper, cited in Block & MacMillan, 1993: 334). Second, options must be extinguished ruthlessly when they no longer promise high upside potential.

With financial options, decisions regarding investment and exercise are relatively straightforward, in the sense that individuals can use mathematical models. Such decisions are more problematic for real options, because the estimation of future prospects is highly uncertain, the decision to terminate is often painful, and the time by which the decision must be made is open—there is no strike date for most real options. These facts suggest that just as processes that increase potential upside variance can increase option value, a complementing set of processes that contain costs similarly can have a positive effect on the value of an entrepreneurial options portfolio.

Sitkin's (1992) distinction between failures with little learning benefit and intelligent failures is useful here. Intelligent failures are those in which expectations are not met but something useful for the future is learned. They result from "thoughtfully planned action," in which results can be compared with plans to achieve increasing understanding. The process is equivalent to the systematic conversion of assumptions to knowledge often advocated in the literature on new business planning (Block & MacMillan, 1985; McGrath & MacMillan, 1995).

To generate valuable insight, individuals planning entrepreneurial initiatives might incorporate the equivalent of clearly articulated research hypotheses as assumptions, which can then be subject to disciplined assessment. New information serves to improve assumptions. This approach introduces a perspective on deviations from plan that is quite different from regarding deviations as mistakes, and it also counters several of the cognitive biases resulting from the avoidance of failure. The approach can counter escalating commitment, for instance, because it offers a way to identify when the provision of resources for noneconomic reasons is preventing failure (Meyer & Zucker, 1989; Ross & Staw, 1986), and it can mitigate such biases as the confirmation bias, because planning to validate assumptions requires the systematic acquisition of potentially disconfirming information. Through disciplined modeling, it can reduce the tendency to draw conclusions from spurious positive or negative correlations.

Proposition 3: At the firm level, planning processes that treat deviations as vehicles for testing assumptions, rather than as failures, are more likely to permit the early redirection of resource inflows to or termination of an entrepreneurial initiative, thus containing costs and increasing the value of the options portfolio.

Recognition that initial hypotheses are incorrect and prompt redirection of strategy without additional investment are consistent with the principle of "asset parsimony" (Hambrick & MacMillan, 1984). This principle suggests that, in uncertain environments, the benefits to be

gained by early containment of fixed costs and avoidance of irreversible investments are considerable. This applies even though total returns from a successful modified project may be somewhat less than returns from a successful strategy involving fixed assets and irreversible commitments—directly analogous to the situation with real options reasoning, in which some potential upside gain may be sacrificed in order to capitalize on the option value of having alternatives. By funding sequentially, and then putting in place mechanisms to spot signals of adverse changes in future value and adjusting expenditure patterns accordingly, the price of a real entrepreneurial option may be contained. The fewer the resources absorbed by initiatives with little option value, the more they are freed to pursue attractive opportunities.

Planning aside, other mechanisms are associated, at both the firm and industry levels, with reducing the potential losses from entrepreneurial initiatives. At the industry level, those who provide slack to new ventures are well known to utilize mechanisms for containing their costs. Venture capitalists, for instance, typically sequence rounds of financing contingent upon the achievement of milestone objectives agreed to in advance (Fast, 1981). Firms that seek to acquire capital through an initial public offering face due diligence inquiries and the scrutiny of financially interested parties, such as investors, investment banks, and analysts. Within a firm, those who provide resources for corporate entrepreneurial initiatives may employ similar techniques. They are likely to utilize such mechanisms as the timed release of funds and high hurdle rates to impose the discipline of asset parsimony upon internal ventures (Dixit & Pindyck, 1994: 47–48).

> *Proposition 4: Other things being equal, the more the potential downside of each initiative in an option portfolio is bounded by limiting fixed costs and irreversible investments, the greater the bundled value of the portfolio will be.*

Just as the resource allocation process in an industry or firm influences which options will be opened and at what cost, so the payoff structure helps determine which will be terminated or permitted to expire. The *structure of payoffs* is a term used by Baumol (1993) to indicate the rewards and sanctions a society offers for various kinds of economic activity. Here, the question of how much flexibility there is within a portfolio of options becomes important.

Consider an economy such as that of Korea, which is dominated by huge conglomerate firms—the *chaebol*. From the perspective of policy makers in Korea, each *chaebol* group represents a single option on a portfolio of assets (as well as a source of desperately desired employment and other social goods). The policy alternatives available should an entire *chaebol* appear to be at risk are fairly straightforward: it can be allowed to fail or it can be supported. Policy makers, in effect, have no choice. Given the trauma of repeatedly having entire conglomerates fail, it is hardly surprising that resources are channeled into supporting the *chaebol*, even in the face of clear evidence of poor performance (and international criticism).

Consider an alternative model, in which policy makers could elect to support (or not) each of the member businesses on a separate basis. Such an approach represents a portfolio of options, rather than a single option on a business portfolio. The impetus to offer special protection to any one of them is likely to be lower, and the ability to contain the costs of supporting chosen businesses is likely to be greater as well. This approach both increases flexibility and decreases costs.

A similar argument can be made at the firm level. Companies that make huge, irreversible investments as single attempts at innovation risk suffering losses that are enormous, compared to losses risked by companies that engage in many smaller initiatives (consider Exxon's failed multibillion-dollar venture into oil shale, as compared to the continuous innovations introduced by 3M).

> *Proposition 5: In the long run, the distribution of the cost of failure for investing in and then foregoing the exercise of options in a portfolio of options will be much narrower than the distribution of the cost of failure for investing the same amount and foregoing the exercise of single options.*

Investing with the goal of promoting intelligent failure aims at generating insights that can be useful elsewhere. By taking this sort of ex-

perimental approach to entrepreneurial investments, firms can reduce incentives to (intentionally or otherwise) distort, misuse, or misunderstand lessons learned from past failures. If executives manage failure intelligently by, for instance, conducting constructive postmortems of option-oriented initiatives, the insights derived can be incorporated into a firm's knowledge base. However, when failures are painful and become undiscussible, the potential for a firm to learn from its mistakes is compromised. Indeed, as Lynn et al. (1997) discovered, proactive analysis of failure can sometimes be the only mechanism by which firms discover how new technologies might meet needs that future customers will have by giving these customers a tangible product to react to.

Action Made More Attractive than Passivity

With financial options, the greater the upside potential of the underlying asset on which an options contract is written, the greater the value of the option. By analogy, the more substantial the upside potential returns on an entrepreneurial investment, the more valuable options on those returns are likely to be. This suggests a way to tackle the problem of asymmetric distributions of costs and benefits to entrepreneurial activity.

As I mentioned, Baumol (1993) has long argued that the incidence of entrepreneurship is related to the structure of payoffs, which is the set of rules regarding the allocation of gains and losses to entrepreneurial activities within a social context. Under Baumol's example, societies that reward litigation rather than entrepreneurship will tend to encourage their brightest people to become litigators rather than entrepreneurs.

One result of this is that the value of an entrepreneurial option may be depressed by societal limitations on upside gains. Many Scandinavian countries, for example, impose high income taxes on entrepreneurial proceeds, which has been associated with diminished entrepreneurial drive in those countries (MacMillan, 1995). In many African countries social obligations can cause funds to be channeled to impoverished family members upon the first sign of any returns, leading to difficulties in sustaining entrepreneurship (Diomande, 1990). And in the United Kingdom the absence of routes to exit and the illiquidity of funds invested in ventures also act to limit upside potential (Birley, 1997).

Within corporations, too, it can be difficult to compensate venture champions adequately. Although this may not interfere with the prospects of a particular venture, if successful champions find their compensation to be inadequate relative to external opportunities, then a corporation is likely to lose its talent (Block & Ornati, 1987).

By implication, a high level of entrepreneurial activity is unlikely to be sustained if the upside potential rewards are limited and the potential for loss unlimited. In that situation doing nothing is a far more attractive alternative. To avoid encouraging passivity, a society or firm would be better off using mechanisms that share the costs of entrepreneurial failure, rather than heaping financial and social sanctions upon those who explore entrepreneurial options. Similarly, a sufficiently large upside must be available to entrepreneurs to encourage the search for high-variance opportunities. Such optionlike payoff structures for entrepreneurial effort truncate the downside, increase the expected payoff, and thus create a greater incentive for the entrepreneur to take action. Such structures also make the payoff function more convex, allowing the entrepreneur to increase expected value further by increasing his or her risk.[2]

> *Proposition 6: The less the social cost of failure in taking entrepreneurial action, the greater the aggregate level of entrepreneurial activity and the greater the cumulative value of the national portfolio of options will be.*
>
> *Proposition 7: The greater the gains from successful entrepreneurial action, the greater the aggregate level of entrepreneurial activity in an economy or firm and the greater the cumulative value of the entrepreneurial options portfolio will be.*

Propositions 6 and 7 address the consequences of an antifailure bias that discourages entrepreneurship by penalizing those who try and holding blameless those who do not. Obviously, there are many mechanisms for instituting optionlike payoff structures, each of which

[2] I thank an anonymous reviewer for this insight.

has a different cost to government and other stakeholders in society. It would be worthwhile for future research to explore such mechanisms.

DISCUSSION AND IMPLICATIONS

Although entrepreneurship in the form of startups in a population of firms differs from entrepreneurship in the form of projects undertaken by a single firm, real options reasoning offers a useful logic for understanding the importance and implications of failure at both levels of analysis. At both levels, seeking greater potential variance is correlated to greater option value; at both levels, there is much to be gained by processes through which costs can be contained; and at both levels, the incentive to engage in entrepreneurial activity increases when potential losses are limited and potential gains are increased. As a theory of real options reasoning continues to develop, it may become possible to apply these concepts to additional levels of analysis. For instance, at the level of the individual, human and social capital have properties analogous to options investments.

I hope I have demonstrated that real options reasoning has the potential to help scholars develop a more balanced perspective on the role of failure. Let me now highlight implications of this discussion for theory and research in entrepreneurship and the related fields of technological change and innovation.

First, real options reasoning can provide the conceptual foundation for a new perspective on the dynamics of performance, survival, and choice in entrepreneurship. Consider the results attained by Gimeno et al. (1997), which show empirically that firms with similar levels of performance may experience different exit rates, owing not to exogenous environmental selection effects but to the recognition of increased value for the founder in exercising options other than continuing to invest in the firm. What is good or adequate performance for a firm at one time, by extension, may be seen at a later date as inferior to the performance that other options generate. Thus, contrary to assertions made by many (particularly in population ecology) that selection environments exert more or less uniform pressure to exit, the exit decision is, in fact, to some extent a choice among options with uncertain future values. When uncertainties are resolved, alternative options to continuation may be exercised. In future work dealing with organizational mortality, scholars should, therefore, apply a more discriminating lens to exit and termination.

Second, populations matter, as does the mechanism through which uncertainty regarding future outcome distributions is resolved. We must avoid the same trap that work attempting to explain performance differentials through the idea of "fitness" (see Drazin & Van de Ven, 1985) must avoid. Just as observed fitness or lack thereof may only mask what is going on at another level of analysis, so, too, observed success may be understood inadequately in studies that compare only two, or only surviving, firms. In effect, in such studies researchers look only at the period after uncertainty is resolved, hoping thereby to gain insight useful for guiding investment in the period prior to this resolution. But, as we have seen, uncertainty reduction for a successful initiative may come from investments made in a failed one—investments that are not visible without a population-level lens.

Further, the potential to avoid downside losses may be fundamentally related to the type and number of other initiatives being pursued simultaneously. The pursuit of opportunities by many entrepreneurs at once may result in key uncertainties becoming resolved more rapidly and less expensively (on a per firm basis) than if only a few entrepreneurs are engaged. In other words, if many entrepreneurs are operating, the cost for a given entrepreneur to resolve certain critical uncertainties can be reduced. This process cannot be understood simply by studying the strategy of the surviving or successful firms.

Third, this discussion suggests that it may be worth pursuing comparative entrepreneurship research, particularly into differences in payoff structures in different industries and cultures. Real options reasoning suggests that the more a payoff structure involves low or containable risk and the potential for high rewards for the entrepreneur, the more likely it will be to motivate entrepreneurship. The risk component is directly related to institutional and legal structures that deal with failure. For instance, in what Hofstede (1980) terms "collectivist" cultures, bankruptcy often has a devastating social and economic impact on the entrepreneur. We can expect individuals in such cultures to assess the potential downside loss associated with the entrepreneurial option as far greater than it would be for

their counterparts in cultures in which failure is easier to overcome. In an "individualistic" culture such as the United States, for instance, failures are "professionally forgiven" (Petzinger, 1997). This reduces potential downside loss, while a tax system that permits the accumulation of vast wealth offers a compelling potential upside. This design maximizes option value for entrepreneurs in the United States.

Fourth, because the value of a real option depends to some extent upon subjective judgments regarding what is likely to happen in an uncertain future, real options reasoning suggests a point of intersection between economic forces and psychological ones. Consider reactance. Reactance is a process whereby a person becomes more motivated to overcome setbacks after experiencing one. If the subsequent attempt is also unsuccessful, reactance can turn into "learned helplessness"—a loss of faith in one's ability to conquer adversity (Brockner et al., 1983). Reactance may have less magnitude and shorter duration in a culture in which failing is extremely costly than in a culture that tolerates failure better, which, in turn, will influence the number and nature of options opened.

Fifth, in future research scholars might fruitfully investigate how interfering with the so-called natural processes by which failures occur has either beneficial or detrimental effects. If artificial support allows a high-variance-seeking firm to survive its initial ordeal, the effects for society can be viewed as positive or negative: positive, if this assistance allows productive firms to overcome the vulnerable startup stage and subsequently succeed on their own; negative, if it has the effect of preserving less "fit" firms in the population to underperform and to set a bad example for others. Real options reasoning is useful for work of this nature, because it highlights where external intervention has unintended negative effects and makes potential benefits clear.

If, for example, governmental intervention allows a failing firm to take out a loan to stave off certain bankruptcy, what has happened from society's point of view is that this entrepreneurial option has just become more expensive. Other things being equal, the increased expense reduces the expected value to be obtained from the option—a point that real options reasoning would show unambiguously. The real options approach reveals that without a concomitant increase in the expected gains, such interventions are a bad idea. However, government intervention intended to increase slack available to high-variance-seeking initiatives might be analyzed as a worthwhile investment, even if the new firms experience a high failure rate.

This leads directly to a sixth implication of this discussion—namely, that real options reasoning offers a useful perspective from which to view such governmental policies as regulation. As Aldrich and Fiol (1994) point out, some policies can have the effect of reducing the option value of an entire industry. Loosen the constraints, as when formerly regulated industries are deregulated, and an explosion of entrepreneurial activity often ensues (a current example being the telecommunications and electric utility industries).

Similarly, real options reasoning suggests the limitations in conventional perspectives on variance-reducing competitive behavior by firms. For instance, exploiting dominance in an industry with high entry barriers is a relatively low-variance position with limited option value. A real options view shows that exploiting dominance creates vulnerability over the long run, because forces that reduce external (industry-level) variance are likely also to reduce the possible range of organizational responses to competitive threat or environmental shift. Correspondingly, within a firm, policy decisions are needed to create greater variety, even in relatively stable, oligolopolistic industries. Senior executives may wish to focus greater energy on deliberate variance generation in the allocation of resources.

CONCLUSION

I began this article with the hope of developing a more balanced theoretical perspective on failure in the entrepreneurial process. Real options reasoning, which explicitly links economic value and uncertainty, offers a useful tool whereby failure can be reconceptualized. Its primary benefit is its systematic method of linking positive and negative outcomes, from which operationalizable propositions can be derived for creating value through entrepreneurship—without the distortions of obsessive failure avoidance.

Real options reasoning suggests that if the point of studying entrepreneurship is to understand wealth creation, then examining failure rates and individual stories of success and failure stories may miss the heart of the matter. It matters relatively little if many inexpensive options expire, provided that returns are substantial for the ones that survive. By the same token, high failure rates for entrepreneurial businesses do not really matter, provided that the cost of failing is contained and that the businesses that do succeed enjoy substantial growth.

One reason why failure offers benefits is because it is often easier to pinpoint why a failure has occurred than to explain a success, making failure analysis a powerful mechanism for resolving uncertainty (Sitkin, 1992). By carefully analyzing failures instead of focusing only on successes, scholars can begin to make systematic progress on better analytical models of entrepreneurial value creation. Such work promises to bring to entrepreneurship research the kind of progress that better valuation models have brought to the world of financial options (Black & Scholes, 1973). Indeed, just as a clearer understanding of the nature of volatility and risk has spawned an explosion of instruments and products for managing their effects better, so, too, a direct and unflinching look at the downside of entrepreneurship will create considerable opportunities. Perhaps, in entrepreneurial scholarship to come, intelligent failures will even be celebrated.

REFERENCES

Aldrich, H., & Fiol, M. 1994. Fools rush in? The institutional context of industry creation. ***Academy of Management Review,*** 19: 645–670.

Argyris, C. 1978. ***Strategy, change, and defensive routines.*** Boston: Pitman Publishing.

Ashby, W. R. 1956. ***An introduction to cybernetics.*** London: Chapman and Hall.

Baker, T., Aldrich, H., Langton, A., & Cliff, J. E. 1997. ***Tempered by the flame: What do entrepreneurs learn from failure?*** Paper presented at the annual meeting of the Academy of Management, Vancouver, British Columbia.

Barney, J. B. 1986. Strategic factor markets: Expectations, luck, and business strategy. ***Management Science,*** 32: 1231–1241.

Barro, R. J. 1997. ***Determinants of economic growth: A cross-country empirical study.*** Cambridge, MA: MIT Press.

Baumol, W. J. 1993. ***Entrepreneurship, management and the structure of payoffs.*** Cambridge, MA: MIT Press.

Birch, D. 1979. ***The job generation process.*** Cambridge, MA: MIT Program on Neighborhood and Regional Change.

Birley, S. 1986. The role of new firms: Births, deaths and job generation. ***Strategic Management Journal,*** 7: 361–376.

Birley, S. 1997. ***Entrepreneurship in the U.K.*** Paper presented at the Waseda University Entrepreneurial Research Unit 1997 International Symposium, Tokyo, Japan.

Black, F., & Scholes, M. 1973. The pricing of options and corporate liabilities. ***Journal of Political Economy,*** 81: 637–654.

Block, Z., & MacMillan, I. C. 1985. Milestones for successful venture planning. ***Harvard Business Review,*** 63(5): 184–196.

Block, Z., & MacMillan, I. C. 1993. ***Corporate venturing: Creating new businesses within the firm.*** Cambridge, MA: Harvard Business School Press.

Block, Z., & Ornati, O. 1987. Compensating corporate venture managers. ***Journal of Business Venturing,*** 2: 41–51.

Bowman, E. H., & Hurry, D. 1993. Strategy through the option lens: An integrated view of resource investments and the incremental-choice process. ***Academy of Management Review,*** 18: 760–782.

Bowman, E. H., & Moskowitz, G. 1998. ***A heuristics approach to the use of options analysis in strategic decision making.*** Working paper, The Wharton School, University of Pennsylvania, Philadelphia.

Brockner, J., Gardner, M., Bierman, J., Mahan, T., Thomas, B., Weiss, W., Winters, L., & Mitchell, A. 1983. The roles of self-esteem and self-consciousness in the Wortman-Brehm Model of Reactance and learned helplessness. ***Journal of Personality and Social Psychology,*** 45: 199–209.

Cable, D. M., & Shane, S. 1997. A prisoner's dilemma approach to entrepreneur–venture capitalist relationships. ***Academy of Management Review,*** 22: 142–176.

Collins, J. C., & Porras, J. I. 1994. Built to last: Successful habits of visionary companies. New York: HarperCollins.

Cyert, R. M., & March, J. G. 1963. A behavioral theory of the firm. Englewood Cliffs, NJ: Prentice-Hall.

Diomande, M. 1990. ***Business creation with minimal resources: Some lessons from the African experience.*** Working paper, Sol C. Snider Entrepreneurial Center, University of Pennsylvania, Philadelphia.

Dixit, A., & Pindyck, R. 1994. ***Investment under uncertainty.*** Princeton, NJ: Princeton University Press.

Drazin, R., & Van de Ven, A. H. 1985. Alternative forms of fit in contingency theory. ***Administrative Science Quarterly,*** 30: 514–539.

The Economist. 1998. Kill or cure? January 10: 13–14.

Fama, E. F., & Miller, M. H. 1972. ***The theory of finance.*** New York: Holt, Rinehart, and Winston.

Fast, N. D. 1981. Pitfalls of corporate venturing. **Research-Technology Management,** 20(March): 21–24.

Garud, R., & Van de Ven, A. H. 1992. An empirical evaluation of the internal corporate venturing process. ***Strategic Management Journal,*** 13: 93–109.

Gimeno, J., Folta, T. B., Cooper, A. C., & Woo, C. Y. 1997. Survival of the fittest? Entrepreneurial human capital and the persistence of underperforming firms. ***Administrative Science Quarterly,*** 42: 750–783.

Gross, N., Judge, P. C., Port, O., & Wildstrom, S. H. 1998. Let's talk: Speech technology is the next big thing in computing. Will it put a PC in every home? ***Business Week,*** February 23: 61–80.

Hambrick, D. C., & MacMillan, I. C. 1984. Asset parsimony—managing assets to manage profits. ***Sloan Management Review,*** 25(2): 67–74.

Hambrick, D. C., & Mason, P. 1984. Upper echelons: The organization as a reflection of its top managers. ***Academy of Management Review,*** 9: 193–206.

Hayek, F. 1945. The use of knowledge in society. ***American Economic Review,*** 35: 519–530.

Hofstede, G. 1980. ***Culture's consequences: International differences in work-related values.*** Beverly Hills, CA: Sage.

Hurry, D., Miller, A. T., & Bowman, E. H. 1992. Calls on high-technology: Japanese exploration of venture capital investments in the United States. ***Strategic Management Journal,*** 13: 85–101.

Kahneman, D., Slovic, P., & Tversky, A. 1982. ***Judgment under uncertainty: Heuristics and biases.*** Cambridge, MA: Cambridge Press.

Kahneman, D., & Tversky, A. 1979. Prospect theory: An analysis of decision under risk. ***Econometrica,*** 47: 263–292.

Kets de Vries, M. 1985. The dark side of entrepreneurship. ***Harvard Business Review,*** 63(6): 160–167.

Kiesler, S., & Sproull, L. 1982. Managerial responses to changing environments: Perspectives on problem sensing from social cognition. ***Administrative Science Quarterly,*** 27: 548–570.

Kirzner, I. 1979. ***Perception, opportunity and entrepreneurship.*** Chicago: University of Chicago Press.

Knight, F. H. 1921. (Reprinted in 1971.) ***Risk, uncertainty and profit.*** Chicago: University of Chicago Press.

Knight, F. H. 1944. Diminishing returns from investment. ***Journal of Political Economy,*** 52: 26–47.

Kogut, B. 1991. Joint ventures and the option to expand and acquire. ***Management Science,*** 37: 19–33.

Kogut, B., & Kulatilaka, N. 1994. Operating flexibility, global manufacturing, and the option value of a multinational network. ***Management Science,*** 40: 123–139.

Langer, E. J. 1975. The illusion of control. ***Journal of Personality and Social Psychology,*** 32: 311–328.

Leonard-Barton, D. 1992. Core capabilities and core rigidities: A paradox in managing new product development. ***Strategic Management Journal,*** 13: 111–126.

Levinthal, D., & March, J. G. 1993. The myopia of learning. ***Strategic Management Journal,*** 14: 95–112.

Levitt, B., & March, J. G. 1988. Organizational learning. ***Annual Review of Sociology,*** 14: 319–340.

Lubatkin, M., & Chatterjee, S. 1994. Extending modern portfolio theory into the domain of corporate diversification: Does it apply? ***Academy of Management Journal,*** 37: 109–136.

Lumpkin, G. T., & Dess, G. G. 1996. Clarifying the entrepreneurial orientation construct and linking it to performance. ***Academy of Management Review,*** 21: 135–172.

Lynn, G. S., Morone, J. G., & Paulson, A. S. 1997. Marketing and discontinuous innovation: The probe and learn process. In M. Tushman & P. Anderson (Eds.), **Managing strategic innovation and change:** 353–375. New York: Oxford University Press.

MacMillan, I. C. 1995. ***Supporting entrepreneurship in different countries and regions.*** Paper presented at the Waseda University Entrepreneurial Research Unit 1995 International Symposium, Tokyo, Japan.

Maidique, M. A., & Zirger, B. J. 1985. The new product learning cycle. ***Research Policy,*** 14: 299–313.

March, J. G. 1991. Exploration and exploitation in organizational learning. ***Organization Science,*** 2: 71–87.

March, J. G., & Shapira, Z. 1987. Managerial perspectives on risk and risk taking. ***Management Science,*** 33: 1404–1418.

March, J. G., & Simon, H. 1963. (Reprinted in 1993.) ***Organizations.*** New York: Wiley.

March, J., & Sutton, R. 1997. Organizational performance as a dependent variable. ***Organization Science,*** 8: 698–706.

McGrath, R. G. 1996. Options and the entrepreneur: Towards a strategic theory of entrepreneurial wealth creation. ***Proceedings of the Academy of Management:*** 101–105.

McGrath, R. G. 1997. A real options logic for initiating technology positioning investments. ***Academy of Management Review,*** 22: 974–996.

McGrath, R. G., & MacMillan, I. C. 1995. Discovery-driven planning. ***Harvard Business Review,*** 73(July-August): 44–54.

Meyer, M. 1997. ***Dilemmas of performance measurement.*** Working paper, The Wharton School, University of Pennsylvania, Philadelphia.

Meyer, M., & Zucker, L. 1989. ***Permanently failing organizations.*** Newbury Park, CA: Sage.

Miller, D. 1993. The architecture of simplicity. ***Academy of Management Review,*** 18: 116–138.

Miller, K. D., & Reuer, J. J. 1996. Measuring organizational downside risk. ***Strategic Management Journal,*** 17: 671–692.

Mitchell, G. R., & Hamilton, W. F. 1988. Managing R&D as a strategic option. ***Research-Technology Management,*** 27(3): 15–22.

Nelson, R. R., & Winter, S. J. 1982. ***An evolutionary theory of economic change.*** Cambridge, MA: Harvard University Press.

Petzinger, T. 1997. The front lines: She failed. So what? An

entrepreneur finds her prestige rising. ***The Wall Street Journal,*** October 31:1 (Marketplace).

Porter, M. 1980. ***Competitive strategy.*** New York: Free Press.

Reynolds, P. D. 1987. New firms: Societal contribution vs. potential. ***Journal of Business Venturing,*** 2: 216–231.

Roberts, K., & Weitzman, M. L. 1981. Funding criteria for research, development and exploration projects. ***Econometrica,*** 49: 1261–1288.

Rogers, K. K. 1998. ***Fields of promise: Monsanto and the development of agricultural biotechnology.*** St. Louis, MO: Monsanto.

Romanelli, E. 1989. Environments and strategies of organization start-up: Effects on early survival. ***Administrative Science Quarterly,*** 34: 369–387.

Romer, P. M. 1987. Growth based on increasing returns due to specialization. ***American Economic Review,*** 77(2): 56–62.

Ross, J., & Staw, B. M. 1986. Expo 86: An escalation prototype. ***Administrative Science Quarterly,*** 31: 274–297.

Rumelt, R. P. 1987. Theory, strategy and entrepreneurship. In D. J. Teece (Ed.), ***The competitive challenge: Strategies for industrial innovation and renewal.*** New York: Harper & Row.

Sahlman, W. A., & Stevenson, H. 1985. Capital market myopia. ***Journal of Business Venturing,*** 1: 7–30.

Schumpeter, J. A. 1934. ***The theory of economic development.*** Cambridge, MA: Harvard University Press.

Schumpeter, J. A. 1950. ***Capitalism, socialism and democracy*** (3rd ed.). New York: Harper & Row.

Shane, S. 1996. Explaining rates of variation in entrepreneurship in the United States: 1899–1988. ***Journal of Management,*** 22: 747–781.

Sitkin, S. B. 1992. Learning through failure: The strategy of small losses. In B. M. Staw & L. L. Cummings (Eds.), ***Research in organizational behavior,*** vol. 14: 231–266. Greenwich, CT: JAI Press.

Starbuck, W. H., & Milliken, F. J. 1988. Challenger: Fine-tuning the odds until something breaks. ***Journal of Management Studies,*** 25: 319–340.

Starr, J., & Bygrave, W. D. 1992. The second time around: Assets and liabilities of prior start-up experience. In S. Birley, I. C. MacMillan, & S. Subramony (Eds.), ***International perspectives on entrepreneurship research:*** 340–363. New York: Elsevier Science Publications.

Starr, J. A., & MacMillan, I. C. 1990. Resource cooptation and social contracting: Resource acquisition strategies for new ventures. ***Strategic Management Journal,*** 11: 79–92.

Statistics Canada. 1997. ***Failing concerns: Business bankruptcy in Canada.*** Ottawa: Micro-Economics Analysis Division, Statistics Canada.

Staw, B. M., McKechnie, P. I., & Puffer, S. M. 1983. The justification of organizational performance. ***Administrative Science Quarterly,*** 28: 582–600.

Stewart, G. B. 1991. ***The quest for value.*** New York: Harper-Collins.

Storey, D. 1997. ***Six steps to heaven: Evaluating small business support programmes.*** Working paper, University of Warwick, England.

Tezuka, H. 1997. Success as the source of failure? Competition and cooperation in the Japanese economy. ***Sloan Management Review,*** 38(2): 83–89.

Trigeorgis, L. 1996. ***Real options: Managerial flexibility and strategy in resource allocation.*** Cambridge, MA: MIT Press.

Tushman, M., & Anderson, P. 1986. Technological discontinuities and organizational environments. ***Administrative Science Quarterly,*** 31: 439–465.

Tushman, M., & O'Reilly, C. 1997. ***Winning through innovation: A practical guide to leading organizational change and renewal.*** Cambridge, MA: Harvard Business School Press.

Venkataraman, S. 1997. The distinctive domain of entrepreneurship research: An editor's perspective. In J. Katz & R. Brockhaus (Eds.), ***Advances in entrepreneurship, firm emergence, and growth.*** Greenwich, CT: JAI Press.

Venkataraman, S., Van de Ven, A. H., Buckeye, J., & Hudson, R. 1990. Starting up in a turbulent environment: A process model of failure among firms with high customer dependence. ***Journal of Business Venturing,*** 5: 277–295.

Watson, J., & Everett, J. E. 1996. Do small businesses have high failure rates? Evidence from Australian retailers. ***Journal of Small Business Management,*** October: 45–63.

Rita Gunther McGrath received her Ph.D. from The Wharton School, University of Pennsylvania. She is an associate professor in the Management Division at the Columbia University Graduate School of Business. Her current research centers on strategic management in highly uncertain situations, particularly when these involve major entrepreneurial change.