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The Evolutionary Dynamics of Strategic Logics and Adaptive Intelligence

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Abstract

I develop a model of the evolutionary dynamics of strategic logics and adaptive intelligence, arguing they are contingent on patterns of resource scarcity and uncertainty within industries. My argument borrows an important insight from evolutionary biology, namely that within environments that are relatively rich in resources and low in uncertainty, the dominant selection mechanism is the extinction of the weakest, not the survival of the fittest. That is, within relatively benign selection environments, even moderately fit actors will survive, while in highly competitive selection environments, only the fittest survive. In applying this insight to industrial environments, I distinguish four broad strategic logics that are best suited to ecologies possessing different degrees of resource scarcity and uncertainty. I further argue that the deployment of one or other of these logics calls for different modes of adaptive intelligence: either more rule-based, calculative reasoning, or more associative reasoning that involves intuition and heuristics. The resulting model distinguishes four broad strategic logics, their related mechanisms of evolutionary selection and dominant modes of adaptive intelligence, and their associated resource ecologies. I discuss implications for research into processes of strategic adaptation, the micro-foundations of strategic capabilities, theories of the firm and organizational design.

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ABSTRACT

I develop a model of the evolutionary dynamics of strategic logics and adaptive intelligence, arguing they are contingent on patterns of resource scarcity and uncertainty within industries. My argument borrows an important insight from evolutionary biology, namely that within environments that are relatively rich in resources and low in uncertainty, the dominant selection mechanism is the extinction of the weakest, not the survival of the fittest. That is, within relatively benign selection environments, even moderately fit actors will survive, while in highly competitive selection environments, only the fittest survive. In applying this insight to industrial environments, I distinguish four broad strategic logics that are best suited to ecologies possessing different degrees of resource scarcity and uncertainty. I further argue that the deployment of one or other of these logics calls for different modes of adaptive intelligence: either more rule-based, calculative reasoning, or more associative reasoning that involves intuition and heuristics. The resulting model distinguishes four broad strategic logics, their related mechanisms of evolutionary selection and dominant modes of adaptive intelligence, and their associated resource ecologies. I discuss implications for research into processes of strategic adaptation, the micro-foundations of strategic capabilities, theories of the firm and organizational design.

INTRODUCTION

Strategy focuses on the conditions whereby firms can improve their chances of survival and success within competitive industrial environments. The literature on this topic is dominated by two broad approaches—the evolutionary learning and positioning approaches—which are viewed as distinct and even incommensurable (Gavetti & Levinthal, 2004). The evolutionary learning approach focuses on the development of firms' behavioral and cognitive capabilities as a source of competitive strength (Helfat, 2000), whereas the positioning approach focuses on firms' activity systems and the achievement of market positions as the key to strategic success (Porter, 1980). The question thus arises: is it possible to identify common principles and processes that might synthesize these two important perspectives on strategy? My paper addresses this question. I propose a synthesis of the different perspectives on competitive strategy in terms of the evolutionary dynamics of industrial environments, variable strategic logics and adaptive intelligence at the firm level. In doing so, I respond to the call by Gavetti, Levinthal & Rivkin (2005:710): "Our hope is that rigorous analysis of cognition will help bridge the chasm between rational, positional perspectives on strategy and behavioral, evolutionary approaches. Understanding how firms identify effective competitive positions requires both perspectives."

Evolutionary behavioral models offer one explanation for the processes of adaptation that improve a firm's relative fitness and chances of survival and success (Augier & Teece, 2008). From the evolutionary learning perspective, processes of variation, selection and replication result in advantageous behaviors and knowledge which strengthen firm-level capabilities to survive and grow. Many such variations originate at the "genetic" level of routine behaviors, defined as recurrent action patterns (Becker, Knudsen, & March, 2006). As firms adopt or adapt new patterns of action, successful or advantageous patterns tend to replicate, are stored in procedural memory, and thus become organizational routines (Cohen & Bacdayan, 1994). New and amended routines thus become part of firm-level capabilities, thereby influencing a firm's relative fitness and enhancing its chances of survival and growth (Levinthal & Myatt, 1994). Scholars argue that these evolutionary processes can be deliberate and systematic (Zollo & Winter, 2002), continuously adaptive (Feldman, 2000) and a source of innovation (Becker et al., 2006).

From another perspective, firm-level strategies evolve to achieve advantageous market positions, defined in terms of a firm's activity systems and relations with suppliers, customers and competitors, and its role within value chains (Porter, 1991). This market positioning perspective also entails behavioral change and adaptation, as firms replace or reconfigure their activity systems in response to environmental change and opportunity. However, in this context, evolution is associated with industrial activities and market positions. That is, variation, selection and replication occur in terms of the firm's productive processes, and the strategically significant outcomes are the firm's realignment of its activity systems and re-positioning within the marketplace, rather than the development of new routines and capabilities per se. Hence, the positioning school of strategy assumes a more market-focused process of evolution in achieving strategic advantage, in comparison to the evolutionary learning school.

Irrespective of one's evolutionary perspective, it is common to imply a selection process that is best characterized as classic Darwinism or the "survival of the fittest" (Barnett, Greve, & Park, 1994). That is, the evolutionary contest is won by firms that are best fitted to the environment, and those that are not are doomed to extinction. This classical perspective reflects the view that firms should strategize to become the best and triumph over their competitors (e.g., Collins, 2001). Yet "survival of the fittest" is a relatively narrow characterization of evolutionary selection, and only one of a number of possible variants of the selection process (Lewontin, 2010; Nelson, 2006). Moreover, "survival of the fittest" is arguably an implausible prescription for practical success, given that few firms can logically achieve this status yet many survive and prosper (Levinthal, 1992). Moreover, firms that appear to be among the fittest often fail (O'Reilly, Harreld, & Tushman, 2009), while other firms survive with only average degrees of fitness (Barnett, 2008).

Leading scholars of evolutionary biology provide a richer understanding of selection. Ernst Mayr (2002), for example, takes a broader view. He draws a distinction between different types of ecologies, defined as identifiable and integrated resource environments. He explains that in relatively resource-rich and stable ecologies, survival pressures are lower than in resource scarce ecologies. There are more resources available, and hence less competition for these resources. Different mechanisms of variation,

selection and replication then come into play. In such ecologies, agents do not compete intensely for resources in order to survive. Instead, they compete more strongly for partners in order to reproduce. Selection is therefore largely determined by an agent's reproductive fitness, not its capacity to acquire resources as such. In these contexts, therefore, variations may be advantageous because they improve an agent's attractiveness to potential partners, not simply because they enhance its capacity to accumulate the resources necessary for survival.

Hence, in relatively abundant resource environments or ecologies, reproductive selection pressures can result in outcomes similar to the peacock's tail, that is, in successful variations that provide no obvious advantage in the competition for resources (Mayr, 2002). Rather, they bestow an advantage in attracting mates and in achieving reproductive success. In these contexts, evolutionary selection pressures are not accurately described as the survival of the fittest. A better description of survival pressures in relatively resource-rich ecologies is the extinction of the weakest, coupled with the survival of the moderately fit. That is, while the fittest may dominate and the weakest become extinct, agents with moderate levels of fitness in the competition for resources will often survive, owing to the relative abundance of resources available to them, the relative stability of the environment and their capacity adequately to reproduce.

I argue that industrial ecologies exhibit similar dynamics, although I am mindful that biological processes cannot be simply transferred to the industrial realm (Nelson, 2006). Rather, I argue that comparable mechanisms of variation and selection can be observed within industrial ecologies defined as identifiable and integrated transaction environments (Luo, Whitney, Baldwin, & Magee, 2011). To begin, I argue that firms' survival fitness primarily depends on the capacity to acquire and exploit necessary resources. When such resources are relatively scarce and exploitation outcomes are relatively uncertain, firms must compete more intensely to acquire and exploit resources and knowledge in order to survive. In such relatively harsh environments, selection is best characterized as survival of the fittest. In contrast, I argue that in more sheltered environments, when resource scarcity and uncertainty are relatively low, survival is more likely and firms can and will compete more intensely to attract partners and grow

(Levinthal, 1992). In these environments, survival selection is determined by extinction of the weakest and reproductive selection by a firm's capacity to partner and collaborate. In short, the evolutionary mechanisms are contextual and contingent (Nelson, 2006).

Furthermore, I argue that these different drivers of selection stimulate different modes of strategic behavior and adaptive intelligence (Dosi & Marengo, 2007; March, 2006). In making these distinctions, I contrast industries where strategic resources are relatively scarce or abundant (degrees of resource scarcity) and where strategic value is relatively uncertain or transparent (degrees of resource uncertainty) (Makadok & Barney, 2001). Adopting the foregoing perspective, I argue that different modes of strategic logic and intelligence, and their associated cognitive capabilities, will be more or less beneficial to a firm, depending on the nature of the resource environment and its dominant selection mechanisms. That is, the relative importance of different types of behavioral and cognitive variation will be contingent on the dominant selection mechanisms at work in the resource environment. In some industrial ecologies, for example, highly coordinated thought and action may be more advantageous, while in others, loosely coordinated thought and action may deliver greater strategic advantage (Eisenhardt, Furr, & Bingham, 2010).

The following sections develop these arguments in greater depth. I first review the literatures on strategic logics and adaptive intelligence, and then argue that different logics imply different modes of adaptive intelligence, or the types of reasoning that agents adopt, depending on the problems they confront and their context. Next, I argue that different resource environments will entail different evolutionary mechanisms that favour alternative strategic logics. Specifically, I identify four broad categories of strategic logics and relate them to evolutionary selection mechanisms and modes of adaptive intelligence. Having done so, I then discuss the implications of my model for future research into processes of strategic adaptation, the micro-foundations of strategic capabilities, the theory of the firm and organizational design.

THEORETICAL BACKGROUND

Industrial sectors can be understood as transaction ecologies (Adner & Kapoor, 2010). That is, as networks of firms engaged in the exchange and utilization of resources and information, typically resulting in the production of related products and services. Consider, for example, the automotive industry. It consists of multiple firms connected through value chains of suppliers and buyers, all contributing to the production, distribution and maintenance of automobiles. Some industrial ecologies are spatially defined, others more widely distributed. All involve the exchange and utilization of resources and information. Moreover, some ecologies, such as the automotive industry, may be relatively mature in an evolutionary sense, possessing dominant designs, powerful incumbents and entrenched transaction networks (Klepper, 2002). While other industries, such as innovative high technology sectors, may be relatively immature in an evolutionary sense, and exhibit emergent designs, high rates of entrepreneurial entry and more adaptive transaction networks for the exchange of resources and information (Brown & Eisenhardt, 1998). And in all cases, industrial ecologies are contextual and possess variable degrees of heterogeneity, equilibrium and disequilibrium (Gavetti, Levinthal, & Ocasio, 2007a; Mathews, 2006).

Importantly, industries vary in terms of the nature and availability the resources required for firms to implement strategies that lead to competitive success (Peteraf & Barney, 2003). In particular, within any industry, resources are more or less scarce and easy to accumulate (relative resource scarcity) (Dierickx & Cool, 1989), and information about their potential value is more or less certain and specific (relative resource uncertainty) (Becerra, 2008; Makadok et al., 2001). Hence, industries can be conceived as resource ecologies or transaction environments that vary along these two dimensions: high-to-low scarcity of resources, and high-to-low uncertainty regarding the strategic value of resources. Moreover, these resource configurations largely determine the evolutionary selection mechanisms that will dominate within any industrial ecology. In every industrial environment, that is, firms must resolve problems in order to access resources that are more or less scarce, and then exploit these resources in ways that are more or less uncertain in terms of their predicted outcomes. Strategic logics model the principles for accomplishing such goals.

Strategic Logics

Formally stated, strategies are logics of action to achieve organizational goals. They model the principles or rules by which firms can understand and respond to their environment. With respect to strategic logics as such, I adapt the typology proposed by Bingham and Eisenhardt (2008). They identify three major strategic logics: position logics, relating to mundane resources with tight mutually reinforcing linkages in stable environments (e.g., Porter, 2008); leverage logics, relating to moderately linked core and complementary resources in moderately dynamic environments (e.g., Collis & Montgomery, 1995); and opportunity logics, relating to loosely linked, semi-structured processes comprised of simple rules and improvisation in high velocity environments (e.g., Eisenhardt & Sull, 2001).

However, I extend this analysis by distinguishing between two different forms of leverage logic. On the one hand, firms that operate in ecologies in which resources are relatively scarce, but uncertainty is relatively low, will tend to leverage resources to gain strategic advantage. That is, they will seek to leverage relatively scarce, moderately linked core and complementary resources (Bingham et al., 2008). On the other hand, firms that operate in environments in which resources are relatively plentiful, but uncertainty is relatively high, will tend to leverage knowledge to gain strategic benefit through resolving uncertainty. Hence my taxonomy includes resource leverage and knowledge leverage as two distinct forms of strategic logic. Clearly, in doing so, I follow other scholars in distinguishing knowledge from resources as such (Eisenhardt & Schoonhoven, 1996; Kogut & Zander, 1992). Figure 1 summarizes these four strategic logics in relation to resource scarcity and uncertainty.

Insert figure 1 about here

Adaptive Intelligence

In order effectively to employ logic, intelligence is required. Not surprisingly, therefore, modes of intelligence and cognitive capabilities are a central topic for many strategy scholars, especially from an evolutionary behavioral perspective (Gavetti, 2010; Gavetti et al., 2005). Indeed, behavioral theories of

the firm and strategy are grounded in bounded rationality and its consequences. As Simon (1979) explained, cognitive resources are limited and practical decision-making only approximates ideals of rationality. Hence behavior matters, as people reason and satisfice within strict cognitive bounds. Yet Simon's original characterization of bounded rationality has been expanded in the intervening years. In fact, his classic formulation of bounded rationality only describes one species of adaptive intelligence, defined as variable patterns of cognition that are typically employed in different decision environments (Fiedler & Wanke, 2009). Other modes of adaptive intelligence are equally feasible and prevalent, and particularly patterns of associative reasoning, intuition and heuristic decision making (Dane & Pratt, 2007; Kahneman, 2003).

Psychologists broadly recognize two fundamental patterns of intelligence—sometimes described as associative and rule-based (Sloman, 1996). In associative thinking, people draw from past experience or reference similar problems encountered in analogous contexts, and employ cognitive shortcuts (heuristics), analogies and intuitions in forming judgements and making decisions. Associative thinking is typically employed when the problems entail relatively high complexity and/or ambiguity, which require extensive cognitive resources and thereby entail conditions of high boundedness. Or when there is limited time or information, requiring decisions to be made without the resources required for more calculative modes of reasoning. Daniel Kahneman (2003) has termed this broad kind of thinking or intelligence “Type 1,” noting its reliance on perception, memory and emotion.

In contrast, in rule-based thinking, people employ more systematic cognitive capabilities to organize and analyze information, and to reach deliberative judgements based on rule-based reasoning. Rule-based thinking is typically employed when the problems entail relatively low complexity, ambiguity and the absence of time pressure, implying moderate conditions of boundedness. Kahneman has labelled this broad kind of thinking or intelligence “Type 2.” Each mode of intelligence is therefore significantly contingent on the informational complexity of the decision environment, time and resource constraints, and the motivations and capabilities of the thinking agent. Indeed, some psychologists therefore argue for an ecological theory of adaptive intelligence (Fiedler et al., 2009; Gigerenzer, 2000). Moreover, and

importantly, associative and rule-based types of intelligence can co-exist, interact and adapt in response to the informational and decision making environment (Dunwoody, Haarbauer, Mahan, Marino, & Chu-Chun, 2000; Kahneman & Klein, 2009). It is also proposed that the two major modes of adaptive intelligence evolved as humans interacted with broad features of their environment. On the one hand, the evolution of rule-based reasoning is attributed to the fact that human environments possess stable, predictable characteristics, requiring calculative problem solving capabilities. While on the other hand, the evolution of associative reasoning is attributed to the fact that human environments also possess unstable, unpredictable characteristics (Gigerenzer, 2000).

However, despite these significant advances in the psychology of human reasoning and intelligence, Simon's original conception of bounded rationality still underpins much behavioral strategy and behavioral theories of the firm (Gavetti et al., 2007a). In contrast, my paper expands the range of adaptive intelligences employed in strategic logics, by incorporating both associative and rule-based modes of intelligence. Furthermore, I explain the processes of adaptive strategic intelligence within an evolutionary framework, and argue that modes of intelligence and their associated logics are responsive to conditions in the resource environment. In this respect, I follow the example of other strategy scholars who explore alternative modes of strategic intelligence, such as analogical and interpretive reasoning (e.g., Gavetti et al., 2005; Smith & Tushman, 2005).

More specifically, I argue that the greater the scarcity of resources, the more complex will be the problem of how to acquire such resources (Payne, Bettman, & Johnson, 1993). For example, when resources are scarce, firms will need to identify potential sources, overcome monopolistic barriers and negotiate with powerful suppliers, often under conditions of limited information and pressure. In these contexts, firms will need to employ more associative modes of intelligence, using heuristics and analogous reasoning to navigate uncharted waters (Eisenhardt et al., 2010; Gavetti et al., 2005). Whereas, when resources are plentiful and more mundane, firms will deploy primarily rule-based reasoning to acquire resources. Similarly, the greater the uncertainty of resources, the more ambiguous will be the problem of how to exploit such resources. For example, when markets are novel and

opportunities are highly uncertain, firms will need to explore distal sources of information, transcend prior competence and learning to absorb new knowledge, also under conditions of limited information and pressure (Barnett, 2008). In these contexts, once again, firms will need to employ more associative modes of intelligence. Whereas, when the conditions of resources usage are transparent and predictable, firms will deploy primarily rule-based reasoning in the exploitation of resources.

DEVELOPMENT OF THEORY

In summary, I argue that the four different strategic logics and resource configurations depicted in Figure 1 entail different combinations of the two major modes of adaptive intelligence – associative and rule-based reasoning. Firstly, I argue that positioning logics are most suited to environments with relatively low resource scarcity and low uncertainty; or as Bingham and Eisenhardt (2008) explain, to stable environments with relatively mundane resources and tight mutually reinforcing linkages. In such environments, resource acquisition problems are relatively non-complex owing to the relatively plentiful nature of resources, and resource exploitation problems are relatively un-ambiguous owing to relatively low uncertainty. Therefore positioning logics tend to exhibit modes of adaptive intelligence that are less bounded, incorporating more rule-based, calculative modes of reasoning and systematic analytic methods (e.g., Porter, 1980). Managers are advised to methodically analyze resource acquisition and exploitation problems, and then to resolve them systematically.

Secondly, resource leverage logics are most suited to environments with relatively high resource scarcity and low uncertainty. These logics exhibit modes of adaptive intelligence that are moderately bounded and employ more associative and heuristic modes on intelligence, but in combination with rule-based methods as well (cf. Collis & Montgomery, 2008). Adapting Bingham and Eisenhardt (2008), resource leverage logics relate to moderately predictable environments with moderately linked, but relatively scarce, core and complementary resources. Consequently, in these environments, resource acquisition problems are relatively complex owing to the relative scarcity of resources, although resource exploitation problems are relatively un-ambiguous owing to relatively low levels of uncertainty. Therefore resource leverage logics tend to exhibit modes of adaptive intelligence that are moderately

bounded. They incorporate more rule-based reasoning about problems of resource exploitation owing to their lower ambiguity and uncertainty, but more associative methods of reasoning about problems of resource acquisition owing to their greater complexity.

Thirdly, knowledge leverage logics are most suited to environments with relatively low resource scarcity and high uncertainty. In these environments, resource acquisition problems are relatively uncomplex owing to the relative abundance of resources, however, resource exploitation problems are relatively ambiguous owing to higher levels of uncertainty. These logics also exhibit modes of adaptive intelligence that are moderately bounded. They combine associative and heuristic modes of intelligence with respect to resolving uncertainty and ambiguity, with more rule-based methods in relation to resource acquisition (e.g., Tripsas & Gavetti, 2000).

Fourthly, opportunity logics are most suited to environments with relatively high resource scarcity and high uncertainty. In these environments, resource acquisition problems are relatively complex owing to high resource scarcity, and resource exploitation problems are relatively ambiguous owing to high levels of uncertainty (Teece, 2009). Resolution of these problems thus entails significant cognitive resources, which are of course bounded. As a result, opportunity logics exhibit modes of adaptive intelligence that are more heavily reliant on associative thinking, intuitions and heuristics (Bingham, Eisenhardt, & Furr, 2007). The following sections discuss each pattern or strategic logic and adaptive intelligence in greater depth, and relate them to the evolutionary selection mechanisms within their associated resource ecologies.

Environments with Low resource Scarcity and Low Uncertainty

Firstly, consider an industrial ecology in which strategic resource scarcity and uncertainty are both relatively low. In such an environment, there will be relatively modest competition for strategically valuable resources, and firms will have relative certainty about the value of these resources. In other words, this type of industrial ecology is resource and information rich, in an evolutionary sense. Resource acquisition problems will be relatively non-complex and resource exploitation problems will be relatively un-ambiguous and soluble. As a result, firms will not need to compete intensely for strategic resources or

strategic information in order to survive. In order to survive, therefore, firms must avoid competitive disadvantages that would deny them access to relatively abundant resources and knowledge. At the same time, firms will compete for value-adding resource and informational linkages that could deliver above average growth and performance. That is, advantageous variations will derive from exceptional resource linkages, alliances and market positions (Porter, 1980). In such ecologies, therefore, firms need to focus on raising barriers to entry and blocking potential substitutes, owing to the fact that the relative abundance of resources and stability present clear entry options for new and existing competitors.

As a result, when resource scarcity and uncertainty are both relatively low, selection pressures will not lead to the survival of the fittest, but rather to the extinction of the weakest. Indeed, many firms will survive because they are sufficiently fit to attract and utilize strategic resources in a relatively abundant environment. Only the weakest or least fit will be destined for extinction. Therefore, the strategic focus for firms will tend to be on blocking competitors and manipulating the variable relationships within the industry, rather than on capturing scarce resources or developing idiosyncratic capabilities to manage uncertainty. That is, firms will tend to adopt a position strategic logic. Moreover, owing to the relative stability and predictability of these environments, it is possible and reasonable for positioning strategies to project distally over time and markets.

As noted above, in such ecologies, resource acquisition problems are relatively straight forward and not highly complex, owing to the mundane and plentiful nature of resources. In addition, resource exploitation problems—or how to create value using resources—are relatively un-ambiguous, owing to low uncertainty. And owing to the relative determinacy and stability of the resource ecology, they will tend to deploy more rule-based, analytic and calculative modes of intelligence with respect to both resolving low resource scarcity and uncertainty. Therefore, positioning logics tend to exhibit modes of adaptive intelligence that are less bounded, incorporating more rule-based, calculative modes of reasoning and systematic analytic methods (Porter, 1980). While such modes of reasoning and their related cognitive capabilities are not trivial, they are nonetheless relatively structured and codified, allowing for widespread deployment and replication within firms.

Proposition 1a: In industrial ecologies where resource scarcity and uncertainty are both relatively low, the weakest become extinct, meaning that firms survive by avoiding disadvantages in the acquisition of resources and knowledge.

Proposition 1b: In industrial ecologies where resource scarcity and uncertainty are both relatively low, above average performance is achieved by adopting a position strategic logic that deploys primarily rule-based modes of intelligence.

Environments with High Scarcity and Low Uncertainty

Next, consider an industrial ecology where strategic resources are relatively scarce, but uncertainty is relatively low. It will be clear which resources bestow strategic advantage and why, even though these resources may be relatively scarce. Resource acquisition problems will be relatively complicated owing to scarcity, yet resource exploitation problems will be relatively un-ambiguous and soluble owing to low uncertainty. As a result, there will be strong competition for strategically valuable resources, yet weaker competition for the knowledge and capabilities required to resolve uncertainty and ambiguity. Firms will need to compete intensely for strategic resources in order to survive and grow. At the same time, in order to survive, firms must avoid competitive disadvantages that would deny them access to available knowledge, while also competing for value-adding knowledge and information that could deliver above average growth and performance.

Within these evolutionary contexts, therefore, survival and success will be strongly linked to the capacity to accumulate scarce resources, but weakly reliant on the capacity to resolve uncertainty, resulting in the survival of the adequately fit. That is, adequately fit firms will often survive because of low strategic uncertainty, despite the relative scarcity of resources. For even moderately fit firms will possess sufficient cognitive capabilities to survive, assuming they can access sufficient resources. However, moderately fit firms will typically remain smaller, less successful actors in their industry.

Superior performance, on the other hand, will be more likely if the firm possesses a strong degree of fitness in leveraging resources.

Consequently, the strategic focus for firms in such ecologies will tend to be on exploiting linkages within the industry to accumulate and control scarce resources, rather than on developing idiosyncratic knowledge and capabilities to manage high uncertainty. Successful firms will establish partnerships to secure complementary resources, akin to reproductive success in the biological realm. As a result, these environments will favor firms that strategize to build tightly linked, mutually reinforcing resource configurations (Bingham et al., 2008). In other words, they will adopt resource leverage strategic logics. Jay Barney (1991) provides an exemplar of this approach, when he argues that firms attain strategic advantage by leveraging valuable, rare, inimitable and non-substitutable resources.

In such ecologies, resource acquisition problems are relatively complex owing to the relative scarcity of resources, although resource exploitation problems are relatively un-ambiguous owing to low or moderate levels of uncertainty. Therefore resource leverage logics tend to exhibit dual modes of adaptive intelligence. On the one hand, they incorporate rule-based reasoning about problems of resource exploitation, while on the other hand, exhibiting more associative modes of reasoning about problems of resource acquisition (see Rivkin, 2000). In summary, such firms will need to employ moderately bounded modes of adaptive intelligence combining both associative and rule-based reasoning (Smith et al., 2005). Combining modes of reasoning in this way requires higher order cognitive and organizational capabilities, implying that fewer firms are likely to possess them.

Proposition 2a: In industrial ecologies where resource scarcity is relatively high and uncertainty is relatively low, firms with adequate fitness will survive, meaning they achieve advantages in the acquisition of resources and avoid disadvantages in the acquisition of knowledge.

Proposition 2b: In industrial ecologies where resource scarcity is relatively high and uncertainty is relatively low, above average performance is achieved by adopting a resource leverage strategic

logic that deploys more associative modes of intelligence to solve problems of scarce resource acquisition and more rule-based modes of intelligence to solve problems of low uncertainty.

Environments with Low Scarcity and High Uncertainty

In other industrial ecologies, strategic resource scarcity is relatively low, but uncertainty is relatively high. In other words, it is relatively uncertain how resources bestow competitive advantage, yet the candidate resources are relatively mundane and abundant. This type of ecology is relatively resource rich and information poor, in an evolutionary sense. In such an industry, there will be weaker competition for strategically valuable resources, yet in order to achieve abnormal returns, firms will compete intensely to accumulate idiosyncratic information, knowledge and cognitive capabilities regarding the value of such resources (Denrell, Fang, & Winter, 2003). Resource acquisition problems will be relatively uncomplicated, although resource exploitation problems will be relatively ambiguous and uncertain. Hence, advantageous variations will relate to the accumulation of idiosyncratic information and knowledge capabilities, whether by deliberate means or in response to exogenous market conditions. At the same time, in order simply to survive, firms must avoid competitive disadvantages that would deny them access to available resources.

Consequently, evolutionary selection in these industries will be less reliant on the capacity to accumulate scarce resources, but strongly reliant on the capacity to resolve uncertainty and learn, resulting in the survival of the adequately fit. That is, even moderately fit firms will often survive because of the relative abundance of strategic resources, despite relatively high ambiguity and uncertainty. Within these environments, abnormal returns will be more dependent on exceptional information accumulation and strategic learning, rather than the acquisition of resources as such. I argue that these environments will tend to favor firms that adopt knowledge leverage logics; that is, firms that strategize in terms of learning routines and the development of idiosyncratic knowledge and cognitive capabilities (Knott, 2003; Nelson & Winter, 2002).

In these contexts, firms will combine more rule-based thinking as they seek to resolve less complex problems about relatively low resource scarcity, but more associative thinking to resolve relatively ambiguous problems owing to high uncertainty. Hence they will more strongly focus on developing and adapting routines and capabilities for associative learning, strategic search and the accumulation of idiosyncratic knowledge and cognitive capabilities. In summary, such firms will employ moderately bounded modes of adaptive intelligence, incorporating both rule-based as well as associative modes of reasoning. As noted previously, doing so entails higher order cognitive capabilities, meaning that fewer firms are likely to achieve these goals.

Moreover, owing to the relatively straightforward nature of resource acquisition problems, strategic search may become increasingly proximal and myopic. That is, because key resources are known and accessible, not distal. Hence, firms may be inclined to view solutions to uncertainty in terms of known resources and their existing patterns of use. The search landscape will be narrowed, owing to the proximal abundance of strategic resources. Additionally, the adequacy of pre-existing resource acquisition processes may retard the firm's capacity to adapt in response to change (Siggelkow, 2002). Similarly, exploratory search and innovation may be restricted, raising a persistent dilemma for knowledge leverage strategic logics: how to seek and identify novel market opportunities using backward looking, experience-based search behaviors (Gavetti & Levinthal, 2000; Levinthal & March, 1988).

Proposition 3a: In industrial ecologies where resource scarcity is relatively low and uncertainty is relatively high, firms with adequate fitness will survive, meaning they avoid disadvantages in the acquisition of resources and achieve advantages in the acquisition of knowledge.

Proposition 3b: In industrial ecologies where resource scarcity is relatively low and uncertainty is relatively high, above average performance is achieved by adopting a knowledge leverage strategic logic that deploys more rule-based modes of intelligence to solve problems of non-scarce resource acquisition and more associative modes of intelligence to solve problems of high uncertainty.

Evolution and Strategy in Environments with High Scarcity and High Uncertainty

Finally, in some industries, strategic resource scarcity and uncertainty are both relatively high. In such industries, there will be strong competition for scarce resources and strategic information. Firms will therefore prize access to resources as well as knowledge and related cognitive capabilities. Often these industries are hypercompetitive, volatile and dynamic, owing to their newness, patterns of rapid innovation or the occurrence of exogenous shocks (Eisenhardt, 2000). Resource acquisition problems will be relatively complicated, and resource exploitation problems will be relatively ambiguous and uncertain. From an evolutionary perspective, advantageous variations in such firms should enhance the accumulation of scarce resources and the development of idiosyncratic capabilities to resolve strategic uncertainty. Both will be critical for firm survival and abnormal returns. Typically, these variations will transcend the routines of ordinary capabilities to include radical innovations, cognitive adaptation and anticipatory risk-taking (Augier & Teece, 2006; March, 2006). Not surprisingly, these variations tend to be rare, result in idiosyncratic capabilities, and therefore constitute a potential source of significant strategic advantage (Denrell et al., 2003).

As a consequence of such rarity, the dominant evolutionary selection mechanism in these industries will be the survival of the fittest. Survival and abnormal success will be highly correlated. For only the fittest firms will be able both to accumulate scarce resources and resolve high uncertainty. Moderately fit firms will tend to fail and become extinct. Indeed, even successful firms will find it challenging to remain competitive and survive in such a demanding environment. Competitive advantage will therefore accrue to firms that strategize in terms of capturing scarce resources and resolving uncertainty through exploratory search, adaptive learning, constant and organizational flexibility, akin to the strategies associated with entrepreneurial dynamic capabilities (Teece, 2009).

The most appropriate strategic logic under such conditions of high resource scarcity and uncertainty is an opportunity strategic logic, deploying more intuitive, heuristic modes of intelligence, coupled with rapid analytical methods (Bogner & Barr, 2000). In these contexts, therefore, firms will employ more associative modes of reasoning as they seek to resolve complex problems of resource scarcity and the

ambiguities of relatively high uncertainty. These firms will analogise from past experience and explore more distal options in order to resolve complexity and novelty (Gavetti et al., 2005). Hence, firms will focus on adaptive routines and capabilities, exploratory search of distal landscapes, acquiring idiosyncratic knowledge, and the cognitive modalities of associative reasoning, such as analogy and heuristics. Such cognitive capabilities, once mature within an organization, will increase its chances of opportunity identification and radical innovation. However, these capabilities are difficult to develop and maintain, exercising them is constantly challenging, and outcomes remain uncertain (Gavetti & Rivkin, 2007b). Hence, relatively few firms are likely to acquire these capabilities, and fewer still will exercise them successfully. Selective pressures will persist as the survival of the fittest, resulting in more frequent firm failure.

Proposition 4a: In industrial ecologies where resource scarcity uncertainty are both relatively high, only the fittest will survive, meaning they achieve advantages in the acquisition of resources and knowledge.

Proposition 4b: In industrial ecologies where resource scarcity uncertainty are both relatively high, above average performance is achieved by adopting an opportunity strategic logic that deploys more associative modes of intelligence to solve problems of scarce resource acquisition and high uncertainty.

Figure 2 summarizes the preceding argument, with quadrants numbered P1, P2, P3 and P4 corresponding to the four sets of propositions I have composed. The figure shows how industrial ecologies vary in terms of relative resource scarcity and uncertainty, and their related evolutionary selection mechanisms. The figure also maps these mechanisms to four dominant strategic logics and their respective modes of adaptive intelligence.

Insert figure 2 about here

DISCUSSION

This paper is framed by the broad distinction between those who argue for the primacy of market positioning strategic logics and the supporters of evolutionary learning strategic logics. In fact, ample evidence exists to support the adoption of either logic, depending on the industrial context, type of firm and its strategic objectives (Gavetti, Levinthal, & Rivkin, 2008). Recognising this fact, some scholars now seek for either a synthesis or over-arching framework that can encompass these two major logics of competitive strategy and provide principles for their application (Gavetti et al., 2004). Evolutionary and behavioral approaches are especially promising in this regard. They typically include mechanisms of variation linked to processes of firm-level adaptation and selection, all nested within industrial contexts conceived as resource transaction ecologies. Strategic variation is then contingent on the maturity, dynamics and evolutionary selection mechanisms within the industrial ecology.

As its major contribution, my paper suggests a novel evolutionary approach to addressing these questions. It does so by explaining how the resource configurations within industries—in particular, patterns of resource scarcity and strategic uncertainty—result in different evolutionary selection mechanisms that favor alternative strategic logics requiring different modes of reasoning or adaptive intelligence. Strategic logics and modes of adaptive intelligence are thus explained as contingent with respect to the underlying evolutionary mechanisms of industrial change. My paper thereby links resource conditions at the industry level with strategic logics and cognitive capabilities at the firm level. In doing so, the paper responds to the challenge set by Gavetti, Levinthal and Rivkin (2005:710) cited earlier, that the “analysis of cognition will help bridge the chasm between rational, positional perspectives on strategy and behavioral, evolutionary approaches.”

Significant implications follow for strategic framing, that is, for determining whether strategy should be framed in terms of position logics that assume relative stability and predictability, or in terms of

leverage or opportunity logics that assume progressively more dynamic industrial conditions (Bingham et al., 2008; Kaplan, 2008). Relatedly, my paper suggests that theories of strategy should more clearly distinguish between firm survival and abnormal returns as evolutionary outcomes, and between the avoidance of competitive disadvantage and the achievement of competitive advantage as the antecedents of such outcomes. In benign or relatively non-competitive resource ecologies, for example, firms may survive by avoiding competitive disadvantages in the acquisition of resources and the resolution of low uncertainty, even if this does not deliver abnormal returns. Whereas, in highly competitive ecologies, both survival and the achievement of abnormal returns may require exceptional capabilities to acquire scarce resources and resolve uncertainty. Future research should investigate the differential causes and effects of these evolutionary mechanisms and their outcomes. In contrast, much of the prior literature fails adequately to distinguish these categories.

Moreover, some industrial contexts may all for the combination of multiple strategic logics. In such environments, firms must deploy dynamic meta-capabilities in strategizing (Adner & Helfat, 2003). For example, when exploiting a pre-existing opportunity in a relatively stable environment, a firm may be wise to employ a positioning logic and relatively fixed performance goals. At the same time, however, it may need to adopt an opportunity logic with more flexible goals in order to explore and exploit an emerging, uncertain market. From this perspective, firms and their leaders must simultaneously deploy different strategic logics and modes of intelligence, reflecting different selection mechanisms, and potentially within different levels or units of the organization (Burgelman & Grove, 2007). In other words, firms and their leaders must be ambidextrous, defined as the capacity simultaneously to explore new opportunities while exploiting existing markets (O'Reilly & Tushman, 2008).

My paper also contributes to the literature on the microfoundations of strategic capabilities. That is, by explaining how and why different modes of reasoning and cognitive capabilities are associated with different strategic logics, the paper suggests how individual and collective cognitions relate to firm-level strategic logics. Further research is needed to explain the specific mechanisms and processes whereby modes of intelligence adapt, combine and recombine (see Gavetti, 2010). In fact, these questions also

occupy significant attention among psychologists (e.g., Fiedler et al., 2009; Kahneman et al., 2009). Nevertheless, by extending the analysis of these processes, we can hope to gain deeper insights into the relationship between strategic logics, bounded rationality as a species of adaptive intelligence, behavioral conceptions of the firm and the dynamics of industrial and market evolution.

At the firm level, my argument suggests that a core strategic challenge is to understand the resource dynamics of an industrial ecology and its evolutionary consequences for securing and maintaining competitive advantage. Also critical is an understanding of the cognitive and adaptive capabilities required to survive and grow in any environment. For example, if a positioning logic is most suitable, then the firm will require strong capabilities in the domain of calculative, rule-based reasoning, experience-based search and systematic decision making. In contrast, if an opportunity logic is more suitable, then the firm will require stronger capabilities in the domain of analogical, associative reasoning, expansive exploratory search and heuristic decision making (Teece, 2007). Once armed with such understanding, firms and their leaders will be better equipped to select the most appropriate strategic logic, given their industrial context, capabilities and strategic ambitions. In this regard, my paper affirms the role of strategic insight and leadership in strategizing (Gavetti, 2010; Montgomery, 2008).

Furthermore, my argument exposes the different evolutionary selection mechanisms and pressures that obtain in various industrial environments. To begin with, I argue that in less contested resource environments, only the weakest firms are destined to fail, even if superior performance still calls for exceptional strategic capabilities employing rule-based reasoning to achieve distinctive market positions. Next, I argue that in moderately competitive resource environments, many average firms will survive, although superior performance will again require exceptional capabilities, although in this context employing a combination of strong rule-based and associative modes of reasoning to leverage resources and/or knowledge. Finally, I argue that in highly contested resource environments, only the fittest firms will survive and prosper, and they will need strong associative reasoning capabilities to capture novel and potentially distant opportunities.

By implication, my argument suggests that strategic capabilities are less relevant for firm survival in weakly contested resource ecologies, and more strongly relevant as levels of competition rise (Levinthal, 1992). In benign ecologies, that is, firms will survive if they avoid disadvantages and can access available resources and knowledge. On face value, this has intuitive appeal. Moreover, it entails that in relation to rates of firm entry and survival, strategy may matter less in weakly contested environments, yet matter a great deal in highly contested environments (cf. Barnett, 2008; Siggelkow, 2002). As a corollary, my argument implies that less contested resource environments will also be more tolerant of behavioral failures, defined as managers' incapacity to manage mental processes in the detection and exploitation of strategic opportunities (Gavetti, 2010). For similar reasons, routine behaviors and local search may be more effective in moderately contested resource environments, but inadequate in highly contested ones. Indeed, a random walk may be equally effective (Denrell, 2004). If so, managers need to be more mindful of change and opportunity in the face of resource scarcity and uncertainty (Levinthal & Rerup, 2006).

By the same token, my argument suggests that strategy will be an important factor in the achievement of abnormal returns beyond mere survival. However, and ironically, it becomes harder to strategize for success at the extremes of resource scarcity and uncertainty. On the one hand, when industrial ecologies are benign with little competition for resources and knowledge, it will be difficult to devise strongly advantageous market positions because all firms have access to plentiful resources and knowledge. Hence, position logics will have limited effectiveness in very stable and resource rich ecologies (Porter, 2008). On the other hand, when the ecology is malignant and the competition for resources and knowledge is intense, it will be difficult to devise strongly advantageous capabilities because of the inherent volatility and indeterminacy of the environment. Hence, opportunity logics will have limited durability in very dynamic and resource scarce ecologies and require constant adaptation (Eisenhardt et al., 2010). In these various respects, my argument helps to illuminate the specific behaviors and cognitive capabilities that characterize different strategic logics, and their impact on firm survival and superior performance.

Related implications follow with regard to selecting the optimal organizational design and resource allocation within particular industrial ecologies. In short, strategists need to understand the evolutionary dynamics of industry architecture, and especially its trajectory of resource scarcity and slack, uncertainty and turbulence, and then select organizational designs and resource configurations that complement the most appropriate strategic logic (or logics) for that environment (cf. Davis, Eisenhardt, & Bingham, 2009; Ethiraj & Levinthal, 2004; Siggelkow, 2001). Different stages of the industry life-cycle, in particular, may be associated with different strategic logics. Early stages may favor opportunity logics, middle stages leverage logics, and mature stages of the industry life-cycle may tend to favour position logics (see Klepper, 1997). Having understood these configurations and their strategic implications, managers will be better equipped to frame and guide the selection of the appropriate strategic logics and cognitive capabilities (Kaplan, 2008). These consequences point towards the practical implications of my argument.

Furthermore, managers may employ the same principles to navigate and influence the evolution of industries conceived as resource ecologies (Jacobides & Billinger, 2006). For example, by leveraging and disrupting existing architectures through the liberation of strategic resources and the sharing of information, firms can stimulate a more benign competitive environment which favors the survival of the moderately fit, thereby eroding the strategic advantage of dominant incumbents and encouraging new entrants (Klepper, 2002; Pisano & Teece, 2007). Such interventions will be more feasible at earlier stages of industry life cycle, when structures and processes are more fluid and dynamic, and opportunity or leverage logics are more appropriate. In this way, firms can try to nurture an evolutionary selection environment that is more supportive of new entrants and innovators, thereby seeding entrepreneurial opportunities to their own advantage. These processes deserve further investigation.

CONCLUSION

Evolutionary thinking provides deep insights about the mechanisms of variation, selection and replication in competitive environments. However, much strategy research adopts a relatively traditional, uni-dimensional approach to evolutionary selection, best characterized as the “survival of the fittest.” In fact, within industries where resources are relatively abundant and uncertainty is relatively low, the more

prevalent selection mechanism is the extinction of the weakest. While in industries possessing moderate levels of resource scarcity and uncertainty, firms with only average fitness often survive. My paper applies this evolutionary distinction to the analysis of strategic logics and their related patterns of adaptive intelligence. The result is a new framework for thinking about the relationship between strategic resources at firm and industrial levels, the determinants of competitive advantage within these contexts, the selection and combination of strategic logics, and the adaptive modes of associative and/or rule-based intelligence which are required to exercise such logics. Future research should develop this framework further and test it in relation to strategizing and firm-level performance under different configurations of resource scarcity and uncertainty at different stages of the industry life-cycle.

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FIGURE 1

Strategic logics, resource scarcity and uncertainty

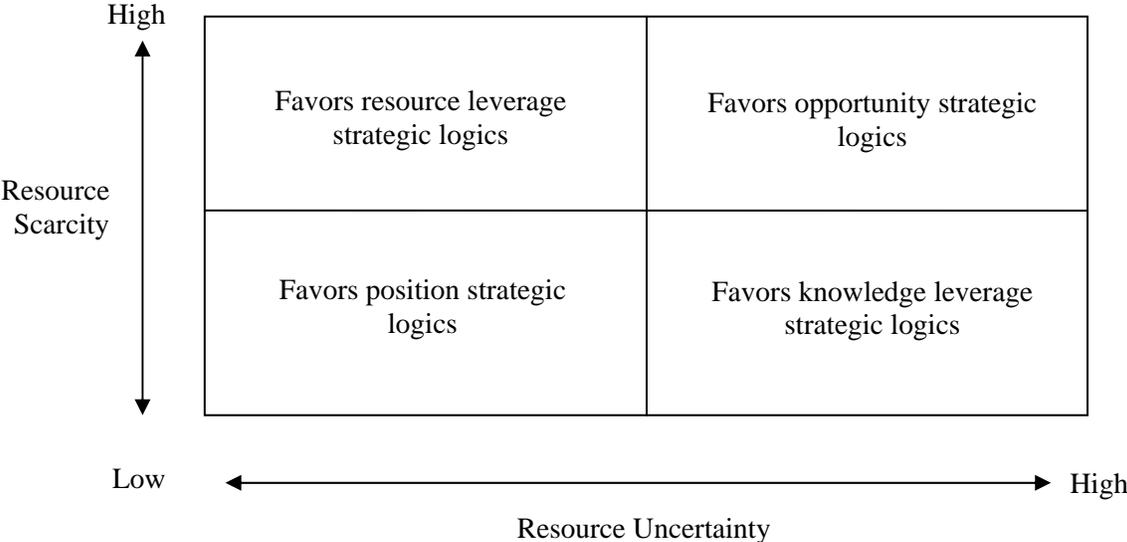


FIGURE 2

Selection mechanisms, strategic logics and adaptive intelligence

