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THE RED QUEEN IN ORGANIZATIONAL EVOLUTION

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We propose that competitive success and failure evolve through an ecology of organizational learning. An organization facing competition is likely to engage in a search for ways to improve performance. When successful, this search results in learning that is likely to increase the organization's competitive strength, which in turn triggers learning in its rivals—consequently making them stronger competitors and so again triggering learning in the first organization. We elaborate the conditions under which this self-reinforcing process, known in evolutionary theory as the 'Red Queen,' is likely to be adaptive or maladaptive. Adaptive consequences are predicted only for recently experienced learning. Experience in the more distant past of an organization's life, by contrast, is predicted to backfire into a 'competency trap.' We predict maladaptive consequences when organizations face many, varied cohorts of rivals. We empirically distinguish these effects using ecological models of competition. Estimates of organizational failure rates reveal a Red Queen among Illinois banks, and support our predictions.

Given a set of competing organizations, which will succeed? This question is fundamental to the field of strategic management, but it is difficult to answer because it requires that we consider both the complexity of strategic interaction and the limitations of the strategy process. On the one hand, competing organizations often engage in complex strategic interactions, with outcomes depending not just on what a firm does, but on what a firm does given what another will do, given what it will do, etc. (Dixit and Nalebuff, 1991; Saloner, 1991). On the other hand, we know that organizations are extremely limited in their ability to cope with such complexity. Strategies develop over time through organizational processes (Barnard, 1938; Bower, 1970; Burgelman, 1994), and managers are constrained by past organizational practices as they deal daily with circumstances often beyond their understanding and control (Sayles, 1964). Consequently, many aspects of an organization's strategy emerge from day-to-day adjustments in organizational routines, often deviating considerably from formal strategic plans (Mintzberg and McHugh, 1985). How can we predict the outcome of competitive interactions among such organizations?

In this paper, we develop and test an evolutionary model to answer this question. Our model allows for competitive interaction among organizations that are limited in their ability to strategize. In particular, we assume that an organization facing competition is likely to respond, but that its response is likely to be limited—merely 'satisficing' through a localized search and decision process (March and Simon, 1958). This response then marginally increases the competition faced by the organization's rivals, triggering in them a similar process of search and decision—which ultimately increases the competitive pressures faced by the first organization. This again triggers the search for improvements in the first organization, and so the cycle continues. We think that

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this reciprocal system of causality, known in evolutionary theory as the 'Red Queen' (Van Valen, 1973),[1] is a central, driving force behind the evolution of competitive success and failure. Our aim is to demonstrate this theoretically and empirically.

For years, researchers in strategy and organizations have been intrigued by various aspects of the Red Queen. Evolutionary theorists have noted that an organization's 'fitness' is best understood as relative to that of other organizations (Alchian, 1950; Nelson and Winter, 1982; Hannan and Freeman, 1984), or as something that 'coevolves' among organizations (Fombrun, 1988). Others claim that the success and failure of entire national industries can be traced, at least in part, to whether or not they have endured competition (Lawrence and Dyer, 1983; Porter, 1990). Such claims imply that Red Queen evolution is ubiquitously adaptive, but what about the limitations of the strategy process? How are organizations constrained when they respond to competition, and what are the consequences of these constraints for Red Queen evolution? We need a predictive model that links competition and organizational learning, but that allows for organizations to be constrained in their ability to adapt.

To develop such a model, we draw on existing research in organizational learning (March, 1988) and organizational ecology (Hannan and Freeman, 1989). The resulting synthesis describes Red Queen evolution within an ecology of learning organizations. By building on these two well-developed schools of thought, we are able to predict the conditions under which Red Queen evolution leads to adaptive or maladaptive consequences for particular organizations—depending on measurable evolutionary constraints. Our approach also allows us to specify these conditions as testable propositions, and to estimate rates of success and failure among a population of organizations that both learn to compete over time.

AN ECOLOGY OF LEARNING ORGANIZATIONS

We assume that strategies develop under uncertain conditions and that organizations possess limited *ex ante* rationality (March and Simon, 1958). Consequently strategies often emerge over time from an accumulation of incremental adjustments rather than through a comprehensive strategic plan (Quinn, 1980; Mintzberg and McHugh, 1985). These adjustments may be policy changes made by top-level managers, but often they include changes initiated at low levels as well (Burgelman, 1994). This view of the strategy process is elaborated in the behavioral model of organizational learning developed by James March (1981, 1988) and his colleagues. The most important parts of that model, for our purposes, are its rules for starting and stopping the search for new routines. Organizational routines that perform satisfactorily probably are left alone, so no search for improvements is triggered even if better practices could be found. But when performance falls below some acceptable range, members of the organization notice the problem and then search for possible solutions. This search continues until a satisfactory solution (if any) is found, at which point the improvement is likely to be adopted by the organization.[2] Over time, an organization's activities and abilities—its *de facto* strategy—change through incremental adaptations in response to environmentally triggered shortfalls in performance.

We also assume that search and learning are costly. It is costly to discover alternatives, especially when they require research and development of new technologies. Of course, it also is costly to implement new products, product attributes, services, and routines (Nelson and Winter, 1982). Aside from the costs of changing the content of organizational activity, change *per se* is costly because of disruptions in existing organizational procedures to which members and external constituents must adjust (Hannan and Freeman, 1984; Barnett and Carroll, 1995).

On balance, whether organizational learning is

[1] Van Valen (1973) coined the term Red Queen when introducing this idea to the study of biological evolution. He was referring to Lewis Carroll's *Through the Looking Glass*, where Alice notices that she appears to be stationary even though she is running a race. The Red Queen's response is that Alice must be from a slow world, since in a fast world one must run just to stay still.

[2] The particulars of any solution are changed during implementation, so that what ends up being adopted may be different from the solution originally intended. Given the fact that there is usually considerable ambiguity about what accounts for good performance, such alterations may in fact turn out to be adaptive (March, 1981).

adaptive depends on whether its results are sufficiently beneficial to offset these costs. As a baseline, we begin by assuming that organizational learning is adaptive on average. This assumption allows for the fact that some searches are not fruitful, that some adjustments are ineffective, and that some changes incur costs that outweigh their benefits. It stipulates only that, on average, organizations tend to adopt changes with benefits that outweigh their costs. This assumption allows us to develop baseline predictions for the case where Red Queen evolution is an adaptive process. We then investigate evolutionary conditions under which this assumption does not hold, and so Red Queen evolution is likely to be maladaptive.

THE RED QUEEN AS AN ADAPTIVE PROCESS

Typically learning theorists do not specify what causes the initial shortfall in performance that then triggers search. Instead they assume that these initial causes are exogenous to the learning process—a reasonable assumption because these causes often are external to the organization. We think, however, that one potential cause of performance problems, competition from other organizations, should be thought of differently. Even though competition is external to a given organization, it is best understood as part of the organization's learning process.

Consider an organizaton 'Alpha' that faces competition from organization 'Beta.' If Beta competes strongly enough, some aspects of Alpha's functioning will no longer be able to bring about satisfactory results. For example, a new retail bank may draw customers away from an incumbent bank in its local market. If this competition is strong enough, performance shortfalls will be noticed within the incumbent bank: demand-deposit customers may be leaving, or new loan application rates may fall. These shortfalls, in turn, are likely to trigger action by the incumbent to stem the problem, such as visits to potential commercial borrowers, changes in customer service routines, or changes in product prices or characteristics. This search will continue until satisfactory performance levels are regained (or, failing this, until performance expectations are lowered).

Once search is ended, we usually consider the learning episode to be complete, but when competition is the initial trigger the episode continues. Alpha has improved its practices in response to the shortfall caused by Beta. Its improvement, in turn, places greater competitive pressure on Beta. If strong enough, this pressure will cause a shortfall in performance within Beta sufficient to trigger its own problemistic search, which continues until Beta locates satisfactory improvements. These improvements then again heat up the competitive pressure on Alpha, and if this competition is sufficiently strong, Alpha again searches for satisfactory improvements in its own practices. In this way, competition triggers self-reinforcing, reciprocal effects in an ecology of learning organizations.

Because it is self-reinforcing, the Red Queen probably is an important stimulus to strategic evolution. Ordinarily, disequilibrium and organizational change are thought to be triggered by large-scale exogenous shocks such as political upheaval (Carroll and Delacroix, 1982), technological advances (Tushman and Anderson, 1986), or regulatory change (Barnett and Carroll, 1993). Of course such changes are important to organizations, but the changes occur as singular—albeit dramatic-episodes. By contrast, the Red Queen emphasizes competition as a force continually upsetting equilibrium—not necessarily through any one great shock to the system but rather by an incremental but constant and self-reinforcing process. In evolutionary perspective such self-reinforcing processes, sometimes referred to as 'arms races' (Dawkins, 1982), can result in important long-term developments even though each individual adaptive change may be small. 'Incremental' change usually is thought to mean small change, but each small change within the Red Queen triggers the next, accumulating over time into a potentially large evolutionary difference.

This process describes strategic interaction among organizations, but it does so without depicting organizations as instruments of top management strategists. In some cases, responses to competition may well be the deliberate acts of top managers. Through the Red Queen, however, ordinary day-to-day reactions to tactical problems by lower-level employees accumulate over time. Search may lead to a changed routine in customer service or a minor alteration in manufacturing specifications. Such changes may set in motion corresponding changes by rivals—which in turn may trigger the organization's next changes. In this way, our model describes *strategic interaction among competing organizational systems.* Organizations coevolve through these reciprocal interactions, developing strategic capabilities whether or not by the design of strategic managers.

Although potentially important, the Red Queen has eluded systematic analysis because it consists of two opposing effects that are likely to disguise one another. On the one hand, the adaptation of an organization to competitive pressures increases its resilience, making it better able to perform in the face of competition. On the other hand, the organization's rivals also have adapted, and so are stronger competitors. Greater resilience would increase an organization's performance; more potent rivals would decrease its performance. Together, these effects potentially mask one another when we observe descriptions of organizational performance over time. Assuming that learning is adaptive, an organization becomes better at serving the market—but so do its rivals—so observations of organizational performance wrongly tell us that nothing has changed.

To study the Red Queen empirically, we need to separate these two opposing effects. Each organization's competitive history needs to be measured, and then this variable can be allowed to have two distinct effects in an empirical model. First, each organization's competitive history should affect *its own* viability (Barnett, Greve, and Park, 1994). For instance, suppose one organization has faced its rivals for a mean duration of 8 years per competitive relationship, whereas a similar second organization of the same age has competed with its rivals on average for only 2 years. Standard models of organizational viability, such as models of failure, growth, or performance, would depict these two organizations as equally viable because they are similar and of the same age. If the Red Queen is an adaptive process, however, then the first organization is likely to be more viable than the second, because the mean duration of its competitive relationships is longer.

Second, and distinctly, the competitive history of each organization's *rivals* should also affect the organization's viability (Barnett, 1996). Typically, researchers model the evolutionary effects of competition by including measures of the 'density' (numbers) of rivals in models of organizational founding and failure (Hannan and Freeman, 1989; Hannan and Carroll, 1992). Generalizations of this approach allow the strength of competition to depend on rivals' characteristics, such as their ages, sizes, or strategies (Barnett, 1993, 1996). In light of our arguments, this approach should be extended so that the strength of competition faced by an organization varies according to its rivals' mean competitive experience. If the Red Queen is adaptive, then more experienced rivals will generate stronger competition, implying that organizations with more experienced rivals will be less viable.

EVOLUTIONARY CONSTRAINTS AND THE MALADAPTIVE RED QUEEN

So far we have assumed that the costs of search and learning are, on average, outweighed by the benefits. This assumption is implicit in theories that depict evolution as a consistently improving force (Nelson, 1994).[3] In the strategy field, this assumption is the basis of theories that describe competition as a cause of evolutionary progress—especially in accounts of national economic success and failure (Lawrence and Dyer, 1983; Porter, 1990). This assumption is useful to elaborate a baseline model, but it does not consider how constraints may affect organizational evolution. Unconstrained, organizations may well adopt changes that improve their viability on average. A fundamental insight of the evolutionary perspective, however, is that each organization is constrained by its history. We consider two such constraints here in order to predict the conditions under which Red Queen evolution is likely to have maladaptive consequences.

First, organizations are constrained by lessons learned in the past. The most notorious form of historical constraint is the 'competence trap' (Levitt and March, 1988). Organizations under this condition respond to new developments using routines that were learned under a previous regime, harming their performance by doing precisely what worked well under different circumstances.

[3] Gould and Lewontin (1979) coined the term 'Panglossian' to describe similar theories in evolutionary biology.

In light of the Red Queen, we speculate that this trap may be deepened by mutual reinforcement in an ecology of organizational learning. For instance, established firms have been known to collectively deny the possibility that new practices and technologies are changing the basis of competition in an industry, preferring instead to stay with well-learned but outdated practices (Cole, 1996). More generally, as time passes and circumstances change, what was learned in a Red Queen during the previous era may end up harming organizations although it had once worked to their advantage (Barnett, Greve, and Park, 1994).

This implies that we specify the historical timing of competitive experiences when modeling this process. For recent competitive experience, we continue to assume that the benefits of learning are likely to outweigh the costs. By contrast, we speculate that an organization's experiences in the more distant past are more likely to have taught now-outdated lessons. Together these ideas suggest both adaptive and maladaptive consequences of competitive experience, depending on historical timing:

Hypothesis 1a: A longer mean duration of an organization's competitive relationships in recent times increases its viability.

Hypothesis 1b: A longer mean duration of an organization's competitive relationships in the distant past decreases its viability.

Similarly, we expect that the strength of rivalry hinges on the same difference in historical timing. Rivals with more recent competitive experience are likely to be more potent competitors, but we predict that the opposite will be true of organizations whose competitive experience was in the distant past. They are more likely to have learned outdated lessons, and so should be weaker competitors:

Hypothesis 2a: A longer mean duration of the competitive relationships experienced by an organization's rivals in recent times decreases the organization's viability.

Hypothesis 2b: A longer mean duration of the competitive relationships experienced by an organization's rivals in the distant past increases the organization's viability.

A second constraint arises when organizations are engaged in more than one coevolutionary process. An organization facing a single cohort of rivals shares with them the same timing and sequence of strategic interactions. But what if an organization has developed within a cohort of rivals for some time, but then is confronted with new rivals that do not share the organization's coevolutionary history? According to our model, the organization can be expected to enter into a new Red Queen process with the new rivals. But the organization has already evolved, adapting to competition from others. Adaptations made in that process represent constraints, preventing some forms of adaptation to its new rivals (Schumpeter, 1934). Similarly, adaptations to its new rivals may require alterations in adaptations made to its earlier rivals—as when adopting a new technology destroys existing competencies (Tushman and Anderson, 1986). In this way, each cohort of rivals brings on the challenge of a new Red Queen, but adaptations made for each cohort constrain those that can be made for others.

This constraint increases in severity according to the variety of coevolutionary processes faced by an organization. An organization facing only one cohort of rivals can freely coevolve with them, whereas an organization facing several cohorts—especially cohorts separated by large time periods—is likely to face very different and possibly conflicting demands. This suggests that we distinguish between organizations according to the *variance*, as well as the mean, of their competitive experiences. For instance, two organizations might each have 10 rivals, and each organization might have endured these 10 competitive relationships for the same mean duration—say, 12 years. But say that the first of these organizations has been competing with rivals all from the same cohort—competing with every one of its rivals for 12 years with no variance among these relationships. By contrast, the second organization might be competing with rivals from various cohorts—some that arrived only 1 or 2 years ago but others that have been rivals with the organization for decades. The mean durations of these organizations' competitive relationships are equal, but their experiences differ greatly according to the variance in these durations.

Controlling for the number and mean duration of competitive relationships, we expect the variance in competitive relationships to reflect increasing constraints among multiple coevolutionary processes. Each constraint lowers the probability that an organization can locate and adopt an adaptive solution to any given competitive threat. As these constraints mount, then, it becomes increasingly unlikely that the benefits of adaptation will be sufficient to outweigh the costs of search. Consequently, we predict:

Hypothesis 3: The greater the variance in the durations of an organization's competitive relationships, the lower its viability.

In sum, each organization can be thought of as being involved in a number of competitive relationships. The history of these relationships can be described for each organization at each point in time according to an *experience distribution*. The density of competitors reflects just one aspect of an organization's experience distribution: its *number of competitive relationships*. But density says nothing about the evolutionary history of these relationships. Three additional variables describe the historical differences among organizations' experience distributions: (1) the *mean duration* of each organization's competitive relationships, measuring how much experience each organization has had per relationship; (2) the *historical timing* of that experience, which separates the amount of competitive experience according to whether it occurred recently or in the more distant past; and (3) the *variance in durations* of an organization's relationships, gauging whether an organization's relationships have been coincident or whether they have been spread among different cohorts of rivals. We argue that each of these properties of the experience distribution has theoretical significance, and that all three together should be modeled empirically in order to reveal both the adaptive and maladaptive consequences of the Red Queen.

SELECTION PROCESSES

We introduce selection processes into our model by allowing selection to serve as an alternative to learning. One could assume that the forces of structural inertia make organizations extremely unlikely to adapt (Hannan and Freeman, 1984). Differences among organizations would then arise mainly at the time of founding (Stinchcombe, 1965), or possibly over time as changes arise essentially at random (Levinthal, 1991). If we assume that selection processes favor relatively more fit organizations, then even under these assumptions the survivors of competition would be more fit. But these relatively more fit survivors would not have learned from competition. They were more fit to begin with, or became that way as luck would have it, and survived competition as a consequence. In this case, spurious evidence of the Red Queen might be found even in the absence of organizational learning.

We have no doubt that such selection takes place, but we think that learning takes place too. In our view, models of organizational evolution should allow for the fact that both selection and learning operate, as do models of cultural evolution (e.g., Boyd and Richerson, 1985). In this spirit, we treat the question of selection vs. learning as an empirical one, explicitly modeling each possibility. This choice requires that we distinguish organizations according to the extent to which each is a survivor. Purely selection-driven evolution will vary from context to context according to the observed selection rate, which will be included in our model as a distinct effect. The full model, then, allows for the observed distribution of organizations to change both through organizational learning and as a result of selection processes (Barnett *et al.*, 1994).

STRATEGIES THAT INHIBIT COEVOLUTION

To this point, we have assumed that organizations respond to their rivals by attempting to outcompete them. If managers become aware of competitive threats, however, they may take strategic actions to lessen rivalry (Porter, 1980). For instance, multimarket organizations may mutually forbear from competing with one another—eliminating the engine of Red Queen evolution (Barnett *et al.*, 1994). Alternatively, strategic alliances among rivals may serve as a mechanism to coordinate their adjustments to one another. Many scholars rationalize such action as beneficial for the collective fate of cooperating organizations. In fact, cooperation often is intended to enhance learning among organizations. By reducing competition, however, such arrangements may eliminate the self-reinforcing learning process that we describe.

Similarly, mergers and acquisitions by organizations may be targeted especially to eliminate the most potent rivals faced by organizations (Pfeffer and Salancik, 1978). Over time, organizations taking this strategy in response to rivalry may still have what appear to be competitive relationships, but the remaining rivals will be their most impotent competitors. Such an outcome directly contradicts our predictions—as it should, given that this sort of strategic action is meant to eliminate the competitive force responsible for accelerating evolution.

For this reason, empirical evolutionary models should control for business policies that inhibit the Red Queen. Such policies may differ from context to context depending on the particular strategic configurations that exist. For instance, organizations that rely on research and development may benefit from patent races. If so, then our predictions are likely to hold—except for organizations that pursue a strategy of coordinating R&D in such a way that it eliminates this sort of competition. In other contexts, other business policies will be more relevant to the particular kinds of competition involved. Here, we study retail banks in Illinois, where over the study period of this century merger and acquisition activity occurred relatively often. Consequently, we will distinguish empirically between organizations according to how frequently they purchased their rivals, in case this eliminated precisely their most threatening—and stimulating—competitors. Whether the net effect of such action increased or reduced viability is not clear. Nonetheless, we need to control for organizations that take strategies designed to preclude the Red Queen, as this difference among organizations might otherwise generate biased results for the other parameters of our model.

EMPIRICAL MODEL

The hypotheses are stated in terms of effects on 'viability.' We operationalize this concept here as organizational failure rates, although one could adapt the model to predict rates of organizational founding, growth, or performance (e.g., Barnett *et al.*, 1994). We specify the organizational failure rate using a multivariate model so that we can test the hypotheses simultaneously and control for other variables likely to affect survival chances.

To test the hypotheses, each organization's relationship with each of its rivals was measured in years and denoted by τ_{jk}, the time that organization j was exposed to competition from rival k. Organization j's experience distribution, then, is just the distribution of its τ_{jk} over all rivals k, with a mean represented by μ_j and variance equal to $\sigma_j^2 = \sum_k (\tau_{jk} - \mu_j)^2$. The hypotheses require that we distinguish between j's experience in recent time and its competitive experience from long ago. To do this, we divided τ_{jk} into two terms, τ_{Rjk} representing organization j's recent exposure to rival k, and τ_{Djk} measuring j's exposure to rival k in the distant past. For Illinois banks in this century, we chose 10 years as a cutoff point for defining these two variables. We judged this window to be sufficient to represent 'recency' as it is understood within banking. That means that for any given rival k, j's recent-experience clock τ_{Rjk} will tick until it reaches 10 years and then maintain that value until the sample period ends or either j or k fails or otherwise disappears. After 10 years, the distant-experience clock τ_{Djk} then begins to tick, recording with each additional year the number of years of competitive experience between j and k before the 10-year window. To test the hypotheses, means were then constructed for each organization for each of these competitive experience clocks: μ_{Rj} and μ_{Dj}. The hyoptheses also require that we create variables representing, for each organization j, the competitive experience of its rivals. We created these rivals' experience measures again using the 10-year window to measure recent and distant experience, respectively: $\sum_{k \neq j} \mu_{Rk}, \sum_{k \neq j} \mu_{Dk}$. Together these terms constitute the failure rate model to be estimated:

$$r(t)_j = r(t)_j^* \exp[a_R\mu_{Rj} + a_D\mu_{Dj} + b\sigma_j^2 + c_R\sum_{k \neq j} \mu_{Rk} + c_D\sum_{k \neq j} \mu_{Dk}]$$

where $r(t)_j$ is the failure rate of organization j, t is organizational age, and $r(t)_j^*$ is the baseline failure rate including the effects of all control variables. The rate is specified as a log-linear function of the variables in order to avoid the estimation of meaningless, negative failure rates. Hypothesis 1a is supported if recent experience enhances viability, such that $a_R<0$. By contrast, if more distant experience makes organizations less viable as predicted by Hypothesis 1b, then $a_D>0$. Hypothesis 2a is supported if recent experience by rivals makes them stronger competitors, indicated by $c_R>0$. If distant experience makes rivals weaker, as predicted by Hypothesis 2b, then $c_D<0$. Hypothesis 3 predicts that high variance in the durations of competitive relationships reduces organizational viability, which is indicated by $b>0$.

The baseline rate $r(t)_j^*$ is specified as a function of three kinds of variables. One set controls for the 'carrying capacity' of organizations, and includes period effects and exogenous variables describing market and institutional conditions likely to affect the organizational failure rate (Hannan and Freeman, 1989). The exogenous variables include measures of the size of the human population in each organization's market, a measure of urbanization, and measures of urban and rural economic development. Also included was the number of organizational failures in each organization's market in the previous year, a measure that increases as an organizational population experiences waves of failure (Carroll and Delacroix, 1982).

A second set of variables controls for competitive effects other than those that we hypothesize. An indicator variable is included for organizations that are monopolists in their market as well as a continuous measure of organizational density. Also included is the number of rivals in an organization's market at its time of founding. This term is meant to control for higher failure rates among organizations founding under high-scarcity circumstances—so called 'density delay' (Carroll and Hannan, 1989). Two other variables are included to control for characteristics of each organization's rivals. The aggregate size of each organization's rivals was measured. Holding constant the size of the market, this variable allows organizations of different sizes to generate stronger or weaker competition (Barnett and Amburgey, 1990). Similarly, older organizations are allowed to generate stronger competition by including the sum of rivals' ages in the model. Barnett (1996) reasoned that through slection and learning organizations become stronger competitors over time, so that an organization facing older rivals will be less viable. In light of the Red Queen, whether an organization's rivals are stronger competitors should depend not just on whether the rivals have aged but also on whether they have endured competition. For this reason, we separate these effects by including a control for rivals' ages less the mean duration of rivals' competitive experience.

The third set of variables controls for characteristics of each organization likely to influence its hazard rate, such as its size, age, and an indicator for whether the organization was a first-mover in its market. Also controlled was a measure of the cumulative number of rivals absorbed by a given organization—a strategy that might retard Red Queen evolution. To control for selection effects, which could otherwise lead to spurious evidence of learning, we include the cumulative number of organizational failures in an organization's market since the time the organization was founded. 'Survivor' organizations will have a high value for this measure, and they should be more viable (regardless of learning) simply as a result of unobserved factors that caused them to be selected over others in the past.

The controls for age dependence are especially important for this study. Age dependence could spuriously affect estimates of the parameters a and c in our model, because age captures development over time, as do our competitive experience effects. By controlling for age, we can also speak to the renewed debate over age-dependent failure rates. For some time it has been thought that failure rates decline with age as organizations move down 'learning curves,' either over time (Freeman, Carroll, and Hannan, 1983) or with accumulated output (Lieberman, 1984). By contrast, Barron, West, and Hannan (1994) recently argued that organizations suffer a liability of aging—becoming less fit over time because of senescence and obsolescence. In view of the Red Queen, whether time is good or bad for viability depends on the ecological context. Isolated organizations are likely to suffer from senescence and obsolescence as time passes, for they lack the Red Queen to stimulate adaptation. By contrast, organizations facing competition benefit from the Red Queen, and so are more likely to improve their relative fitness as a function of their exposure to competition. These two patterns probably coexist in most industries depending on market segment. This may explain why there have been such mixed results in empirical tests of age-dependent failure rates. Our model, by including both age- and experience-dependence, will be able to separate these two patterns of development.

DATA AND METHOD

The model can be estimated with organizational life history data, so long as there are ample differences between the competitive histories of organizations and their rivals. Without these differences, the mean duration of each organization's competitive relationships would be equal to that of its rivals, and so an empirical model including both of these variables would not be identified. This problem is attenuated the more that organizations come and go at different times throughout the data, as each organization's experience then can differ from its rivals'. Such differences can be found within a single organizational population as it changes over time, but ideally one would study both contemporaneous and temporal differences by pooling data on many markets with different competitive histories.

The data analyzed here fit these requirements well. They document the life histories of each of the 2970 retail banks that have ever operated since 1900 in any of the 650 local banking markets in the state of Illinois, excluding Chicago. Illinois retail banking was chosen because competition is geographically localized in retail banking, and the many local markets of Illinois have remained distinct over time because of the state's prohibition of branch banking and intrastate holding companies (until recently—see Barnett *et al.*, 1994). These facts allow us to separately map the competitive histories of organizations in each of the 650 local banking markets as if they were distinct organizational populations. Figure 1 shows the total number of banks in the data over this century.

The data were collected from each yearly issue of *The Bankers Directory* series (Rand McNally, 1900–90; Thomson Financial Publishing, 1991–93). Data on size (real assets), market location, and birth and death events were coded for every bank. Each organization's assets were measured every 5 years, as well as in the year of the bank's birth and death. Estimates of size during the intervening years were obtained by linear interpolation. Literally dozens of types of death events were listed in the directory. From these, 'failures' included bank closures that occurred because of actual or impending insolvency—whether or not the closure was managed by regulators. Failures that eventually were resolved by restructuring and reopening the bank were recorded as failures, and the new bank was treated as such. Of the 2970 banks in the data, 1444 failures were recorded over the 107,151 organization-years. Mergers and acquisitions not associated with a bank failure were treated as a competing risk in the analysis (Kalbfleisch and Prentice, 1980).

Exogenous variables were coded from several sources. All variables that were measured in intervals of greater than 1 year were linearly interpolated to provide approximate values for each year of the study period. The size of the human population in each local market was recorded from the *Banker's Directory* series in 5-year intervals. From the decennial census, we included the proportion of each county's population considered urban in 10-year intervals. Also from the census we included the number of manufacturing establishments and the number of farms in each county, measured in 10-year intervals, to control for urban and rural development. Each local banking market's age in years was included to control for unobserved factors that develop as the local economy matures. This clock begins with the founding of the first-ever bank in a locality. Ten historical period effects were included, corresponding to periods of turbulence, stability, and regulatory change over the century: 1900–10, 1910–19, 1920–28, 1929–32, 1933–39, 1940–45, 1946–59, 1960–69, 1970–79, and 1980–93. Descriptive statistics for all variables used in the analysis are listed in Table 1.

The failure model was estimated in terms of the instantaneous hazard rate (Tuma and Hannan, 1984). We used the piecewise exponential model as implemented in the statistical program TDA (Rohwer, 1993). This program was written to accommodate cases where organizations do not fail before the end of the observation period. Excluding these 'right censored' cases leads to severely biased results (Tuma and Hannan, 1984). The piecewise exponential specification was chosen for two reasons. First, it estimates age dependence without making strong parametric

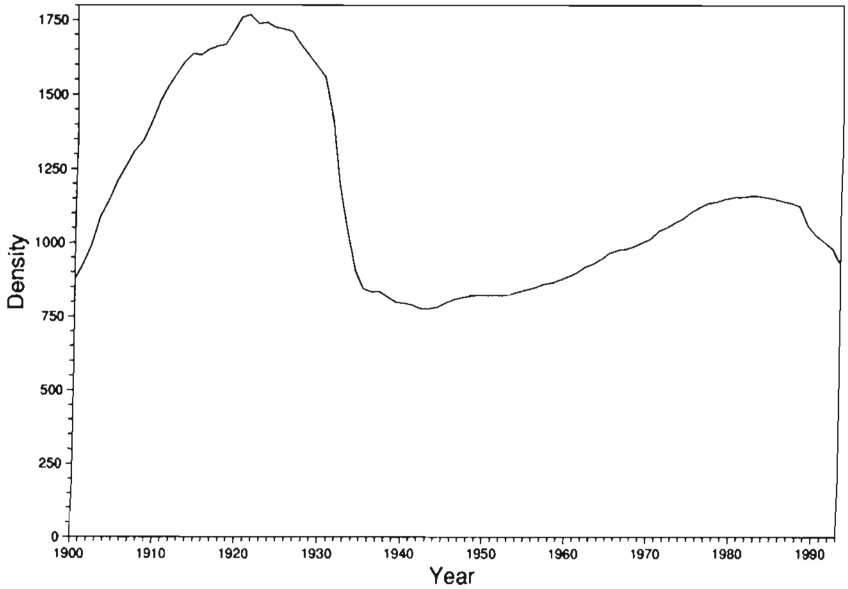

Figure 1. Banks in Illinois (excluding Chicago)

Table 1. Description of variables

Variables	Minimum	Maximum	Mean	S.D.
Age of local market	0	148	54	32
Population in local market	16	139426	8596	17815
Proportion of population urban (in county)	0	1	0.46	0.28
Number of manufacturing estabs (in county)	1	19998	933	2934
Number of farms (in county)	161	5827	2139	1100
Bank failures in locale (prior year)	0	3	0.018	0.143
Bank failures in locale (since org.'s founding)	0	10	0.687	1.087
Real assets in locale/10^5 (focal bank omitted)	0	16618	404	1384
Natural log (Bank's real assets)	8.7	20.3	15.6	1.6
Number of banks absorbed by bank	0	7	0.14	0.44
Bank was first mover	0	1	0.026	0.159
Density of locale at time of founding	0	13	1.58	1.62
Bank has monopoly in local market	0	1	0.47	0.5
Density in local market (other than focal bank)	0	13	1	1.6
Bank's competitive experience (mean duration)	0	121	11.6	18.7
Bank's recent competitive experience (mean duration)	0	10	4.2	4.5
Bank's distant competitive experience (mean duration)	0	111	8.2	16.4
Bank's competitive experience (variance in duration)	0	4802	55	261
ΣRivals' ages	0	550	37	65
ΣRivals' ages less their mean competitive experience	0	318	15	32
ΣRivals' competitive experience (mean duration)	0	294	22	39
ΣRivals' recent competitive experience (mean duration)	0	119	8	13
ΣRivals' distant competitive experience (mean duration)	0	305	16	33

assumptions. We are concerned that misspecification of age dependence might spuriously influence the competitive history effects, as they grow alongside organizational age. The piecewise exponential model avoids this problem, because it does not require a parametric specification of age dependence. Second, the piecewise exponential can be estimated without bias even when some of the organizations were born before the sample period began, as is the case in our data. These 'left censored' cases would introduce bias to many other commonly used parametric hazard rate models (Guo, 1993).

RESULTS

Tables 2 and 3 show the model estimates. In Table 2, three different specifications of the model are listed for comparison, and then Table 3 lists the age- and historical-period effects corresponding to Model 3—the most complete specification. Model 1 omits the hypothesis tests, and so serves as a baseline model for comparison. Model 2 adds the variables corresponding to our theory, but does not distinguish between recent and distant-past experiences. Those distinctions are made in the full specification, Model 3.

As predicted by Hypothesis 1a, banks with more competitive experiences recently were significantly less likely to fail. Meanwhile, this effect was reversed for banks with experience in the distant past, as predicted by Hypothesis 1b. The relative magnitudes of these effects are interesting. The beneficial effect of recent competitive experience is about 15 times greater than the deleterious effect of having outdated experiences. This finding means that 1 year of recent experience can compensate for 15 years of old experiences—suggesting that these organizations were relatively corrigible. Of course, this effect might be offset by having a very large amount of outdated experience. Comparing the means in Table 1 indicates that there was in the sample only about twice as much distant-past experience as recent experience, so the adaptive effect of recent experience appears to have been more than sufficient to make up for most organizations' prior histories. Note also that in Model 2 these opposing effects were masked, as the competitive experience measure did not distinguish between recent and distant-past experience.

Failure rates are lower as a result of an organization's recent competitive experience, but does this effect counteract the hazards that come with age and with not being a monopolist? To help answer this question, Figure 2 combines the effects of recent competitive experience, age dependence, and the monopoly indicator variable, using the estimates of Model 3. The solid line shows how a monopolist's life chances change as it ages, starting with an initial advantage due to the monopoly effect but then becoming increasingly likely to fail because of positive age dependence. By contrast, the dashed line shows the failure rate multiplier for an organization with competition. For the first 10 years of life, organizations with rivals are more likely to fail than are monopolists, and they become increasingly likely to fail because of positive age dependence. But these organizations benefit from the Red Queen with each passing year, so that the pattern reverses by year 5 and then begins falling rapidly. (This nonmonotonic pattern is similar to one attributed solely to age in studies that did not consider the Red Queen; see Brüderl and Schüssler, 1990; Levinthal, 1991.) By our estimates, the hazards that come with age and not being a monopolist both are strong, but the increase in viability due to recent competitive experience is strong enough to counteract these effects.

Hypotheses 2a and 2b also are supported. Rivals generated significantly stronger competition when they had more competitive experience—but this finding holds only for recent experience. As predicted, rivals with distant-past experience generated weaker competition. As predicted, rivals with distant-past experience generated weaker competition. These two effects are best understood by comparison to the effect of the sum of rivals' ages (less their mean experience). That age term shows the increase in competitive strength that develops among rivals as they age, as predicted by Barnett (1996). Note that the effect is increased two-fold for banks with rivals—at least if their experience with rivals is recent. Taken together, these effects suggest that the strength of competition depends largely on whether organizations are part of a Red Queen, but that having been in a Red Queen long ago has the reverse effect.

It is interesting to compare the magnitudes of the effects of an organization's experience and

Table 2. Piecewise exponential models of Illinois bank failures, 1900–93 (excluding Chicago)

Variables	Models[a] (1)	(2)	(3)
Age of local market	–0.0032 (0.0028)	–0.0081** (0.0029)	–0.0071** (0.0029)
Population in local market/1000	0.0086* (0.0050)	0.0119** (0.0051)	0.0119** (0.0051)
Proportion of population urban (in county)	0.0300 (0.1316)	0.0627 (0.1313)	0.0390 (0.1315)
Number of manufacturing estabs/1000 (in county)	0.0396** (0.0130)	0.0420** (0.0127)	0.0406** (0.0128)
Number of farms/1000 (in county)	–0.0068 (0.0324)	–0.0108 (0.0324)	–0.0067 (0.0325)
Bank failures in locale (prior year)	0.4386** (0.1156)	0.1703 (0.1268)	–0.0706 (0.1384)
Bank failures in locale (since org.'s founding)	–0.0742* (0.0449)	–0.0792* (0.0460)	–0.0806* (0.0457)
Real assets in locale/10^5 (focal bank omitted)	–0.0002* (0.0001)	–0.0003** (0.0001)	–0.0003** (0.0001)
Natural log (Bank's real assets)	–0.7840** (0.0273)	–0.7869** (0.0276)	–0.7871** (0.0277)
Number of banks absorbed by bank	0.2243** (0.0842)	0.1521* (0.0830)	0.1059 (0.0846)
Bank was first mover	0.2377 (0.1489)	0.1825 (0.1497)	0.1487 (0.1510)
Density in locale at time of founding	0.0821** (0.0406)	0.1222** (0.0412)	0.1222** (0.0400)
Bank has monopoly in local market	–0.3613** (0.0783)	–0.8473** (0.1070)	–1.447** (0.1388)
Density in local market (other than focal bank)	0.0608 (0.0541)	–0.0857 (0.0601)	–0.1467* (0.0871)
Bank's competitive experience (mean duration)		–0.0284** (0.0050)	
Bank's recent competitive experience (mean duration)			–0.1508** (0.0185)
Bank's distant competitive experience (mean duration)			0.0104* (0.0060)
Bank's competitive experience (variance in duration)		0.0015** (0.0001)	0.0011** (0.0002)
ΣRivals' ages	0.0009 (0.0015)		
ΣRivals' ages less their mean competitive experience		0.0092** (0.0021)	0.0103** (0.0023)
ΣRivals' competitive experience (mean duration)		0.0013 (0.0024)	
ΣRivals' recent competitive experience (mean duration)			0.0195* (0.0109)
ΣRival's distant competitive experience (mean duration)			–0.0054* (0.0031)
Chi-squared[b]	785.66	912.26	959.04
d.f.	15	18	20

$*p < 0.10$; $**p < 0.05$. Standard errors are in parentheses.
[a] Models include 9 historical period effects and 11 age-period effects. The data include 107,151 organization-years, 2970 organizations and 1444 failures.
[b] Compared to a model with only the age and historical period effects.

Table 3. Age and historical period effects on the bank failure rate[a] (corresponding to Model 3 in Table 2)

Variables	Estimates	Variables	Estimates
Age 0–1	4.236** (0.6264)	1910–19	0.0770 (0.1090)
Age 1–2	6.191** (0.4280)	1920–28	0.5660** (0.1111)
Age 2–3	6.506** (0.4270)	1929–32	2.541** (0.1105)
Age 3–5	6.994** (0.4055)	1933–39	2.300** (0.1272)
Age 5–10	7.548** (0.4036)	1940–45	1.139** (0.2013)
Age 10–15	7.697** (0.4063)	1946–59	0.0865 (0.2565)
Age 15–20	7.646** (0.4139)	1960–69	−1.054** (0.4816)
Age 20–25	7.745** (0.4178)	1970–79	−1.451** (0.6147)
Age 25–30	7.912** (0.4190)	1980–93	−0.8551** (0.3512)
Age 30–40	7.858** (0.4249)		
Age 40–	7.985** (0.4367)		

**$p < 0.05$. Standard errors are in parentheses.
[a] For historical period effects, 1900–09 is the left-out category.

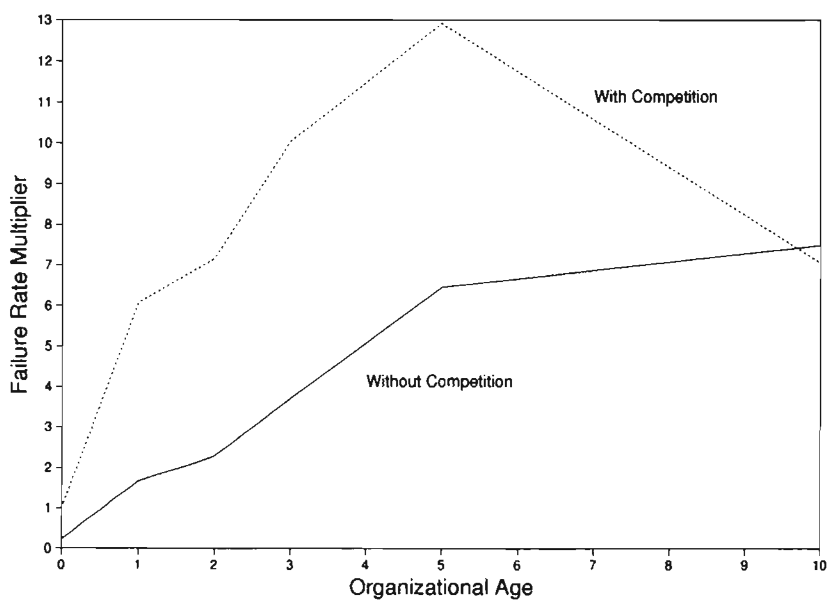

Figure 2. Age, competition and organizational failure

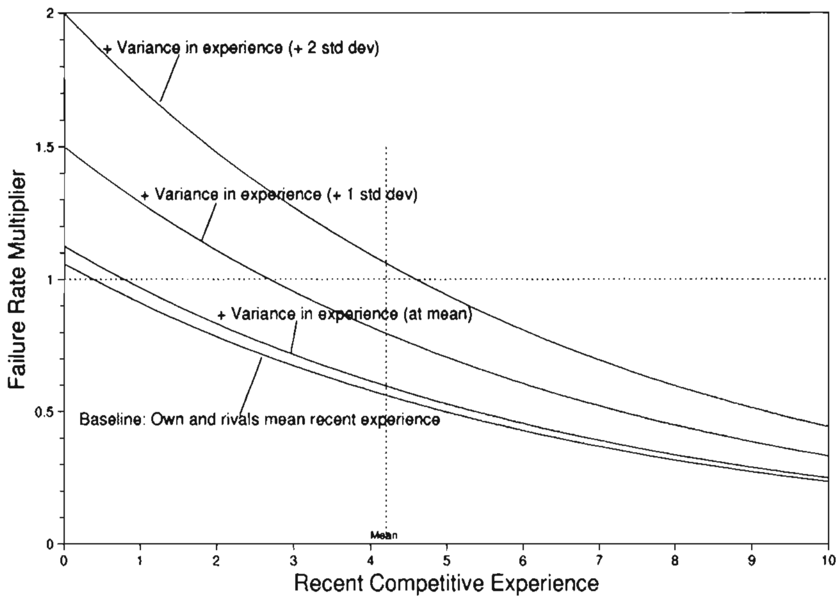

Figure 3. Varied competitive experience and organizational failure

its rivals' experience. By our estimates, it would take about 15 experienced rivals to offset the benefits going to one experienced organization, but the maximum number of rivals observed in any local market was 13. This finding suggests that the Red Queen has asymmetric consequences, increasing an organization's viability more than it increases the competitive effect of the organization's rivals.

Support also is found for Hypothesis 3, which predicted that failure rates increase for organizations with high variance in the durations of their competitive relationships. As expected, then, Red Queen evolution appears to have had both adaptive and maladaptive consequences for Illinois banks—with these effects depending on the duration and variance of competitive experience.

An interesting empirical question is whether the adaptive consequences were strong enough to offset the maladaptive consequences according to our estimates. Figure 3 illustrates failure rate multipliers as a function of recent competitive experience, evaluated at difference levels of variance in competitive experience. The lowest solid line serves as a baseline, showing the combined effect of the mean duration of an organization's recent experience ($\exp[-0.1508]$) and its rivals' recent experience ($\exp[0.0195 \times 3]$), assuming three rivals). The other three solid lines add the increased hazard due to variance in an organization's competitive experience, with this variable evaluated at its mean, at its mean plus 1 standard deviation, and at its mean plus 2 standard deviations (from Table 1).[4] When these plots are above 1 on the vertical axis, the combined effects are predicted to increase the organization's failure rate. By contrast, a multiplier below 1 indicates that the combined effects reduce the organization's hazard of failure. According to our estimates, the combined effects of the Red Queen were usually adaptive for Illinois banks, reducing their failure rates. Higher failure rates are predicted only in the rare case where a bank's competitive experience was both very high in variance and short in mean duration. Otherwise, our model predicts that the Red Queen typically lowered organizational failure rates.

The effects of numbers of competitors were interesting. The powerful and significant monopoly effect shows that the arrival of one's first

[4] In this figure, rivals' recent experience is set equal in duration to the organization's, and only variance is changed from plot to plot. Of course, in reality these durations must differ in order for variance to be defined. We compare plots with all durations set equal in order to simplify the illustration. More complicated plots with differences among durations show very similar patterns. Also, Figure 3 does not include the effects of distant-past experience because these are smaller in magnitude and, at the mean, the hazard due to an organization's past experience is roughly offset by the effects of rivals' past experience.

competitor accounts for a whopping increase in the hazard rate. After that, additional increases in numbers of competitors in a local market actually decrease failure rates. This effect, however, needs to be understood together with the effects of the Red Queen. Model 1, which does not include the full specification of each organization's experience distribution, showed a competitive density effect more consistent with the established literature (although the effect is not significant). Once the mean and variance of the experience distribution are included in Models 2 and 3, the density effect then turns negative and significant.

Among other effects, larger banks were less likely to fail, replicating the well-known liability of smallness effect. Density at the time an organization is founded has a positive, ongoing effect on its failure rate consistent with the findings of Carroll and Hannan (1989). Predation by banks (the number of banks each has absorbed as of a given year) is significant and positively related to failure in Models 1 and 2—possibly evidence that this strategy precludes Red Queen evolution—but this effect is not robust in Model 3. Larger markets as measured by the sizes of rivals were less hazardous, but larger markets as measured by the human population turned out to be more hazardous. Similarly, banks in areas with many manufacturing establishments were more likely to fail.

Finally, two effects included to capture unobserved heterogeneity were statistically significant. The age of each local banking market was negatively related to failure rates—an effect over and above the historical period effects. Meanwhile, the control variable for selectivity effects—the number of failures in the local market over an organization's lifetime—predicts a lower failure rate for the surviving organizations, as expected.

DISCUSSION AND CONCLUSION

We found evidence of Red Queen evolution among Illinois banks. Organizations were less likely to fail if they had more competitive experience, and at the same time they generated stronger competition—results that hold even after we control for the effects of selection on survival. This finding supports our baseline prediction that organizations learn over time as a response to competition, which in turn intensifies competition in a self-reinforcing process. Our results suggest that lone organizations reap the static benefits of monopoly, but lack the dynamic advantage that comes from exposure to competition. This result cuts both ways, however, as organizations with experienced rivals were more likely to fail. Taken together, these findings support our predictions and demonstrate the usefulness of our model.

We also found that the Red Queen has maladaptive consequences, evidence of evolutionary constraints. As predicted, the results of exposure to competition hinge on historical timing, completely reversing for competitive experience in the more distant past. In fact, evidence was suppressed in models that did not consider historical timing and so confounded the opposing effects of recent and distant-past experience. Once historical timing was considered, it turned out that organizations with distant-past experience were both more likely to fail and weaker competitors, evidence consistent with our prediction that distant-past experience leaves organizations in a competence trap. Nevertheless, by our estimates this historical constraint was quickly overcome: 1 year of recent competition among Illinois banks was sufficient to offset the deleterious effects of 15 years of outdated experience. On balance, then, our results suggest that Red Queen evolution remains adaptive despite this constraint.

A more powerful constraint was revealed in our test of Hypothesis 3, where we found support for the prediction that organizations are more likely to fail if they have competed against rivals from varied cohorts. Organizations facing various cohorts of rivals, we argued, are constrained in their ability to coevolve with any one cohort, because adaptations made for each cohort constrain adaptations that can be made for other cohorts. As the variance among cohorts of rivals increases, these constraints compound, reducing the marginal benefits of learning until they no longer offset the costs. This result suggests that Red Queen evolution can turn maladaptive with the entry of new rivals to a market, as they can dramatically increase the variance in an organization's competitive experience. Nevertheless, the magnitudes of our estimates show that the advantage due to exposure to recent competition is much stronger than the deleterious effect of variance, so that the Red Queen is likely to remain adaptive except in extreme cases of high variance and low mean duration.

The full pattern of results suggests that current research on competition would be improved by taking a more evolutionary perspective. As it stands, most work depicts competition as a function of the numbers or size distribution of competitors. Such studies acknowledge only one part of an organization's experience distribution—its number of competitive relationships. Meanwhile, other properties of that distribution—the mean duration, historical timing, and variance in duration of these relationships—are unwittingly ignored. If our findings prove robust, these properties may be decisive predictors of organizational viability, and crucial variables that will allow us to discriminate between strong and weak competitors. In fact, our results suggest that competitive effects attributed to numbers of competitors may be spuriously reflecting the effects of the mean and variance of the experience distribution. This raises a question about whether the prevailing view of competition as 'crowding' is too static, and whether our more dynamic model of Red Queen evolution would provide a more accurate description of the competitive process.

These results imply that strategic evolution has a maladaptive side, suggesting that we use caution when advancing normative prescriptions based on evolutionary thinking. In particular, Porter's (1990: 586) model of international competition suggests that firms should seek challenging competitors as motivators in order to improve their international competitive strength. Our findings direct attention to whether cultivating competitors will increase the variance in a firm's competitive relationships. If so, this prescription could backfire as firms are confronted by multiple, conflicting evolutionary demands. More generally, this problem illustrates the need to consider the constraints that inhibit organizational evolution, and to explicitly build these constraints into our theoretical and empirical research on the Red Queen.

Our findings raise a fundamental problem for the theory of strategic management. Current thinking suggests that organizations are advantaged by being isolated from competition. In fact, this idea is so widely accepted that it practically defines the field of strategic management. Some scholars in the field speculate about how organizations can gain and maintain an isolated position that allows for market power. Others focus on how organizations can build inimitable abilities that assure them sole occupancy of a strategic position into the future. In light of the Red Queen, however, these prescriptions may be counterproductive. Organizations that achieve an isolated strategic position lose the Red Queen in the process, and so will be disadvantaged over time. There appears to be a fundamental contradiction between the benefits of strategic position and those of Red Queen, so that organizations that aspire for the former do so at the expense of the latter.

Our findings have similar implications for the management of strategic resources. It is widely thought that firms benefit if they can protect their strategic resources from imitation by rivals (Mahoney and Pandian, 1992). Strategic management, then, becomes centrally concerned with isolating these resources (Rumelt, 1984). This thinking changes entirely when the evolutionary source of capabilities is considered. If the development of resources depends on the ecological context of an organization, then isolation may be a disadvantage, as remaining unique today is traded off against developing new strategic resources for tomorrow.

The strategy field may also be able to use the Red Queen as a model of strategic interaction. Ordinarily, this topic is analyzed in strategic management by recourse to highly rational, game-theoretic models. Yet our model allows for strategic interaction among organizations even when top-level management are not aware of what has caused performance problems. In fact, even 'diffuse' competition from a population of unknown competitors can trigger this evolutionary process. In this light, Burgleman's (1994) study of Intel's 'bottom up' evolution is a glimpse of one step taken by the Red Queen in the modern semiconductor industry.

Our ideas and findings suggest that competition is an important cause of disequilibrium among organizations—in contrast to much current thinking about competition. Social scientists generally conceive of competition as a mechanism that moves organizational systems toward steady-state equilibrium (Stigler, 1968; Hannan and Freeman, 1989; Nelson, 1994).[5] Although theories differ in

[5] Disequilibrium arises from some classes of ecological models. In particular, competition among multiple populations often generates unstable dynamics (May, 1974), and when such systems do equilibrate, the process can take an extremely long time (Carroll and Harrison, 1994).

the particular processes involved, in general two opposing forces are thought to drive organizational populations to steady state. On the one hand, organizations are expected to conform to the behavior of their rivals. This is a central assumption in the neoclassical economic model where efficient forms of production diffuse throughout a market (Stigler, 1968). Similarly, sociologists argue that organizations respond to uncertainty by imitating other, usually competing, organizations (DiMaggio and Powell, 1983; Burt, 1987; Haveman, 1993; Miner and Haunschild, 1995; Greve, 1996). On the other hand, competition also is expected to limit such imitation, striking a balance that produces an equilibrium. Selection pressures place a ceiling on imitation, as larger numbers of imitators increase competition, increasing failure rates and reducing founding rates (Hannan and Freeman, 1989; Mezias and Lant, 1994). Also, as rivalry intensifies, some organizations try to adapt by differentiating (White, 1981; Carroll, 1985; Delacroix, Swaminathan, and Solt, 1989; Amburgey, Dacin, and Kelly, 1994)—at least to the extent permitted by market possibilities. Together, these forces are thought to push competitive systems to an equilibrium where the diffusion of strategies is balanced by selection and differentiation.

By contrast, Red Queen evolution depicts competition as a force that continually disturbs equilibrium. The difference hinges on whether organizations learn from competition. If competition triggers organizational learning, then change may be occurring even when aspects of market structure, such as numbers of organizations, are stable. Furthermore, if learning in turn intensifies competition, then the system is self-reinforcing—continually upsetting steady-state equilibrium rather than producing it. This means that hypotheses about Red Queen evolution cannot be usefully formulated as steady-state equilibrium predictions. Rather, we need to make predictions about the dynamics that arise among organizations involved in the Red Queen, as we do here.

Our paper demonstrates coevolution among organizations involved in an ecology of competition and learning (Baum and Singh, 1994). Additional work needs to investigate the particular processes involved in this evolution. For instance, do research efforts in one organization respond to—and cause—the research efforts in other organizations? Similarly, we could ask how cooperation affects the Red Queen, especially because many advocate cooperation as a mechanism to increase the rate at which organizations learn. For example, it would be interesting to know whether research and development consortia inadvertently harm the Red Queen by encouraging cooperation among competitors.

To conclude, we hope that this study demonstrates the potential pay-off from taking an evolutionary approach to the study of strategy and organizations. Many of the same questions that are asked in conventional strategic analysis can be asked from an evolutionary perspective as well. Our answers, however, are often radically different—in some cases directly contradictory to received understandings in the strategy field. Precisely for this reason, we think an evolutionary perspective is a useful tool to be used to understand the difficult but exciting problems of strategic change, and to question and, we hope, advance what we know about competitive advantage.

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