Journal of Economic Perspectives—Volume 16, Number 2—Spring 2002—Pages 23–46

Evolutionary Theorizing in Economics

Richard R. Nelson and Sidney G. Winter

Modern economic analysis, oriented toward understanding the workings of economies that make extensive use of markets, came into existence with three guiding questions, all central in Adam Smith's (1776 [1937]) *The Wealth of Nations.* One question concerned order. Without any central authority guiding and commanding action, how is economic activity coordinated? The second question was the challenge of explaining the prevailing constellation of prices, inputs and outputs. What explains the price of labor and the rent of land? The third question addressed the processes of economic progress, or development. Smith and other early economists clearly were impressed by the inventiveness, the energy and the growing productivity generated by the evolving market economy. How to understand its dynamics?

The first two questions have defined continuing central concerns of the discipline of economics since they first were posed over two centuries ago. When not posed in the context of an economy that is understood as in the process of developing, they seem to pull the focus of theorizing toward equilibrium conditions. The third question, concerned with the processes driving economic progress, pulls the theorizing toward an evolutionary orientation. The question of economic development has waxed and waned in centrality to the discipline, as has the importance of evolutionary theorizing.

During the first several decades of the twentieth century, evolutionary thinking and language was widespread in economics. But as one contrasts the economic

■ *Richard R. Nelson is George Blumenthal Professor of International and Public Affairs, Columbia University, New York, New York. Sidney G. Winter is Deloitte and Touche Professor of Management, Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania. Their e-mail addresses are ⟨rrn2@columbia.edu⟩ and ⟨winter@wharton.upenn.edu⟩, respectively.*

textbooks and journals from prior to World War II with after, it is clear that while economics before the war still contained many evolutionary strands and concepts, these seemed to vanish in the early postwar period. What happened?

The central factor, we believe, was the increasing fixation of neoclassical economic theory on equilibrium conditions (as contrasted with, for example, Alfred Marshall's considerable attention to economic dynamics) and the mathematical formulation of that theory (Hicks and Allen, 1934; Samuelson, 1947). It became the standard view that microeconomic theory was about equilibrium conditions. That theory treated questions about economic progress awkwardly and pushed them to the side.

A corollary of this shift was a subtle but important change in the connotations of "profit maximization." In earlier writings, the striving for profits was a standard assumption about business motivation, but mathematically stated theories interpreted it as true optimization with a sharply defined opportunity set. No longer was it legitimate to think of firms as gradually groping, innovating or evolving toward more profitable ways of doing things. Similarly, no longer was equilibrium treated in terms of where the economy was tending, but rather where it was actually located. Analysis of deviations from equilibrium was considered difficult and unconvincing, and such analysis tended to be repressed.

One consequence was that it became very difficult to theorize about competition as a dynamic process. The Schumpeterian notions of what competition was about in technologically dynamic industries, which captured the attention of many industrial organization economists in the early postwar era, had to be treated outside the context of mainline microeconomic theory (for example, see the treatment and references in Scherer, 1980). Another consequence was that when the attention of economists again turned to economic growth, the apparently natural way to formulate a growth theory was to build a simple dynamic into a neoclassical formulation, preserving the assumptions that firms correctly maximized profits and that the economy as a whole was in continuing (moving) equilibrium (Solow, 1956; 1957). This theoretical formulation was of course sharply at odds with the arguments of Joseph Schumpeter that capitalist economic growth had to be understood as a process involving disequilibrium in a fundamental way.

In recent years, evolutionary arguments have begun to come back into economics, at least around the fringes of the field. This change is partly the result of a growing awareness that standard neoclassical theory cannot deal adequately with the disequilibrium dynamics involved in the kind of competition one observes in industries like computers or pharmaceuticals or, more broadly, with the processes of economic growth driven by technological change. These topics again have come to the center of attention, and an evolutionary theory is a natural approach to them. In some degree, the return of evolutionary arguments results from new analytic tools that permit evolutionary theories to be determined with the rigor economists have come to require.

In this review, we seek to suggest the appeal of an evolutionary approach to economics. We begin by exploring what is different about an evolutionary theory. Some economists have proposed that, in fact, evolutionary arguments are subsumed by neoclassical conclusions about the characteristics of economic equilibria. In response, we argue that the situation here is more complex than many economists seem to believe and that an evolutionary theory differs in essential ways from contemporary neoclassical theory. Next, we review the behavioral foundations of the evolutionary approach, stressing its reliance on a cumulative learning-based view of organizational competence and its emphasis on the development of capabilities at the level of the broader society.

We then turn to two particular areas where, we think, the recent renaissance of evolutionary thinking has made a substantial contribution. One is focused on organizations, generally business firms, on the nature of the routines that guide their action, on how effective routines are developed and how they are changed over time. This strand of evolutionary thinking leads into a theory of competition among firms in industries where innovation is important and of firm and industry dynamics. The other strand focuses on the broader question of how better routines and more effective ways of doing things get created and spread. This thread of analysis leads into a theory of technological and institutional change and economic growth. In the concluding sections, we briefly discuss the evolutionary approach to formal modeling and the implications of evolutionary theorizing for interdisciplinary dialogue.

Evolutionary Processes and Neoclassical Outcomes

Many neoclassical economists seem to hold the view that an evolutionary theory of firm and industry behavior and a neoclassical one really amount to the same thing. In this, they follow a path Milton Friedman blazed in a famous essay on methodology. Friedman wrote (1953, p. 22):

> Let the apparent immediate determinant of business behavior be anything at all—habitual reaction, random chance or what not. Whenever this determinant happens to lead to behavior consistent with rational and informed maximization of returns, the business will prosper and acquire resources with which to expand; whenever it does not the business will tend to lose resources . . . . [G]iven natural selection, acceptance of the hypothesis [of maximization of returns] can be based largely on the assumption that it summarizes appropriately the conditions for survival.

As was noted by Koopmans (1957, p. 140), this statement leaves open the question of why one would prefer a theory that conflicts with the "apparent immediate determinant(s) of business behavior" if in fact it is possible to build a theory directly upon what appear to be the actual determinants of business behavior, the conditions for survival. But in practice, Friedman's argument has served as an instrumental myth, encouraging neoclassical theorists to get on with their business and discouraging the pursuit of any more unified approach to firm and industry behavior, evolutionary or otherwise.

Is it possible to support neoclassical predictions with process accounts constructed on evolutionary foundations? Yes, it is possible to specify a set of restrictive assumptions on the "neoclassical predictions" and the "evolutionary processes" so that the outcomes of the latter will match the neoclassical predictions (Winter, 1964, 1971; Nelson and Winter, 1982; Hodgson, 1994). Of course, this research program also offers counterexamples that illustrate what happens when certain restrictive assumptions are abandoned.

Before noting some of the specific assumptions that are necessary for evolutionary processes to support neoclassical outcomes, it is worth noting one broad concern about this entire enterprise. If the analysis concerns a hypothetical static economy, where the underlying economic problem is standing still, it is reasonable to ask whether the dynamics of an evolutionary selection process can solve it in the long run. But if the economy is undergoing continuing exogenous change, and particularly if it is changing in unanticipated ways, then there really is no "long run" in a substantive sense. Rather, the selection process is always in a transient phase, groping toward its temporary target. In that case, we should expect to find firm behavior always maladapted to its current environment and in characteristic ways—for example, out of date because of learning and adjustment lags, or "unstable" because of ongoing experimentation and trial-and-error learning. We argue that, in reality, the broader currents of historical change in the socioeconomic system are forever imposing exogenous change on the economic subsystem, posing new and unfamiliar problems to firms. To capture the phenomena characteristic of this reality requires a fully dynamic analysis.

However, let us assume for the sake of argument that the economic problem is static, in the sense that the evolution of business firm behavior constitutes the only systematically dynamic element. Then, one can pose the question of whether in the long run, the system approaches an equilibrium in which market level outcomes are the same as they would be if all firms were consistent profit maximizers. (Of course, firm-level outcomes will generally be different because some firms disappear by virtue of their failure to maximize.) Such an argument necessitates addressing four major considerations: variety, behavioral continuity, profit-induced growth and limited path dependence.

The problem of *variety* is that for the selection process to arrive at a neoclassical destination, the existing firms must represent a wide enough variety of strategies and actions that the profit-maximizing neoclassical behavior is represented—if only by accident. An argument that firms systematically fail to explore certain ranges of feasible action identifies a departure from the neoclassical standard that cannot be addressed by appeal to the selection argument. As Alchian (1950, p. 220) emphasized: "What really counts is the various actions actually tried, for it is from these that success is selected, not from some set of perfect actions." Hence also, evolutionary economists emphasize that a system promoting a variety of experimental solutions to economic problems may perform better than one in which the same imperfect rationality guides every firm.

The *behavioral continuity* assumption reflects the point that it does matter whether firm behavior arises from systematic and persistent causes or merely reflects "random chance or what not." Behavioral continuity might take the form of persistence in actions, in rules of action or something else (with differing specific implications). In general, if the winners of the competitive struggle at time t have nothing that commends them as strong contenders at $t + 1$, it is not helpful that the system rewards their earlier success by placing additional resources at their disposal.

As Friedman (1953) suggested, the natural selection argument is based on *profit-induced growth*; that is, successful firms earn profits and expand. But responses to profits are discretionary at the level of the firm. If the winners of the struggle at t will not accept a larger role at $t + 1$, rewarding their success contributes nothing toward improving the efficiency of the system. Further, this larger role must embody behavioral continuity with the sources of prior success; otherwise, again, nothing systematic is accomplished by conferring more resources on successful firms. For example, if successful firms are overly eager to diversify, forever undertaking new activities that they may not be good at, evolutionary progress is undercut.

The natural selection story also clearly contemplates that some firms may fail on the way to equilibrium; indeed, it requires the failure of the less efficient firms. But the story will not reach the desired conclusion if transient conditions eliminate the very firms needed to support the neoclassical equilibrium. Since both the challenges and the behavioral responses to out-of-equilibrium conditions may be quite different from those of equilibrium, this possibility can certainly arise. Thus, some additional assumption assuring *limited path dependence* is needed.

With the above checklist in view, it is not particularly hard to generate theorems detailing circumstances and senses in which evolutionary processes can support neoclassical predictions with respect to market outcomes and surviving firm actions in the long run. For example, to deal with the possibility of lack of sufficient variety of behavior and the concern that path dependence may cause the premature elimination of certain types before equilibrium is reached, one can assume continuing entry of firms with a variety of rules, so that the required variety exists indefinitely.

While it is not difficult to construct successful models with these kinds of assumptions, it is hard to derive from such results much confidence in the conclusions of neoclassical analysis of economic reality. To begin with, the accumulating evidence from behavioral decision research and other sources suggests that certain departures from rational decision norms may be very typical, calling into question the "variety" assumption (Tversky and Kahneman, 1974; Thaler, 1992; Schwartz, 1998).[1] Also, assuming constant entry raises the possibility of continuing entry of inefficient firms, which could disrupt the tendency to neoclassical equilibrium.[2] Moreover, assuming that entrants can display a wide range of high competencies is very dubious if one believes, as evolutionary economists tend to, that the achievement of high competence depends on sustained learning from experience.

In short, if evolutionary processes are to lead to neoclassical results, the list of conditions is demanding, the articulation of these conditions is often delicate and the reassuring implications are narrow at best.

We do not, however, consider the analysis summarized above simply as an effort to dispose of an error of overstatement. Instead, we follow the Koopmans (1957) suggestion and accept Friedman's (1953) defensive move as a valuable hint at a positive research agenda. Mainstream neoclassical conclusions about the virtues of market arrangements rest foursquare on the comprehensive rationality of individual agents. Neoclassical economics discovers social virtue in human selfishness, but not virtue that is robust against the human limitation of incompetence—and the possible role of the market process in achieving that robustness is not featured.[3] However, if the conditions just stated do tend to hold, they form a major piece of a persuasive account of how a market economy might be able to achieve impressive results in spite of limitations on the rationality of individual agents. Conversely, where the conditions do not hold, they might help to explain why the market economy may perform poorly.

In the context of such an affirmative research program, the meanings of the four conditions mutate significantly; they become topics for investigation, not theoretical assumptions. With regard to variety, for example, the question becomes whether enough variety is generated to accomplish the effective exploration of new technological and organizational territories. The postulate of behavioral continuity is a keystone of the evolutionary program because its general plausibility is supported by much organizational research. But the details matter a great deal; below we return to this subject and its connection to learning. The extent to which profits induce growth in a "more of the same" sense is a key empirical question from an evolutionary point of view, as is the issue of path dependence. How often does it happen that significant innovations arise before their time, are squelched by a hostile environment and then are lost or reappear only with great delay? Thus, all four of the conditions present significant issues for evolutionary analysis.

[1] For a striking application of behavioral decision research to economics involving the "optimism bias," see the experimental work on entry decisions by Dosi and Lovallo (1997) and Camerer and Lovallo (1999).

[2] There is a delicate analytical issue here; see Winter (1971) for one resolution.

[3] We take note here of two adjacent literatures. There is a significant theoretical and empirical literature on industry and firm dynamics with heterogeneous firms (exemplified by Jovanovic, 1982; Hopenhayn, 1992; Ericson and Pakes, 1995; Pakes and Ericson, 1998). This work is not concerned with "robustness against incompetence," nor with evolution considered as the unfolding of a fundamentally unknown future. By contrast, the evolutionary games literature is quite compatible with ours on the question of rationality and foresight, but mainly does not share the substantive focus on firms and industries. See Dosi and Winter (2002) for some comments on connections to the evolutionary games literature.

Competence, Learning and Routines

The positive program of evolutionary economics must be built on a view of economic behavior that is plausible in its own terms and has substantial specific content. The view of economic behavior that follows is rooted in our book, *An Evolutionary Theory of Economic Change* (Nelson and Winter, 1982), which in turn draws on many earlier sources. Over the past two decades, that basic view of the behavioral foundations of evolutionary theory has been supported, refined and extended by a variety of research contributions. In this section and the next, we frame the problem and then discuss how the basic behavioral continuity issue can be addressed in terms of skills, routines, learning and cognition.

We begin at a very impressionistic level with what we call the "competence puzzle." Mainstream economic theory typically sees rationality as undifferentiated, inhering in the actor at a uniformly high level and independent of the situation the actor confronts. The specific kind of rationality that economists usually build into their theories typically implies, or at least connotes, careful deliberation and attempted foresight. Real actors, however, simply do not have the vast computational and cognitive powers that are imputed to them by optimization-based theories. Organizational decision processes, in particular, often display features that seem to defy basic principles of rationality and sometimes border on the bizarre.[4] Yet all of us stake everything from our convenience to our lives on the ability of individuals and organizations to perform highly complex tasks—many of which could not be performed at all only a few decades ago. We do this on a daily basis, with very little thought or concern. Further, this faith is amply justified, at least if historical comparisons of technical performance and risk levels are relevant.

How can the same organizations be so impressively competent from one perspective and yet so strikingly "bounded" in their rationality? A serious account of the role that organizations play in society should acknowledge the reality of the competence puzzle and deal with it.

In the evolutionary view, the key to the puzzle lies in the contrasting demands of different types of situations. High competence is often achievable where skills and routines can be learned and perfected through practice. For individuals and organizations (not to speak of animals), learning guided by clear short-term feedback can be remarkably powerful, even in addressing complex challenges. But that sort of learning does little to enable sophisticated foresight, logically structured deliberation and/or the improvisation of novel action patterns—and situations that demand these are rarely handled well. Further, competence must always be assessed against the background of historically evolving competitive standards. Standards change; mostly, they rise. Observers tend to see an organization as highly

[4] In our experience, few economists are comfortable with the suggestion that the workings of their own academic departments or universities might illustrate *typical* characteristics of organizational decision making; they prefer to think that the locally available data in their nonprofit employers are somehow special or anomalous. Organizational research does not, on the whole, support them in that view.

competent when the comparison is against the standards of the past or in contexts where competition is weak. By contrast, strong and up-to-date rivals highlight the "bounded rationality" of the focal organization. Thus, the evolutionary response to the competence puzzle focuses on the role of learning and practice and specifically on the degree of correspondence between the current challenge and the earlier contexts in which experience trained the actors.

This approach treats organizational and individual competence in similar terms; we treat *organizational routine* as the organizational analogue of individual skill. When rich and relevant information is available to guide action, organizations often find routinized ways of exploiting it. The ice cream shop does not, after all, yield to its cognitive limitations and follow the simple rule of stocking only vanilla. In ice cream shops and elsewhere, technical and organizational innovations have supported remarkable increases in the product variety that is handled routinely. In this sense, evolutionary economics explains how behavior can be complex and effective by pointing out that it is routinized.[5]

The concept of routines has multiple virtues as a foundation for evolutionary economics. As just noted, routines provide a focal point for a learning-based answer to the competence puzzle.[6] Most fundamentally, routines are the basis of the characterization of behavioral continuity in our evolutionary theory: "routines as genes" is the catch phrase. Nelson and Winter (1982, p. 134) write: "As a first approximation, therefore, firms may be expected to behave in the future according to the routines they have employed in the past."[7]

Of course, routines persist for a variety of reasons, including an irrational resistance to change. But there are two reasons that are rational in a broad sense and also conceptually significant. The first relates to the problem of storing and accessing knowledge. The common neoclassical economic assumption is that all techniques along a production function are equally and costlessly accessible today, regardless of whether or when they have been practiced. Realistically, however, learning or relearning routines has costs, which rise as the behavior leaves the domain of recent practice—and this supports the tendency to adhere to prevailing routines. Second, since every organization is a coalition of sorts, routines almost necessarily include ways of coping with the occasions for conflict within an organization, whether between managers and shareholders, or managers and workers, or managers and managers. Departures from established routines provoke height-

[5] This argument about routines is subtly different than the claim, which advocates of a more behavioral approach to economics often make, that real actors follow "simple rules" rather than performing the complex calculations imputed to them by economic theory. This idea contains much truth, but it relates primarily to handling uncertainty about the future and other domains where rich short-term feedback is not available. It is also true that a routine can be "simple" relative to an infeasibly large optimization calculation, while being far too complex by practical standards to be called a "simple rule."

[6] When an organization's "routines" include higher-order routines that govern learning itself, the evolution of behavior at the level of the organization becomes a complex matter in which the structure of the problems faced, the structure of the organization and the historical path of the system are all intertwined.

[7] For an extended discussion of the successive approximations, see Winter (1986).

ened anxieties and often involve heightened stakes; conflict therefore tends to be more intense—a contrast often noted in the context of labor-management struggles over organizing a union as compared to renewal of a union contract. Because conflict tends to be costly to all participants, there is reason to avoid it by sticking with established routines.

While a few business firms, and other formal organizations, are very long lived, analysis of economic development almost always is concerned with much longer time periods than the life of particular organizations and also has a much broader institutional scope. Yet the competence puzzle is there, perhaps in even more striking form, when the question is about the determinants of long-run economic development. The heart of the economic development puzzle is how the enormously powerful technologies, and effective modes of organization, that characterize advanced modern economies could have come about, given the cognitive limits of individual men and women, and organizations. Actually, Mandeville (1705 [1924]) asked this question almost three hundred years ago as he reflected on the mighty warships of his day, and his answer is in the spirit of modern economic evolutionary theory: it was the work of many minds operating over many generations.

The general account we have given of how individual skills, organizational routines, advanced technologies and modern institutions come into being has stressed trial-and-error cumulative learning, partly by individuals, partly by organizations, partly by society as a whole. We do not deny the vital role played in the progress of all these variables by the body of knowledge—in modern days often scientific knowledge—that humankind has accumulated, that directs its problem solving and makes those efforts powerful. But then one can ask the same question about the origins of that powerful body of knowledge: how did humans of such bounded rationality manage to do that? Again, the answer we evolutionary theorists would give is that it evolved.

Behavioral Continuity: Foundational Issues

In contrast to the usual quest for micro-foundations in economics, seeking consistency with rationality assumptions, our quest is for consistency with the available evidence on learning and behavior at both the individual and organizational levels.

With respect to individual learning, the plausibility of our behavioral foundations for evolutionary economics has received support from an unexpected quarter. Studies linking cognitive abilities and brain physiology have established the existence of anatomically distinct memory processes supporting the skilled behavior of individuals. Skill memory is acquired through practice, activated by the attempt to perform and not accessible to consciousness in terms of its specific content.[8] It tends to be highly durable and functions in some ways that are alien to theories of calculative rationality.

In an intriguing experimental study, Cohen and Bacdayan (1994) demonstrated connections between the characteristics of skill memory at the individual level and some widely noted phenomena associated with organizational routines. In their study, subjects used playing cards in a two-person cooperative game of moderate complexity. The objective of each team was to manipulate the cards into a specified goal configuration in the minimum possible time. As subjects played the game repeatedly, they became more and more efficient at recognizing the needed moves and making them quickly. In one variant of the experiment, the experimenters then confronted such experienced teams with a modified game in which the roles of the red and black playing cards were interchanged—with otherwise identical rules. Theorizing based on rationality certainly suggests that interchanging the card colors should have little effect, since the new game is a simple isomorphism of the one already learned. However, as often happens in much larger organizations, the subject teams had difficulty with this seemingly minor adjustment of their prevailing routines. The consequence of interchanging the roles of red and black cards was an initial efficiency decline on the order of 25 percent; one pair had failed to progress much toward its previous efficiency after 40 more plays. This result has many counterparts in the literature on transfer of learning: a close logical connection between a learned task and a newly presented task does not necessarily indicate a potential for easy transfer.[9]

These and many related results suggest that the micro-foundations of our routine-based perspective do reflect the realities of human physiology and cognitive functioning. At the least, this is true for routines that involve a substantial amount of skilled behavior at the individual level. However, other aspects of behavioral continuity perhaps do not derive from the same sources. In particular, continuity derives from sustained commitments to organizational strategies and heuristics that presumably involve higher-level cognitive processes in the individuals involved.[10] In a still broader context, cognitive frameworks and paradigms are known as a source of long-lasting influence and continuity for both scientific disciplines and industrial technologies (Kuhn, 1970; Dosi, 1982).

Recent work by Tripsas and Gavetti (2000) provides a striking illustration of

[8] "Skill memory" is also sometimes known as "procedural memory" or "nondeclarative memory." See Squire (1987) for a discussion of the substantive distinctions and the relevant terminology. Skill memory can also be usefully compared with what Polanyi (1964) discussed as "tacit knowledge."

[9] Empirical evidence on routines and related organizational knowledge issues is gradually accumulating; it is quite diverse in type and source. Space does not permit a review of this literature. We mention here some studies that substantially share our theoretical perspective: Helfat (1994), Usselman (1993), Zander and Kogut (1995), Narduzzo, Rocco and Warglien (2000), Szulanski (2000); the latter two are among several relevant studies presented in Dosi, Nelson and Winter (2000).

[10] We say "perhaps" and "presumably" here because, so far as we are aware, the extent to which there are underlying physiological mechanisms linking skill memory and other cognitive functions remains unknown.

the impact of inherited strategies. They studied the processes that led Polaroid to stumble in its attempted transition to digital imaging. Beginning in the early 1980s, Polaroid's management made digital imaging technologies a strategic priority, shifted the composition of its technical personnel and invested substantially in research and development. Polaroid developed superior sensor technology and had a prototype digital camera by 1992. However, Polaroid didn't get a digital camera to market until 1996 and seems to have mishandled the marketing and distribution. By the late 1990s, Polaroid had dropped the digital camera and divested the digital imaging system it had developed for the medical diagnostics market.

Tripsas and Gavetti (2000) document the key role played in this story by the "razor/razor blades business model." In the past, Polaroid had sold cameras cheaply to promote the highly profitable film. The (simple) idea that you don't make money on the camera turned out to have a tighter grip on the company than the (complex) chemical film technology. As a result, Polaroid passed up the opportunity to hasten its digital camera to market while it sought alternatives compatible with its traditional business model. This was not a matter of mindless, automatic response, but of systematically flawed calculation.

The literatures of management and business history report numerous similar episodes, though few so carefully documented as this one. For example, a number of commentators have noted the paradoxical fact that IBM—the leading information technology company in the world—was strategically blindsided in the early 1990s by the emerging implications of a by then familiar technology, the microprocessor (for example, Fransman, 1994).

The idea that the habits of management thought channel strategic choices is not a radical new discovery of the evolutionist camp. The challenge, however, is to build a theoretical structure that is capable of making effective use of that insight, exploiting this aspect of behavioral continuity for purposes of explanation and prediction in specific cases. We believe that evolutionary theory provides an accommodating framework for such an effort, though most of the actual work remains to be done.

Evolutionary Analysis of Schumpeterian Competition

Even as modern neoclassical theory took a firm grip on abstract economic thinking, it was clear to many empirically oriented scholars of industrial economics that this theoretical formulation could not come to grips with the nature of competition they saw in a number of industries where technological innovation was important. Schumpeter's (1950) complaint says it very well:

> But in the capitalist reality as distinguished from its textbook picture, it is not that kind of [price] competition which counts, but the competition from the new commodity, the new technology . . . . This kind of competition is as much

> more effective than the other as bombardment is in comparison with forcing a door.

Scholars working in or near the evolutionary tradition have given considerable attention to these Schumpeterian themes. Indeed, one major area of application of evolutionary thinking has been the dynamic analysis of economic change at the organization and the industry level, particularly in contexts where innovative performance is a key element in the competitive struggle. This central problem is simultaneously about the returns to innovation, the sustainability of competition, the role of entrepreneurial start-ups, the distribution of firm size, the determinants of market structure and many other questions. These topics play to the strengths of the evolutionary approach, both in their emphasis on learning and because they abjure imputing rational foresight to actors who are encountering historical novelties.

In our 1982 book, we explored several different questions about Schumpeterian competition. In the model presented there, the organized research and development efforts of firms are the source of innovation. There are lags before an innovation can be imitated in the model, but no patent protection. Large firms tended to spend more on R&D than did smaller firms. Successful innovation tended to enhance the profitability of a firm, in an absolute amount proportional to its scale, and thus to lead to that firm's growing larger and to spending more on R&D.

A central question regarding Schumpeterian competition is whether, through mechanisms like these, competition has a tendency to self-destruct and give way to long-lasting monopolies. In our models, such a tendency did exist. However, it was checked by some opposing tendencies, including in particular one that depended on the sources of technological change.

When the ultimate dynamic for change comes from outside the industry, as in the case where change comes from the external development of science, or innovations by equipment suppliers, the function of R&D within the industry is essentially to identify new opportunities and to adapt and to commercialize them. In such a technological regime, which we called "science based," the fact that a firm has been a successful innovator today does not necessarily position it favorably to seize the important opportunities that will be presented tomorrow. In the contrasting case, technological change is "cumulative" at the firm level in the sense that efforts to advance technology today build from what the firm achieved yesterday. In our early simulation studies, the tendency for a dominant firm to emerge and continue to dominate was enhanced when technological advance was cumulative. In this case, firms that are behind have little chance to leapfrog the leader. On the other hand, in the science-based regime, a smaller firm would sometimes seize a new technological possibility before its larger rival, beating the unfavorable odds imposed by the size discrepancy, and ultimately catch up both in size and R&D spending.

In recent years, an originally quite separate strand of evolutionary economic analysis has come to join the one just described. This body of research explores the historical evolution of industries, often by looking at the co-evolution of technology and industry structure, with a focus on whether a natural industry "life cycle" exists.[11] The industry life cycle hypothesis was originally put forth by James Utterback and William Abernathy (1975; see also Abernathy and Utterback, 1978) in a history of the American automobile industry. Their underlying theoretical story goes this way. When a technology is new, there is uncertainty both about how the technology can improve and about what the customers really want. Both kinds of uncertainty make it hard to say which paths of development would be successful in meeting the needs better. Different inventors and firms lay their bets in different ways. New innovators and firms keep entering the industry, trying new things, and innovators and companies that have tried and failed go broke and leave. With time and accumulated efforts, one pathway or a set of pathways turns out to be effective, and the products of the new technology begin to attract a significant market. A "dominant design" gradually emerges. Firms whose products exemplify that dominant design do well, and firms that are producing something else either have to switch over, which is not easy to do, or they fail. With product design more stabilized, it becomes profitable for research and development to focus on process innovation. More firms in the business tend to become increasingly skillful, and potential entrants are increasingly at a visible disadvantage. Entry slows down, while exit remains at high levels for a while. The number of firms in the industry diminishes, sometimes sharply, even as output growth accelerates. Typically, a relatively small number of large firms come to dominate the scene.

While this account of the industry life cycle is clearly not universally applicable, the validity of its principal generalizations has been documented for a number of industries.[12] Recent work by Steven Klepper and various collaborators has mapped the general phenomenon (Klepper and Graddy, 1990; Klepper, 1997), elaborated the theoretical logic (Klepper, 1996) and demonstrated its relevance for tires (Klepper and Simons, 2000a), television sets (Klepper and Simons, 2000b) and other industries.[13] The recent volume edited by Mowery and Nelson (1999) contains a number of detailed industry histories and explores, among other matters, the extent to which the industry life cycle seems to fit. It does in several of the industries studied.

Recently, Klepper has focused on the backgrounds of the entrants in various industries (Klepper and Sleeper, 2000), strongly confirming the role of various forms of prior exposure to the knowledge base relevant to the industry (Winter,

[11] One of the problems with this literature is that the level of analysis is sometimes unclear. Sometimes the analysis seems to shift among an industry life cycle, a product life cycle or a technology life cycle. This fuzziness may reflect, in part, the fact that similar mechanisms are operating at different levels and on different time scales.

[12] Lasers are one example of a technology that does not display the typical patterns, probably because of the fragmentation of the market for applications.

[13] While Klepper's theoretical view is close to our own, his account of firm behavior in the short run is more in terms of myopic profit maximization than of observed behavioral regularities.

1984). Not all entrants bring such knowledge advantages with them, but those who do not tend to be at a disadvantage.

This account of the industry life cycle provides a useful and important perspective on the points about variety and path dependence raised earlier. Variety tends to be at a maximum in the early stages of an industry's history, when major issues of technology and design remain unresolved. The move toward a dominant design exemplifies economic natural selection at work—destroying variety. Industry dynamics include self-reinforcing mechanisms that create path dependence, making it impossible for the system to return to earlier branch points and "reconsider." Thus, an important part of the evolutionary testing of firm behaviors by the marketplace is compressed into the early design stages of industry evolution. In a mature industry, the evolutionary process may not have much variety to work with.

Of course, the "life cycle" of an industry is not an inexorable process of aging. Renewal may come on the winds of the "perennial gale of creative destruction" that Schumpeter celebrated. If the leaders cannot be challenged on the ground of the cumulative technology they have built, more fundamental challenges may arise to upend them, coming from outside the industry. Such episodes provide illustrations of the logic of our science-based case; developments exogenous to the focal industry have endowed some entrants with new competitive weapons that the incumbents do not possess.

The technology and management literatures have given a lot of attention to struggles between new firms and incumbents. A number of relevant causal factors have been identified and persuasively argued to be critical in particular cases. Incumbents are said to be more at risk when innovative change affects the "architecture" of the system, as opposed to its "components" (Henderson and Clark, 1990). Paralleling our distinction between the "science-based" and "cumulative" cases, it has been argued that incumbents are not likely to be threatened when new technology is "competence enhancing"—drawing on the skills and capabilities developed previously—but they are when it is "competence destroying" (Tushman and Anderson, 1986). When incumbents control key specialized assets that are complementary to the new technology, they may be able to make advantageous deals to access the technology or, at least, to gain time to build their own capabilities (Teece, 1986; Tripsas, 1997; Henderson, Orsenigo and Pisano, 1999). Incumbents who focus too narrowly on prevailing applications of a basic technology may leave niches open in which entrants can extend the technology and ultimately mount a broader threat (Christensen and Rosenbloom, 1995; Christensen and Bower, 1996; Christensen, 1997).

All of these studies are compatible with and illustrative of the evolutionary perspective. None display a logic in which foresight plays a key role; in some, the weakness of foresight is a featured consideration. All take for granted strong elements of continuity in firm behavior, so that a firm's fate is determined in the first approximation by how the environment rewards its heritage of routines, and only in the second approximation do abilities to adapt and to change enter the story.

The theory, the empirics and the reality of Schumpeterian competition have all evolved over the years. In his earlier work, specifically, *The Theory of Economic Development,* Schumpeter (1911 [1934]) emphasizes the role of individual entrepreneurs and new firms. His later work *Capitalism, Socialism, and Democracy* (Schumpeter, 1950) says that innovation has been "routinized" and now comes from the R&D laboratories of the large corporations. Schumpeter's two views of the role of entrants provided the basis for an extension of the science-based/cumulative contrast into the notion that industries differ in their "technological regimes"—broadly, the conditions affecting the availability and advance of relevant knowledge (Winter, 1984). Several authors have employed this concept in trying to account empirically for the way innovative entry varies in importance across industries (for example, Malerba and Orsenigo, 1990; Breschi, Malerba and Orsenigo, 2000; Marsili, 2001; Shane, 2001). In the quarter century after World War II, most readers of Schumpeter, ourselves included, believed that the regime supporting the large corporate R&D lab was the modern regime, while the individual entrepreneur with a new firm was largely a thing of the past. The history of the last few decades clearly indicates that that judgment was premature. Today, a number of industries are experiencing rapid technological advance where entrepreneurial start-ups whose innovations are based largely on the work of one or a few individuals play a prominent role and offer significant competitive threats to larger firms. In many of these cases, the technology tends to be science based.

The analysis of science-based regimes involves a number of interesting questions, including the linked issues of the vertical scope of entrants and the possible recombination of capabilities through mergers and acquisition. The early history of biotech—the quintessential "science-based" case, but also a quintessential "complementary assets" case—is now available as a vivid illustration of how these various themes can play out. This case has attracted the sustained attention of a number of authors, who analyze it from an evolutionary perspective (Orsenigo, 1995; McKelvey, 1996; Henderson, Orsenigo and Pisano, 1999).

Technology, Institutions and Economic Growth

We have highlighted above one of the important strands of research that evolutionary economic theory strongly influenced: that concerned with understanding the behavior of business firms, and their capabilities and limits for adaptation, in an environment of change. A second important strand has been concerned with understanding technological advance and economic growth largely driven by advances in technology.

While most of the literature we have considered in earlier sections has been focused on business practice, the literatures we describe here are very much concerned with the advance of the broader bodies of knowledge that constrain practice, as well as practice itself. New technologies appear and develop not only in the context of business firms seeking new routines, but also in other contexts, such as universities, government labs and professional societies. Pursuing the causal explanation of technological change into these contexts, we find processes that are again "evolutionary"—but in a broader sense than is suggested by our "routines as genes" analysis of market competition and industrial dynamics. This section discusses these broader aspects of economic evolution.

The 1960s were marked by the rekindling of interest in the processes of technological advance, largely as a result of a series of empirical studies that had concluded that technological advance was the key driving force behind economic growth (Schmookler, 1952; Abramovitz, 1956; Solow, 1957). The economists (and other scholars) who were studying particular inventions or technologies soon became impressed by several apparently quite general features. First, very considerable uncertainties were involved in trying to achieve a significant advance over prevailing technology, and the relevant perceptions of these risks could be highly idiosyncratic. The range of alternatives considered was very much a function of the particular backgrounds and perceptions of those contemplating the task and so also the perceived promise of pathways that were actively attended. Second, differences of opinion and insight among experts in a field were widespread. These differences generally were manifest in the presence of a variety of different efforts being made by different parties at any time, in competition with each other and with prevailing technology. Third, the winners and losers were determined in competition that often occurred after substantial resource commitments to the contestants had been made. These features, together, naturally suggested evolutionary language and led to the development of explicit evolutionary theories of technological advance.

The proposal that technological advance proceeds through an evolutionary process seems to have been advanced, or rediscovered, independently by several scholars in several different disciplines. The two of us articulated that proposition in our first articles on evolutionary theory in the mid-1970s (Nelson and Winter, 1973, 1974, 1977). But by that time, Edwin Mansfield also had recognized the characteristics we described above and was working with an implicit, if not an explicit, evolutionary theory (for example, Mansfield, 1968, 1971). So were Christopher Freeman and his colleagues at the Science Policy Research Unit (SPRU) (for example, Freeman, 1974). Keith Pavitt's (1999) recent book reflects the subsequent development of evolutionary thinking at SPRU (see also Dosi and Freeman, 1988). Nathan Rosenberg's (1976) writings on the economics of technological advance had a strong evolutionary flavor. Several historians of technological advance also came up with similar theoretical arguments (for example, Constant, 1980; Basalla, 1988; Mokyr, 1990; Vincenti, 1990; Petroski, 1992). With a somewhat different orientation, sociologists studying technological advance also have taken an evolutionary perspective.

We want to highlight three features of this general body of understanding here. The first feature is what one might call "the co-evolution of technology and industry structure." The other side of the process of different "technological bets" competing against each other is the story of different firms competing against each other. A number of studies of industries in which technological innovation is an important vehicle of competition are basically stories of the playing out of this co-evolutionary process (for example, Dosi, 1984; Malerba, 1985; Orsenigo, 1995; Mowery and Nelson, 1999; Bottazzi et al., 2001). Still other aspects of this co-evolution were discussed in the preceding section, in particular, the tendency for entry to diminish and the industry to concentrate as a specific technology matures.

Second, these studies reveal that technology must be understood as involving both a body of artifacts, or practice, and a body of understanding. Some authors have concentrated on just one of these aspects. Thus, Petroski's (1992) exploration of *The Evolution of Useful Things* is concerned with artifacts, while Constant's (1980) focus in *The Origins of the Turbojet Revolution* is on the broad body of design understanding. But more generally, artifacts, practice and understanding co-evolve. Efforts to advance practice are informed by an often impressive body of understanding, often scientific understanding. Nevertheless, the process of inventing or designing is still to some extent "blind," because efforts to invent something new almost invariably reach well beyond what is known with certainty. Thus, despite the often strong knowledge base for advancing technology, the process remains evolutionary. Over time, practice and understanding tend to advance together.

Third, scholars of technological advance have come to recognize the range of institutions that are involved. Economists have tended to stress the role of business firms. But other scholars have highlighted the role of university research in many fields, and increasingly, economists have been looking at universities (Rosenberg and Nelson, 1994). In many cases, government programs are involved. Recently, a considerable literature has grown up describing "innovation systems," which contain different kinds of institutional actors. Economists have written on innovation systems characterized at the level of a nation (Freeman, 1988; Lundvall, 1992; Nelson, 1993), an industry (Mowery and Nelson, 1999) or a technology (Carlsson, 1995).

This latter strand of research and writing has been closely associated with the developing evolutionary analysis of economic institutions (Langlois, 1986; North, 1990; Nelson, 1998; Hodgson, 1999; Nelson and Sampat, 2001). Evolutionary, institutional and sociological perspectives converge in the view that individual and organizational behavior tends to be governed by engrained, taken-for-granted patterns—what we call routines. Increasingly, economists studying institutions are coming around (returning) to the notion that institutions evolve.

Formal Economic Evolutionary Modeling

A considerable development of formal evolutionary models has run parallel to the body of empirical work oriented by evolutionary thinking described above. While it is not practical here to describe these in detail, it is worth noting the characteristics that differentiate them from formal neoclassical models.

First, formal evolutionary models assume "bounded" rationality, at least in the sense that actors are not assumed to have accurate foresight (even probabilistically). At one extreme, the actors simply have a set of routines that determine their actions that they stick to through thick or thin. Over time, competition winnows out many of the actors from the ones that survive having routines that cope best with the environment. Other evolutionary models treat the actors as operating with a particular set of routines "in the short run," but as having mechanisms that enable them to improve routines or to learn about significantly better ones as time elapses and they gain experience. In any case, the actors are not modeled as having the capability to "see through" the context in which they are imbedded with sufficient clarity to be able to determine the best thing to be doing or to understand the causal structure of their experience. Indeed, most of the economic evolutionary models are sufficiently complicated so that the modeler or anyone else would have great difficulty in deducing optimizing strategies for all the actors. It is a basic premise of economic evolutionary theory that this state of affairs accurately reflects the problem facing real-world economic actors.

Second, these models generally take the form of dynamic equations that determine the time paths of firm characteristics and actions taken, as well as the consequences of those actions. Many of them take the form of random walk (Markov) processes, in high-dimensional state spaces, and often with some time-varying parameters. Solution paths may include a steady state or a set of them. But the commitment to the underlying behavioral assumptions—as appropriate to the problem—does not depend on the achievement of a steady state. The modelers typically sought to analyze behavior and phenomena under out-of-equilibrium conditions.

The models that have been developed fall roughly into two classes. Some are designed to explore the time paths generated by particular model specifications and the difference made by varying particular assumptions or parameter values. Other models have been designed to explain, or to explore theories about, particular empirical phenomena.

Some examples of exploring model specifications are the evolutionary economists who have explored economic variants of R.A. Fisher's "Fundamental Theorem of Natural Selection," to the effect that the rate of growth of average "fitness" (profitability) in an industry or a firm is proportional at each point of time to the share-weighted variance of profitability (Nelson and Winter, 1982; Metcalfe, 1998). Others have considered the effects of cumulative learning by experience in an evolutionary model (Silverberg, Dosi and Orsenigo, 1988; Chiaromonte and Dosi, 1993) or explored how the requirement that new technology needs to be embodied in new capital affects the pattern of output growth (Silverberg and Lehnert, 1993). Issues of path dependence and "lock-in" have been explored and modeled by various authors, including Kwasnicki (1996) and Saviotti (1996), following in the footsteps of Arthur (1989). While the particular aspects being studied are different, in all of these models, the orientation is quite abstract, with the objective to illuminate how a particular subprocess or aspect influences the course of an economic evolutionary process.

An early example of an evolutionary model targeted a specific empirical phenomena: our own effort dedicated to demonstrating that a formal evolutionary model could generate, at least qualitatively, the time paths of aggregate output, inputs, factor prices and measured "total factor productivity" that had been the subject of the standard growth accounting explanations—explanations that implicitly or explicitly assumed that the economic growth process was characterized by a moving competitive equilibrium (Nelson and Winter, 1974). In a similar spirit, Gunnar Eliasson and colleagues have developed a very detailed micro-macro model of the Swedish economy, which aims to "explain" (and partially succeeds in doing so) a variety of observed patterns at both the macro and micro levels (Eliasson, 1985). Andersen (1994) extends and explores the early simulation models of Schumpeterian competition. Recently, Malerba et al. (1999) developed an evolutionary model that aimed to capture key mechanisms governing the evolution of the U.S. computer industry and, thus, to explain the course of industry history.

Evolutionary economists have made substantial use of computer simulation for stating and investigating their models. We consider such models "formal" in the sense that the logic is fully explicit and on display—and have listed simulation as well as analytical models in the discussion above. The uses and limitations of computer simulation is a large subject, worthy of an essay itself. But among the relatively noncontroversial claims, we trust, is that a simulation model can provide an "existence proof" for the ability of a certain sort of dynamical system to produce results of a characteristic kind. That is precisely the nature of the exercise in the economic growth model described above and of several models that focus on the size distribution of firms.

Closely related to the evolutionary modeling efforts just described is a class of formal models at the level of the individual organization, typically focusing on related issues of structure, coordination and organizational learning. A major theme of these efforts is the functioning of behaviorally plausible "local search" mechanisms for problems where multiple nonlinear interactions create a multiplicity of local optima (for example, Margeno, 1992; Levinthal, 1997; Gavetti and Levinthal, 2000; Marengo et al., 2000).

Evolutionary Economics and Interdisciplinary Discourse

As the economics discipline deepened its commitment to the proposition that economic actors are rational in the sense of true optimization, an intellectual gulf appeared that separated economics from its sibling social sciences. Outside of the territories "colonized" by economics with the tools of rational choice theory, social scientists tend to be skeptical about the rationality of human action. One characteristic of the new evolutionary economics is that it provides a bridge across the gap. The particular intellectual barriers attributable to differing rationality assumptions are lowered significantly (although many other barriers remain). As a result, one sees considerable interdisciplinary interaction in the areas where evolutionary economics has taken hold.

The view of firm behavior built into evolutionary economic theory fits well with the view of firms contained in modern organization theory, especially the part that shares our own debt to the "Carnegie school" (March and Simon, 1958; Cyert and March, 1992). The emphasis on the accumulation of firm-specific capabilities has appealed to business historians as a useful way to frame detailed historical analysis of the competitive process (Chandler, 1992; Usselman, 1993; Raff, 2000). Similarly, much research and writing in the field of business strategy feature distinctive capabilities as the basis of competitive advantage and "dynamic capabilities" as the key to lasting success in a rapidly changing economy (Teece, Pisano and Shuen, 1997). Indeed, the citations to our 1982 book suggest that the evolutionary approach has had broad appeal to a wide range of scholars from a variety of different disciplines working on business organization and strategy.

We noted earlier that scholars in several different disciplines have come to the proposition that technological advance needs to be understood as an evolutionary process. Recently, John Ziman (2000) published a book of essays by scholars from several different disciplines on *Technological Innovation as an Evolutionary Process.* The concept of "innovation systems" also has broad cross-disciplinary appeal.

More generally, evolutionary economics offers great advantages in areas where interdisciplinary dialogue is needed for progress. As stressed above, this is primarily because the evolutionary view of firm and organizational behavior, which stresses the bounds on rationality, is broadly consistent with prevailing views of firm behavior outside economics. Evolutionary economics therefore has open frontiers, lives with other disciplines in what is recognizably the same intellectual world and has much to offer and to gain from trade.

■ *We are indebted to Brad De Long, Giovanni Dosi, Timothy Taylor and Michael Waldman for extremely helpful comments and editorial suggestion; more than the usual absolution is granted. We also acknowledge research support from the Reginald H. Jones Center of the Wharton School.*

References

Abernathy, William J. and James M. Utterback. 1978. "Patterns of Innovation in Technology." *Technology Review.* 80:7, pp. 41–47.

Abramovitz, Moses. 1956. "Resource and Output Trends in the United States Since 1870." *American Economic Review.* May, 46, pp. 5–23.

Alchian, Armen. 1950. "Uncertainty, Evolution and Economic Theory." *Journal of Political Economy.* 58:3, pp. 211–22.

Andersen, Esben S. 1994. *Evolutionary Economics: Post-Schumpeterian Contributions.* London: Pinter.

Arthur, W. Brian. 1989. "Competing Technologies, Increasing Returns, and Lock-In by Historical Events." *Economic Journal.* March, 99:394, pp. 116–31.

Basalla, George. 1988. *The Evolution of Technology.* Cambridge: Cambridge University Press.

Bottazzi, Giulo et al. 2001. "Innovation and Corporate Growth in the Evolution of the Drug Industry." *International Journal of Industrial Organization.* July, 19:7, pp. 1161–187.

Breschi, Stefano, Franco Malerba and Luigi Orsenigo. 2000. "Technological Regimes and Schumpeterian Patterns of Innovation." *Economic Journal.* April, 110:463, pp. 388–410.

Camerer, Colin and Dan Lovallo. 1999. "Overconfidence and Excess Entry: An Experimental Approach." *American Economic Review.* 89:1, pp. 306–18.

Carlsson, Bo, ed. 1995. *Technological Systems and Economic Performance: The Case of Factory Automation.* Dordrecht: Kluwer Academic Publishers.

Chandler, Alfred D. 1992. "Organizational Capabilities and the Economic History of the Industrial Enterprise." *Journal of Economic Perspectives.* Summer, 6:3, pp. 79–100.

Chiaromonte, Francesca and Giovanni Dosi. 1993. "Heterogeneity, Competition and Macroeconomic Dynamics." *Structural Change and Economic Dynamics.* June, 4:1, pp. 39–63.

Christensen, Clayton M. 1997. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail.* Boston: Harvard Business School Press.

Christensen, Clayton M. and Joseph L. Bower. 1996. "Customer Power, Strategic Investment and the Failure of Leading Firms." *Strategic Management Journal.* 17:3, pp. 197–218.

Christensen, Clayton M. and Richard S. Rosenbloom. 1995. "Explaining the Attacker's Advantage: Technological Paradigms, Organizational Dynamics, and the Value Network." *Research Policy.* 24:2, pp. 233–57.

Coase, Ronald. 1960. "The Problem of Social Cost." *Journal of Law and Economics.* October, 3, pp. 1–44.

Cohen, Michael and Paul Bacdayan. 1994. "Organizational Routines are Stored as Procedural Memory." *Organization Science.* 5:4, pp. 554–68.

Constant, Edward W. 1980. *The Origins of the Turbojet Revolution.* Baltimore: Johns Hopkins University Press.

Cyert, Richard M. and James G. March. 1992. *A Behavioral Theory of the Firm.* Malden, Mass.: Blackwell.

Demsetz, Harold. 1967. "Towards a Theory of Property Rights." *American Economic Review.* 57: 347, pp. 347–59.

Dosi, Giovanni. 1982. "Technological Paradigms and Technological Trajectories." *Research Policy.* 11:3, pp. 147–62.

Dosi, Giovanni. 1984. *Technical Change and Industrial Transformation: The Theory and an Application to the Semiconductor Industry.* New York: St. Martin's Press.

Dosi, Giovanni and C. Freeman, eds. 1988. *Technical Change and Economic Theory.* London: Pinter.

Dosi, Giovanni and Dan Lovallo. 1997. "Rational Entrepreneurs or Optimistic Martyrs? Some Considerations on Technological Regimes, Corporate Entries, and the Evolutionary Role of Decision Biases," in *Technological Innovation: Oversights and Foresights.* R. Garud, P. R. Nayyar and Z. B. Shapira, eds. Cambridge, U.K.: Cambridge University Press, pp. 41–70.

Dosi, Giovanni and Sidney G. Winter. 2002. "Interpreting Economic Change: Evolution, Structures and Games," in *The Economics of Choice, Change and Organizations: Essays in Memory of Richard M. Cyert.* M. Augier and J. March, eds. Cheltenham, U.K.: Edward Elgar, forthcoming.

Dosi, Giovanni, Richard R. Nelson and Sidney G. Winter. 2000. *The Nature and Dynamics of Organizational Capabilities.* Oxford: Oxford University Press.

Eliasson, Gunnar. 1985. *The Firm and Financial Markets in the Swedish Micro-to-Macro Model: Theory, Model and Verification.* Stockholm: IUI.

Ericson, Richard and Ariel Pakes. 1995. "Markov-Perfect Industry Dynamics: A Framework for Empirical Work." *Review of Economic Studies.* January, 62:1, pp. 53–82.

Fransman, Martin. 1994. "Information, Knowledge, Vision and Theories of the Firm." *Industrial and Corporate Change.* 3:3, pp. 713–58.

Freeman, Christopher. 1974. *The Economics of Industrial Innovation.* Hammondsworth, England: Penguin.

Freeman, Christopher. 1988. "Japan: A New National System of Innovation?" in *Technical Change and Economic Theory.* G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete, eds. London: Pinter, pp. 330–48.

Friedman, Milton. 1953. "The Methodology of Positive Economics," in *Essays in Positive Economics.* Chicago: University of Chicago Press, pp. 3–43.

Gavetti, Giovanni and Daniel Levinthal. 2000. "Looking Forward and Looking Backward: Cognitive and Experiential Search." *Administrative Science Quarterly.* 45:1, pp. 113–37.

Hayek, Friedrich A. 1988. *The Fatal Conceit.* Chicago: University of Chicago Press.

Helfat, Constance E. 1994. "Evolutionary Trajectories in Petroleum Firm R&D." *Management Science.* 40:12, pp. 1720–747.

Henderson, Rebecca and Kim Clark. 1990. "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms." *Administrative Science Quarterly.* 35:1, pp. 9–30.

Henderson, Rebecca, Luigi Orsenigo and Gary Pisano. 1999. "The Pharmaceutical Industry and the Revolution in Molecular Biology: Exploring the Interactions among Scientific, Institutional and Organizational Change," in *Sources of Industrial Leadership: Studies of Seven Industries.* D. C. Mowery and R. R. Nelson, eds. New York: Cambridge University Press, pp. 267–311.

Hicks, John R. and Roy G. D. Allen. 1934. "A Reconsideration of the Theory of Value." *Economica.* 1, pp. 52–76, 191–219.

Hodgson, Geoffrey. 1994. "Optimisation and Evolution: Winter's Critique of Friedman Revisited." *Cambridge Journal of Economics.* August, 18:4, pp. 413–30.

Hodgson, Geoffrey. 1999. *Evolution and Institutions.* Cheltenham, U.K.: Edward Elgar.

Hopenhayn, Hugo A. 1992. "Entry, Exit and Firm Dynamics in Long Run Equilibrium." *Econometrica.* September, 60:5, pp. 1127–150.

Jovanovic, Boyan. 1982. "Selection and the Evolution of Industry." *Econometrica.* May, 50:3, pp. 649–70.

Klepper, Steven. 1996. "Entry, Exit, Growth and Innovation Over the Product Life Cycle." *American Economic Review.* June, 86:3, pp. 562–83.

Klepper, Steven. 1997. "Industry Life Cycles." *Industrial and Corporate Change.* 6:1, pp. 145–81.

Klepper, Steven and Elizabeth Graddy. 1990. "The Evolution of Industries and the Determinants of Market Structure." *RAND Journal of Economics.* Spring, 21:1, pp. 27–44.

Klepper, Steven and Kenneth L. Simons. 2000a. "The Making of an Oligopoly: Firm Survival and Technological Change in the Evolution of the U.S. Tire Industry." *Journal of Political Economy.* August, 108:4, pp. 728–60.

Klepper, Steven and Kenneth L. Simons. 2000b. "Dominance by Birthright: Entry of Prior Radio Producers and Competitive Ramifications in the U.S. Television Receiver Industry." *Strategic Management Journal.* 21:10-11, pp. 997–1016.

Klepper, Steven and Sally Sleeper. 2000. "Entry by Spinoffs." Working Paper, Carnegie Mellon University.

Koopmans, Tjalling C. 1957. *Three Essays on the State of Economic Science.* New York: McGraw-Hill.

Kuhn, Thomas S. 1970. *The Structure of Scientific Revolutions, Second Edition.* Chicago: University of Chicago Press.

Kwasnicki, Witold. 1996. *Knowledge, Innovation and Economy: An Evolutionary Exploration.* Cheltenham, U.K.: Elgar.

Langlois, Richard, ed. 1986. *Economics as a Process.* Cambridge: Cambridge University Press.

Levinthal, Daniel. 1997. "Adaptation on Rugged Landscapes." *Management Science.* July, 43, pp. 934–50.

Lundvall, Bengt-Aake, ed. 1992. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning.* London: Pinter.

Malerba, Franco. 1985. *The Semiconductor Business.* Madison: University of Wisconsin Press.

Malerba, Franco and Luigi Orsenigo. 1990. "Technological Regimes and Patterns of Innovation: A Theoretical and Empirical Investigation of the Italian Case," in *Evolving Technology and Market Structure.* A. Heertje, ed. Ann Arbor: University of Michigan Press, pp. 283–305.

Malerba, Franco et al. 1999. "'History-Friendly' Models of Industry Evolution: The Computer Industry." *Industrial and Corporate Change.* March, 8:1, pp. 1–36.

Mandeville, Bernard 1705 [1924]. *The Fable of the Bees.* Oxford: Oxford University Press.

Mansfield, Edwin. 1968. *Industrial Research and Technological Innovation.* New York: Norton.

Mansfield, Edwin. 1971. *Research and Innovation in the Modern Corporation.* New York: Norton.

March, James and Herbert Simon. 1958. *Organizations.* New York: Wiley.

Margeno, Luigi. 1992. "Coordination and Organizational Learning in the Firm." *Journal of Evolutionary Economics.* December, 2:4, pp. 313–26.

Marengo, Luigi et al. 2000. "The Structure of Problem-Solving Knowledge and the Structure of Organizations." *Industrial and Corporate Change.* December, 9:4, pp. 757–88.

Marsili, Orietta. 2001. *The Anatomy and Evolution of Industries: Technological Change and Industrial Dynamics.* Cheltenham, U.K.: Edward Elgar.

McKelvey, Maureen. 1996. *Evolutionary Innovations: The Business of Biotechnology.* Oxford: Oxford University Press.

Metcalfe, J. Stanley. 1998. *Evolutionary Economics and Creative Destruction.* London: Routledge.

Mokyr, Joel. 1990. *The Lever of Riches: Technological Creativity and Economic Progress.* Oxford: Oxford University Press.

Mowery, David C. and Richard R. Nelson, eds. 1999. *Sources of Industrial Leadership: Studies of Seven Industries.* New York: Cambridge University Press.

Narduzzo, Alessandro, Elena Rocco and Massimo Warglien. 2000. "Talking About Routines in the Field: The Emergence of Organizational Capabilities in a New Cellular Phone Network Company," in *The Nature and Dynamics of Organizational Capabilities.* G. Dosi, R. R. Nelson and S. G. Winter, eds. New York: Oxford University Press, pp. 27–50.

Nelson, Richard R., ed. 1993. *National Innova-*

tion Systems: A Comparative Analysis. New York: Oxford University Press.

Nelson, Richard R. 1998. "The Agenda for Growth Theory: A Different Point of View." *Cambridge Journal of Economics*. July, 22:4, pp. 497–520.

Nelson, Richard R. and Bhaven Sampat. 2001. "Making Sense of Institutions as a Factor Shaping Economic Performance." *Journal of Economic Behavior and Organization*. January, 44:1, pp. 3–54.

Nelson, Richard R. and Sidney G. Winter. 1973. "Toward an Evolutionary Theory of Economic Capabilities." *American Economic Review*. May, 63, pp. 440–49.

Nelson, Richard R. and Sidney G. Winter. 1974. " Neoclassical vs. Evolutionary Theories of Economic Growth: Critique and Prospectus." *Economic Journal*. December, 84:336, pp. 886–905.

Nelson, Richard R. and Sidney G. Winter. 1977. "In Search of Useful Theory of Innovation." *Research Policy*. January, 5, pp. 36–76.

Nelson, Richard R. and Sidney G. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, Mass.: Harvard University Press.

North, Douglas. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.

Orsenigo, Luigi. 1995. *The Emergence of Biotechnology*. London: Pinter.

Pakes, Ariel and Richard Ericson. 1998. "Empirical Implications of Alternative Models of Firm Dynamics." *Journal of Economic Theory*. March, 79:1, pp. 1–45.

Pavitt, Keith. 1999. *Technology, Management and Systems of Innovation*. Cheltenham, U.K.: Edward Elgar.

Petroski, Henry. 1992. *The Evolution of Useful Things*. New York: Alfred Knopf.

Polanyi, Michael. 1964. *Personal Knowledge: Towards a Post-Critical Philosophy*. New York: Harper & Row.

Raff, Daniel M. G. 2000. "Superstores and the Evolution of Firm Capabilities in American Bookselling." *Strategic Management Journal*. October/November, 21, pp. 1043–059.

Rosenberg, Nathan. 1976. *Perspectives on Technology*. Cambridge: Cambridge University Press.

Rosenberg, Nathan and Richard Nelson. 1994. "American Universities and Technical Advance in Industry." *Research Policy*. 23:3, pp. 323–48.

Samuelson, Paul A. 1947. *Foundations of Economic Analysis*. Cambridge, Mass.: Harvard University Press.

Saviotti, Paolo. 1996. *Technological Evolution, Variety and the Economy*. Cheltenham, U.K.: Edward Elgar.

Scherer, F. Michael. 1980. *Industrial Market Structure and Economic Performance*. Chicago: Rand McNally.

Schmookler, Jacob. 1952. "The Changing Efficiency of the American Economy." *Review of Economics and Statistics*. 34, pp. 214–31.

Schumpeter, Joseph A. 1911 [1934]. *The Theory of Economic Development*. Cambridge: Harvard University Press.

Schumpeter, Joseph A. 1950. *Capitalism, Socialism and Democracy*. New York: Harper & Row.

Schwartz, Hugh. 1998. *Rationality Gone Awry?* Westport, Conn.: Prager.

Shane, Scott. 2001. "Technology Regimes and New Firm Formation." *Management Science*. 47:9, pp. 1173–190.

Silverberg, Gerald and Doris Lehnert. 1993. "Long Waves and 'Evolutionary Chaos' in a Simple Schumpeterian Model of Embodied Technical Change." *Structural Change and Economic Dynamics*. 4:1, pp. 9–37.

Silverberg, Gerald, Giovanni Dosi and Luigi Orsenigo. 1988. "Innovation, Diversity and Diffusion: A Self-Organisation Model." *Economic Journal*. December, 98:393, pp. 1032–054.

Smith, Adam. 1776 [1937]. *The Wealth of Nations*. New York: Modern Library.

Solow, Robert M. 1956. "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics*. February, 70, pp. 65–94.

Solow, Robert M. 1957. "Technical Change and the Aggregate Production Function." *Review of Economics and Statistics*. August, 39, pp. 312–20.

Squire, Larry R. 1987. *Memory and Brain*. New York: Oxford University Press.

Szulanski, Gabriel. 2000. "Appropriability and the Challenge of Scope: Banc One Routinizes Replication," in *The Nature and Dynamics of Organizational Capabilities*. G. Dosi, R. R. Nelson and S. G. Winter, eds. New York: Oxford University Press, pp. 69–98.

Teece, David J. 1986. "Profiting from Technological Innovation." *Research Policy*. 15:6, pp. 285–305.

Teece, David, Gary Pisano and Mary Shuen. 1997. "Dynamic Capabilities and Strategic Management." *Strategic Management Journal*. 18:7, pp. 509–33.

Thaler, Richard H. 1992. *The Winner's Curse: Paradoxes and Anomalies of Economic Life*. New York: Free Press.

Tripsas, Mary. 1997. "Unraveling the Process of Creative Destruction: Complementary Assets and Incumbent Survival in the Typesetter Industry." *Strategic Management Journal.* Special Summer Issue, 18, pp. 119–42.

Tripsas, Mary and Giovanni Gavetti. 2000. "Capabilities, Cognition, and Inertia: Evidence from Digital Imaging." *Strategic Management Journal.* October, 21:10-11, pp. 1147–161.

Tushman, Michael and Philip Anderson. 1986. "Technological Discontinuities and Organization Environments." *Administrative Science Quarterly.* September, 31, pp. 439–65.

Tversky, Amos and Daniel Kahneman. 1974. "Judgment Under Uncertainty: Heuristics and Biases." *Science.* 185, pp. 1124–131.

Usselman, Steven W. 1993. "IBM and its Imitators: Organizational Capabilities and the Emergence of the International Computer Industry." *Business and Economic History.* Winter, 22, pp. 1–35.

Utterback, James M. and William J. Abernathy. 1975. "A Dynamic Model of Process and Product Innovation." *Omega.* 3:6, pp. 639–56.

Veblen, Thorstein. 1898. "Why is Economics Not an Evolutionary Science?" *Quarterly Journal of Economics.* 12, pp. 373–97.

Vincenti, Walter G. 1990. *What Engineers Know and How They Know It.* Baltimore: Johns Hopkins University Press.

Williamson, Oliver. 1985. *The Economic Institutions of Capitalism.* New York: Free Press.

Winter, Sidney G. 1964. "Economic 'Natural Selection' and the Theory of the Firm." *Yale Economic Essays.* Spring, 4, pp. 225–72.

Winter, Sidney G. 1971. "Satisficing, Selection and the Innovating Remnant." *Quarterly Journal of Economics.* May, 85, pp. 237–61.

Winter, Sidney G. 1984. "Schumpeterian Competition in Alternative Technological Regimes." *Journal of Economic Behavior and Organization.* September/December, 5, pp. 287–320.

Winter, Sidney G. 1986. "The Research Program of the Behavioral Theory of the Firm: Orthodox Critique and Evolutionary Perspective," in *Handbook of Behavioral Economics.* B. Gilad and S. Kaish, eds. Greenwich, Conn.: PAI Press, pp. 155–88.

Zander, Udo and Bruce Kogut. 1995 "Knowledge and the Speed of Transfer and Imitation of Organizational Capabilities: An Empirical Test." *Organization Science.* 6:1, pp. 76–92.

Ziman, John, ed. 2000. *Technological Innovation as an Evolutionary Process.* Cambridge: Cambridge University Press.

This article has been cited by:

1. Alessandro Zardini, Cecilia Rossignoli, Francesca Ricciardi. 2016. A bottom-up path for IT management success: From infrastructure quality to competitive excellence. *Journal of Business Research* **69**, 1747-1752. [CrossRef]
2. Minyoung Kim. 2016. Geographic scope, isolating mechanisms, and value appropriation. *Strategic Management Journal* **37**:10.1002/smj.2016.37.issue-4, 695-713. [CrossRef]
3. Muhamed Kudic, Andreas Pyka, Marco Sunder. 2016. The formation of R&D cooperation ties: an event history analysis for German laser source manufacturers. *Industrial and Corporate Change* dtv047. [CrossRef]
4. Rongwei Ren, Lei Yu, Yunxia Zhu. 2016. Innovation-orientation, dynamic capabilities and evolution of the informal Shanzhai firms in China. *Journal of Entrepreneurship in Emerging Economies* **8**, 45-59. [CrossRef]
5. Massimiliano Vatiero. 2016. ON THE (POLITICAL) ORIGIN OF 'CORPORATE GOVERNANCE' SPECIES. *Journal of Economic Surveys* n/a-n/a. [CrossRef]
6. Markus Grillitsch, Josephine V. Rekers. 2016. Revisiting the role of selection for the evolution of industries. *Industry and Innovation* 1-18. [CrossRef]
7. Charlotta Sirén, Marko Kohtamäki. 2016. Stretching strategic learning to the limit: The interaction between strategic planning and learning. *Journal of Business Research* **69**, 653-663. [CrossRef]
8. Dev K. Dutta, Shavin Malhotra, PengCheng Zhu. 2016. Internationalization process, impact of slack resources, and role of the CEO: The duality of structure and agency in evolution of cross-border acquisition decisions. *Journal of World Business* **51**, 212-225. [CrossRef]
9. Herman Aguinis, Ernest O'Boyle, Erik Gonzalez-Mulé, Harry Joo. 2016. Cumulative Advantage: Conductors and Insulators of Heavy-Tailed Productivity Distributions and Productivity Stars. *Personnel Psychology* **69**:10.1111/peps.2016.69.issue-1, 3-66. [CrossRef]
10. Juliana Subtil Lacerda, Jeroen C.J.M. van den Bergh. 2016. Diversity in solar photovoltaic energy: Implications for innovation and policy. *Renewable and Sustainable Energy Reviews* **54**, 331-340. [CrossRef]
11. Xiao-Shan Yap, Rajah Rasiah. 2015. Catching up and leapfrogging in a high-tech manufacturing industry: towards a firm-level taxonomy of knowledge accumulation. *Knowledge Management Research & Practice* . [CrossRef]
12. Peter Neuhäusler, Torben Schubert, Rainer Frietsch, Knut Blind. 2015. Managing portfolio risk in strategic technology management: evidence from a panel data-set of the world's largest R&D performers. *Economics of Innovation and New Technology* 1-17. [CrossRef]
13. Michael C. J. Mayer, Christian Stadler, Julia Hautz. 2015. The relationship between product and international diversification: The role of experience. *Strategic Management Journal* **36**, 1458-1468. [CrossRef]
14. Milan Zafirovski. 2015. Toward Economic Sociology/Socio-Economics? Sociological Components in Contemporary Economics and Implications for Sociology. *The American Sociologist* . [CrossRef]
15. Paul Almeida, Jan Hohberger, Pedro ParadaInformal Knowledge and Innovation 383-402. [CrossRef]
16. Gianluca Misuraca, Gianluigi Viscusi. 2015. Shaping public sector innovation theory: an interpretative framework for ICT-enabled governance innovation. *Electronic Commerce Research* **15**, 303-322. [CrossRef]
17. Massimo G. Colombo, Chiara Franzoni, Reinhilde Veugelers. 2015. Going radical: producing and transferring disruptive innovation. *The Journal of Technology Transfer* **40**, 663-669. [CrossRef]

18. Jim Quinn. 2015. Editorial: re-introducing evolutionary theory to business history: making sense of today's structure. *Business History* **57**, 655-663. [CrossRef]
19. L. M. Ricard. 2015. Aligning innovation with grand societal challenges: Inside the European Technology Platforms in wind, and carbon capture and storage. *Science and Public Policy* . [CrossRef]
20. Michael D. Makowsky, David M. Levy. 2015. INCREASING RETURNS TO SCALE, PRICE DISPERSION, AND THE DISTRIBUTION OF RETURNS TO INNOVATION. *Macroeconomic Dynamics* **19**, 334-362. [CrossRef]
21. Peter R. Dickson. 2015. The adoption of customer service improvement practices. *Marketing Letters* **26**, 1-15. [CrossRef]
22. Ioanna D Constantiou, Jannis Kallinikos. 2015. New games, new rules: big data and the changing context of strategy. *Journal of Information Technology* **30**, 44-57. [CrossRef]
23. D. Gertner, B. A. G. Bossink. 2015. The evolution of science concentrations: The case of Newcastle Science City. *Science and Public Policy* **42**, 121-138. [CrossRef]
24. Mark Lubell. 2015. Collaborative partnerships in complex institutional systems. *Current Opinion in Environmental Sustainability* **12**, 41-47. [CrossRef]
25. Kamal Kishore Jain, Manjit Singh Sandhu, See Kwong Goh. 2015. Organizational climate, trust and knowledge sharing: insights from Malaysia. *Journal of Asia Business Studies* **9**, 54-77. [CrossRef]
26. ULRICH WITT. 2014. The future of evolutionary economics: why the modalities of explanation matter. *Journal of Institutional Economics* **10**, 645-664. [CrossRef]
27. Milan Zafirovski. 2014. Rational Choice Requiem: The Decline of an Economic Paradigm and its Implications for Sociology. *The American Sociologist* **45**, 432-452. [CrossRef]
28. Arun Kumar Jain, Ajay Kumar Singal. 2014. Mapping vulnerability: how emerging markets respond to multinationals. *Journal of Business Strategy* **35**, 41-48. [CrossRef]
29. Alberto Silva. 2014. How to Become an Innovative Company: A Case Study. *International Journal of Innovation Science* **6**, 177-182. [CrossRef]
30. Bernard Lew Shian Loong. 2014. Tourism and Simulacrum: The Computational Economy of Algorithmic Destinations. *Procedia - Social and Behavioral Sciences* **144**, 237-246. [CrossRef]
31. Alessandro Hinna, Ernesto De Nito, Gianluigi Mangia, Danila Scarozza, Andrea TomoAdvancing Public Governance Research: Individual and Collective Dynamics in and Around the Boardroom 3-39. [CrossRef]
32. Duarte N. Leite, Sandra T. Silva, Oscar Afonso. 2014. INSTITUTIONS, ECONOMICS AND THE DEVELOPMENT QUEST. *Journal of Economic Surveys* **28**:10.1111/joes.2014.28.issue-3, 491-515. [CrossRef]
33. Quan Hoang Vuong, Nancy K. Napier. 2014. Resource curse or destructive creation in transition. *Management Research Review* **37**, 642-657. [CrossRef]
34. C. N. Pitelis. 2014. Rejuvenating 'Old Europe': Towards a Strategy for Reindustrialisation and Sustainable Competitiveness. *Contributions to Political Economy* **33**, 69-98. [CrossRef]
35. Thomas Berger, Christian Troost. 2014. Agent-based Modelling of Climate Adaptation and Mitigation Options in Agriculture. *Journal of Agricultural Economics* **65**:10.1111/jage.2014.65.issue-2, 323-348. [CrossRef]
36. Bin Guo, Yueqi Wang. 2014. Environmental turbulence, absorptive capacity and external knowledge search among Chinese SMEs. *Chinese Management Studies* **8**, 258-272. [CrossRef]
37. T. A. C. Reydon, M. Scholz. 2014. Searching for Darwinism in Generalized Darwinism. *The British Journal for the Philosophy of Science* . [CrossRef]

38. Olli Lehtonen, Markku Tykkyläinen. 2014. Delphi path simulator for unveiling development opportunities in the forest industries by contrasting forest management practices — The case of North Karelia. *Technological Forecasting and Social Change* **84**, 171-185. [CrossRef]

39. Murray J. Pyle, Jeffrey K. Liker. 2014. Imitation in Large Complex Organizations: A Case of Design for Six Sigma in the Automobile Industry. *Journal of Enterprise Transformation* **4**, 76-99. [CrossRef]

40. Dani Rodrik. 2014. When Ideas Trump Interests: Preferences, Worldviews, and Policy Innovations. *Journal of Economic Perspectives* **28**:1, 189-208. [Abstract] [View PDF article] [PDF with links]

41. Son A. Le, Jung Chul Park, Mark Kroll. 2014. Differential effects of pre- and post-acquisition R&D expenditures on post-acquisition performance. *Journal of Business Research* **67**, 92-99. [CrossRef]

42. Maryam Dilmaghani. 2014. Dynamics of social influence: an evolutionary approach. *International Journal of Social Economics* **41**, 123-145. [CrossRef]

43. Ganesh D. Bhatt, Pankaj Pankaj, James A. Rodger. 2014. Managing Knowledge in Shared Spaces. *Intelligent Information Management* **06**, 240-247. [CrossRef]

44. Fangrui Wang, Jin Chen, Yuandi Wang, Ning Lutao, Wim Vanhaverbeke. 2014. The effect of R&D novelty and openness decision on firms' catch-up performance: Empirical evidence from China. *Technovation* **34**, 21-30. [CrossRef]

45. R. Mazzoleni, R. R. Nelson. 2013. An interpretive history of challenges to neoclassical microeconomics and how they have fared. *Industrial and Corporate Change* **22**, 1409-1451. [CrossRef]

46. Vanesa Barrales-Molina, Francisco J. Martínez-López, Juan Carlos Gázquez-Abad. 2013. Dynamic Marketing Capabilities: Toward an Integrative Framework. *International Journal of Management Reviews* n/a-n/a. [CrossRef]

47. Krzysztof Obloj, Marc Weinstein, Shujun Zhang. 2013. Self-Limiting Dominant Logic: An Exploratory Study of Chinese Entrepreneurial Firms. *Journal of East-West Business* **19**, 291-316. [CrossRef]

48. Steven M. Shugan, Debanjan Mitra. 2013. A Theory for Market Growth or Decline. *Marketing Science* 131216105840005. [CrossRef]

49. Tuomas Huikkola, Juho Ylimäki, Marko Kohtamäki. 2013. Joint learning in R&D collaborations and the facilitating relational practices. *Industrial Marketing Management* **42**, 1167-1180. [CrossRef]

50. CHRISTIAN HENNING, VOLKER SAGGAU. 2013. NETWORKS, KNOWLEDGE SPILLOVERS AND TECHNOLOGICAL PROGRESS OF FIRMS: SIMULATIONS IN AN EVOLUTIONARY FRAMEWORK. *International Journal of Innovation and Technology Management* **10**, 1340018. [CrossRef]

51. Sandra M. Ríos-Núñez, Daniel Coq-Huelva, Roberto García-Trujillo. 2013. The Spanish livestock model: A coevolutionary analysis. *Ecological Economics* **93**, 342-350. [CrossRef]

52. Peter Frederiksen, Tue Jagtfelt. 2013. Exponential Expansion in Evolutionary Economics: A Model Proposition. *Journal of Economic Issues* **47**, 705-718. [CrossRef]

53. Minyoung Kim. 2013. Many roads lead to Rome: Implications of geographic scope as a source of isolating mechanisms. *Journal of International Business Studies* . [CrossRef]

54. Giulio Bottazzi, Pietro Dindo. 2013. Evolution and market behavior in economics and finance: introduction to the special issue. *Journal of Evolutionary Economics* **23**, 507-512. [CrossRef]

55. Giulio Bottazzi, Pietro Dindo. 2013. Selection in asset markets: the good, the bad, and the unknown. *Journal of Evolutionary Economics* **23**, 641-661. [CrossRef]

56. Eduardo Pol. 2013. Reconciling the Invisible Hand and innovation. *Economics of Innovation and New Technology* **22**, 431-446. [CrossRef]

57. Jerald Hage, Jonathon E. Mote, Gretchen B. Jordan. 2013. Ideas, innovations, and networks: a new policy model based on the evolution of knowledge. *Policy Sciences* **46**, 199-216. [CrossRef]

58. Bernard Triomphe, Anne Floquet, Geoffrey Kamau, Brigid Letty, Simplice Davo Vodouhe, Teresiah Ng'ang'a, Joe Stevens, Jolanda van den Berg, Nour Selemna, Bernard Bridier, Todd Crane, Cornelia Almekinders, Ann Waters-Bayer, Henri Hocdé. 2013. What Does an Inventory of Recent Innovation Experiences Tell Us About Agricultural Innovation in Africa?. *The Journal of Agricultural Education and Extension* **19**, 311-324. [CrossRef]

59. Klaus Edenhoffer, Roger Hayter. 2013. Organizational restructuring in British Columbia's forest industries 1980–2010: The survival of a dinosaur. *Applied Geography* **40**, 222-231. [CrossRef]

60. Krsto Pandza, Paul Ellwood. 2013. Strategic and ethical foundations for responsible innovation. *Research Policy* **42**, 1112-1125. [CrossRef]

61. Klaus Edenhoffer, Roger Hayter. 2013. Reprint of "Organizational restructuring in British Columbia's forest industries 1980–2010: The survival of a dinosaur". *Applied Geography* . [CrossRef]

62. J. P. Eggers, Sarah Kaplan. 2013. Cognition and Capabilities: A Multi-Level Perspective. *The Academy of Management Annals* **7**, 295-340. [CrossRef]

63. Marcelo Hoss, Carla Schwengber ten Caten. 2013. Lean schools of thought. *International Journal of Production Research* **51**, 3270-3282. [CrossRef]

64. Qingyan Shang, Jessie P. H. Poon. 2013. International spillovers, knowledge acquisition and transfer among Japanese fi rms in the United States. *Journal of Business Economics and Management* **14**, 535-557. [CrossRef]

65. J. Catalan, R. Ramon-Munoz. 2013. Marshall in Iberia. Industrial Districts and Leading Firms in the Creation of Competitive Advantage in Fashion Products. *Enterprise and Society* . [CrossRef]

66. Jonathan Linton, Steven Walsh. 2013. The effect of technology on learning during the acquisition and development of competencies in technology-intensive small firms. *International Journal of Entrepreneurial Behavior & Research* **19**, 165-186. [CrossRef]

67. C. Heinzel. 2013. Schumpeter and Georgescu-Roegen on the foundations of an evolutionary analysis. *Cambridge Journal of Economics* **37**, 251-271. [CrossRef]

68. Wasko Rothmann, Jochen Koch. 2013. Creativity in strategic lock-ins: The newspaper industry and the digital revolution. *Technological Forecasting and Social Change* . [CrossRef]

69. Erk P. Piening. 2013. Dynamic Capabilities in Public Organizations. *Public Management Review* **15**, 209-245. [CrossRef]

70. Yoguel Gabriel, Barletta Florencia, Pereira Mariano. 2013. De Schumpeter a los postschumpeterianos: viejas y nuevas dimensiones analíticas**Se agradecen los comentarios de los árbitros de la revista a una versión previa de este artículo;. *Problemas del Desarrollo* **44**, 35-59. [CrossRef]

71. Mamun Ul Ala. 2013. A Firm-level Analysis of the Vulnerability of the Bangladeshi Pharmaceutical Industry to the TRIPS Agreement: Implications for R&D Capability and Technology Transfer. *Procedia Economics and Finance* **5**, 30-39. [CrossRef]

72. C. Pitelis. 2012. Clusters, entrepreneurial ecosystem co-creation, and appropriability: a conceptual framework. *Industrial and Corporate Change* **21**, 1359-1388. [CrossRef]

73. Giulio Bottazzi, Angelo Secchi. 2012. Productivity, profitability and growth: The empirics of firm dynamics. *Structural Change and Economic Dynamics* **23**, 325-328. [CrossRef]

74. Philipp H. Grünewald, Timothy T. Cockerill, Marcello Contestabile, Peter J.G. Pearson. 2012. The socio-technical transition of distributed electricity storage into future networks—System value and stakeholder views. *Energy Policy* **50**, 449-457. [CrossRef]

75. Eleonora Bartoloni. 2012. The persistence of innovation: a panel data investigation on manufacturing firms. *International Review of Applied Economics* **26**, 787-810. [CrossRef]

76. Lei Ma, Yongjiang Shi, Wenwen Zhao. 2012. Habitual domain exploration in inter-firm networks. *Journal of Manufacturing Technology Management* **23**, 1057-1070. [CrossRef]

77. Dilek Çetindamar, Ayşe Günsel. 2012. Measuring the Creativity of a City: A Proposal and an Application. *European Planning Studies* **20**, 1301-1318. [CrossRef]
78. Allan Afuah, Christopher L. Tucci. 2012. Crowdsourcing As a Solution to Distant Search. *The Academy of Management Review* **37**, 355-375. [CrossRef]
79. Kelly Levin, Benjamin Cashore, Steven Bernstein, Graeme Auld. 2012. Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. *Policy Sciences* . [CrossRef]
80. Anna Mansikkasalo, Patrik SoderholmEnergy efficient and low-carbon technology in process industries: Innovation, diffusion and the role of public policy 1-8. [CrossRef]
81. Hendrik Wortmann. 2012. Re-Reading Robert E. Park on Social Evolution: An Early Darwinian Conception of Society. *Biological Theory* . [CrossRef]
82. Peter Zettinig, Zsuzsanna Vincze. 2012. How clusters evolve. *Competitiveness Review* **22**, 110-132. [CrossRef]
83. Stefan Ouma. 2012. Creating and Maintaining Global Connections: Agro-business and the Precarious Making of Fresh-cut Markets. *Journal of Development Studies* **48**, 322-334. [CrossRef]
84. Giovanni Gavetti. 2012. PERSPECTIVE—Toward a Behavioral Theory of Strategy. *Organization Science* **23**, 267-285. [CrossRef]
85. D. MaclennanTime and the Economic Analysis of Housing Systems 196-200. [CrossRef]
86. Helga Weisz, Eric Clark. 2011. SOCIETY-NATURE COEVOLUTION: INTERDISCIPLINARY CONCEPT FOR SUSTAINABILITY. *Geografiska Annaler: Series B, Human Geography* **93**:10.1111/geob.2011.93.issue-4, 281-287. [CrossRef]
87. Richard B. Norgaard, Giorgos Kallis. 2011. COEVOLUTIONARY CONTRADICTIONS: PROSPECTS FOR A RESEARCH PROGRAMME ON SOCIAL AND ENVIRONMENTAL CHANGE. *Geografiska Annaler: Series B, Human Geography* **93**:10.1111/geob.2011.93.issue-4, 289-300. [CrossRef]
88. Doris Hanappi. 2011. Economic Action, Fields and Uncertainty. *Journal of Economic Issues* **0**, 785-804. [CrossRef]
89. Richard R. Nelson. 2011. Human Behavior and Cognition in Evolutionary Economics. *Biological Theory* **6**, 293-300. [CrossRef]
90. Sandra Tavares Silva, Jorge M. S. Valente, Aurora A. C. Teixeira. 2011. An evolutionary model of industry dynamics and firms' institutional behavior with job search, bargaining and matching. *Journal of Economic Interaction and Coordination* . [CrossRef]
91. Marcus Wagner, Patrick Llerena. 2011. Eco-Innovation Through Integration, Regulation and Cooperation: Comparative Insights from Case Studies in Three Manufacturing Sectors. *Industry & Innovation* **18**, 747-764. [CrossRef]
92. M. Segarra-Oña, A. Peiró-Signes, L. Miret-Pastor, J. Albors-Garrigós. 2011. Â¿Eco-innovación, una evolución de la innovación? Análisis empírico en la industria cerámica española. *Boletín de la Sociedad Española de Cerámica y Vidrio* **50**:10.3989/cyv.2011.v50.i5, 253-260. [CrossRef]
93. Jie Mein Goh, Guodong (Gordon) Gao, Ritu Agarwal. 2011. Evolving Work Routines: Adaptive Routinization of Information Technology in Healthcare. *Information Systems Research* **22**, 565-585. [CrossRef]
94. Joseph E. Stiglitz. 2011. RETHINKING MACROECONOMICS: WHAT FAILED, AND TO HOW REPAIR IT. *Journal of the European Economic Association* **9**:10.1111/jeea.2011.9.issue-4, 591-645. [CrossRef]

95. William Collier, Francis Green, Young-Bae Kim, John Peirson. 2011. Education, Training and Economic Performance: Evidence from Establishment Survival Data. *Journal of Labor Research* . [CrossRef]
96. Rafael Cáceres, Joaquín Guzmán, Marek Rekowski. 2011. Firms as source of variety in innovation: influence of size and sector. *International Entrepreneurship and Management Journal* . [CrossRef]
97. Andy Stirling. 2011. Pluralising progress: From integrative transitions to transformative diversity. *Environmental Innovation and Societal Transitions* **1**, 82-88. [CrossRef]
98. Till Grüne-Yanoff. 2011. Models as products of interdisciplinary exchange: Evidence from evolutionary game theory. *Studies in History and Philosophy of Science Part A* **42**, 386-397. [CrossRef]
99. MARK BLYTH, GEOFFREY M. HODGSON, ORION LEWIS, SVEN STEINMO. 2011. Introduction to the Special Issue on the Evolution of Institutions. *Journal of Institutional Economics* 1-17. [CrossRef]
100. Sören Steger, Raimund Bleischwitz. 2011. Drivers for the use of materials across countries. *Journal of Cleaner Production* **19**, 816-826. [CrossRef]
101. Joseph E. Stiglitz. 2011. Rethinking Macroeconomics: What Went Wrong and How to Fix It. *Global Policy* **2**:10.1111/gpol.2011.2.issue-2, 165-175. [CrossRef]
102. Christian Gärtner. 2011. Putting new wine into old bottles. *Management Decision* **49**, 253-269. [CrossRef]
103. Christine Benna Skytt, Lars Winther. 2011. Trust and local knowledge production: Inter-organisational collaborations in the Sønderborg region, Denmark. *Geografisk Tidsskrift-Danish Journal of Geography* **111**, 27-41. [CrossRef]
104. Annetta Fortune, Will Mitchell. 2011. Unpacking Firm Exit at the Firm and Industry Levels: The Adaptation and Selection of Firm Capabilities. *Strategic Management Journal* n/a-n/a. [CrossRef]
105. Erk Piening. 2011. Insights into the Process Dynamics of Innovation Implementation. *Public Management Review* **13**, 127-157. [CrossRef]
106. Imoh Antai. 2011. Supply chain vs supply chain competition: a niche-based approach. *Management Research Review* **34**, 1107-1124. [CrossRef]
107. Clement Smartt, Susan Ferreira. 2011. Constructing a general framework for systems engineering strategy. *Systems Engineering* n/a-n/a. [CrossRef]
108. Herbert Dawid, Marc Reimann. 2010. Diversification: a road to inefficiency in product innovations?. *Journal of Evolutionary Economics* . [CrossRef]
109. Geoffrey M. Hodgson, Kainan Huang. 2010. Evolutionary game theory and evolutionary economics: are they different species?. *Journal of Evolutionary Economics* . [CrossRef]
110. Zhang Chi, Zhang Xiao-diEvolution of innovation regime and industrial cluster in developing countries: A case study of Shaoxing, China 1433-1438. [CrossRef]
111. Reina Y. Arakji, Karl R. Lang. 2010. Adoption and Diffusion of Business Practice Innovations: An Evolutionary Analysis. *International Journal of Electronic Commerce* **15**, 145-168. [CrossRef]
112. Peter E. Earl, Tim Wakeley. 2010. Economic perspectives on the development of complex products for increasingly demanding customers. *Research Policy* **39**, 1122-1132. [CrossRef]
113. Lalit Manral. 2010. Demand competition and investment heterogeneity in industries based on systemic technologies: evidence from the US long-distance telecommunications services industry, 1984–1996. *Journal of Evolutionary Economics* **20**, 765-802. [CrossRef]
114. Orion Lewis, Sven Steinmo. 2010. Taking evolution seriously in political science. *Theory in Biosciences* **129**, 235-245. [CrossRef]

115. Christos N Pitelis, David J Teece. 2010. The (new) nature and essence of the firm. *European Management Review* **6**, 5-15. [CrossRef]
116. Mary M. Crossan, Marina Apaydin. 2010. A Multi-Dimensional Framework of Organizational Innovation: A Systematic Review of the Literature. *Journal of Management Studies* **47**, 1154-1191. [CrossRef]
117. ELINOR OSTROM, XAVIER BASURTO. 2010. Crafting analytical tools to study institutional change. *Journal of Institutional Economics* 1-27. [CrossRef]
118. Pablo del Río, Javier Carrillo-Hermosilla, Totti Könnölä. 2010. Policy Strategies to Promote Eco-Innovation. *Journal of Industrial Ecology* **14**, 541-557. [CrossRef]
119. Anthony M. Endres, Christine R. Woods. 2010. Schumpeter's 'conduct model of the dynamic entrepreneur': scope and distinctiveness. *Journal of Evolutionary Economics* **20**, 583-607. [CrossRef]
120. Javier Carrillo-Hermosilla, Pablo del Río, Totti Könnölä. 2010. Diversity of eco-innovations: Reflections from selected case studies#. *Journal of Cleaner Production* **18**, 1073-1083. [CrossRef]
121. C. N. Pitelis, V. Vasilaros. 2010. The Determinants of Value and Wealth Creation at the Firm, Industry, and National Levels: A Conceptual Framework and Evidence. *Contributions to Political Economy* **29**, 33-58. [CrossRef]
122. Marcus Wagner. 2010. The role of corporate sustainability performance for economic performance: A firm-level analysis of moderation effects. *Ecological Economics* **69**, 1553-1560. [CrossRef]
123. Shari S C Shang, Shu-Fang Lin. 2010. A model of intellectual capital management capability in the dynamic business environment. *Knowledge Management Research & Practice* **8**, 15-23. [CrossRef]
124. Miguel A. Gual, Richard B. Norgaard. 2010. Bridging ecological and social systems coevolution: A review and proposal. *Ecological Economics* **69**, 707-717. [CrossRef]
125. Victor Hiller. 2010. WORKERS' BEHAVIOR AND LABOR CONTRACT: AN EVOLUTIONARY APPROACH. *Metroeconomica* **61**:10.1111/meca.2009.61.issue-1, 152-179. [CrossRef]
126. Giovanni Dosi, Richard R. NelsonTechnical Change and Industrial Dynamics as Evolutionary Processes 51-127. [CrossRef]
127. Karl R. Lang, Reina Y. ArakjiEvolution of Innovations Across Web 2.0 Service Platforms through Mutation, Natural Selection and Reuse 1-10. [CrossRef]
128. Tomasz Obloj, Krzysztof Obloj, Michael G. Pratt. 2010. Dominant Logic and Entrepreneurial Firms' Performance in a Transition Economy. *Entrepreneurship Theory and Practice* **34**:10.1111/etap.2010.34.issue-1, 151-170. [CrossRef]
129. Joseph T. Mahoney, Anita M. McGahan, Christos N. Pitelis. 2009. Perspective —The Interdependence of Private and Public Interests. *Organization Science* **20**, 1034-1052. [CrossRef]
130. JAN-ERIK JOHANSON. 2009. STRATEGY FORMATION IN PUBLIC AGENCIES. *Public Administration* **87**:10.1111/padm.2009.87.issue-4, 872-891. [CrossRef]
131. Sören Kupke, Christoph Lattemann. 2009. Emergenz organisationaler Fähigkeiten. *Zeitschrift für Management* **4**, 257-281. [CrossRef]
132. Sandra Tavares Silva, Aurora A. C. Teixeira. 2009. On the divergence of evolutionary research paths in the past 50 years: a comprehensive bibliometric account. *Journal of Evolutionary Economics* **19**, 605-642. [CrossRef]
133. Ju Liu, Angathevar Baskaran, Shiming Li. 2009. Building Technological-Innovation-Based Strategic Capabilities at Firm Level in China: A Dynamic Resource-Based-View Case Study. *Industry & Innovation* **16**, 411-434. [CrossRef]

134. Walter Bataglia, Dimária Silva E. Meirelles. 2009. Population Ecology and Evolutionary Economics: Toward an Integrative Model. *Management Research: Journal of the Iberoamerican Academy of Management* **7**, 87-101. [CrossRef]

135. Hong Park, Geon-Cheol Shin, Iksu Jurn. 2009. Corporate Strategies and Performances of Korean Firms: The Unified Theory of the Firm Perspective. *Global Economic Review* **38**, 185-203. [CrossRef]

136. Arnab Bhattacharjee, Eduardo de Castro, Chris Jensen-Butler. 2009. Regional variation in productivity: a study of the Danish economy. *Journal of Productivity Analysis* **31**, 195-212. [CrossRef]

137. Kishore Gopalakrishna Pillai. 2009. Managers' Perceptual Errors Revisited: the Role of Knowledge Calibration. *British Journal of Management* . [CrossRef]

138. Grazia Cecere. 2009. VoIP Diffusion among New Entrants: A Path Dependent Process. *Industry & Innovation* **16**, 219-245. [CrossRef]

139. Krsto Pandza, Richard Thorpe. 2009. Creative Search and Strategic Sense-making: Missing Dimensions in the Concept of Dynamic Capabilities. *British Journal of Management* **20**:10.1111/bjom.2009.20.issue-s1, S118-S131. [CrossRef]

140. Christos N. Pitelis. 2009. The Sustainable Competitive Advantage and Catching-up of Nations: FDI, Clusters and the Liability (Asset) of Smallness. *Management International Review* **49**, 95-120. [CrossRef]

141. Sandra Tavares Silva. 2009. On evolutionary technological change and economic growth: Lakatos as a starting point for appraisal. *Journal of Evolutionary Economics* **19**, 111-135. [CrossRef]

142. Marcel Truche, Sophie Reboud. 2009. Contribution à la compréhension du processus d'élaboration de la stratégie des PME. *Revue internationale P.M.E.: Économie et gestion de la petite et moyenne entreprise* **22**, 129. [CrossRef]

143. Joel West. 2008. Commercializing Open Science: Deep Space Communications as the Lead Market for Shannon Theory, 1960-73. *Journal of Management Studies* **45**:10.1111/joms.2008.45.issue-8, 1506-1532. [CrossRef]

144. Ulrich Witt. 2008. What is specific about evolutionary economics?. *Journal of Evolutionary Economics* **18**, 547-575. [CrossRef]

145. S RAMANI, M ELAROUI, M CARRERE. 2008. On estimating a knowledge production function at the firm and sector level using patent statistics. *Research Policy* **37**, 1568-1578. [CrossRef]

146. Sean R. Lauer. 2008. Exchange Relationships in Inshore Fisheries 1. *Sociological Forum* **23**:10.1111/socf.2008.23.issue-3, 503-535. [CrossRef]

147. John Stanley Metcalfe. 2008. Accounting for economic evolution: Fitness and the population method. *Journal of Bioeconomics* **10**, 23-49. [CrossRef]

148. Barbara Krug, Hans Hendrischke. 2008. Framing China: Transformation and Institutional Change through Co-evolution. *Management and Organization Review* **4**:10.1111/more.2008.4.issue-1, 81-108. [CrossRef]

149. David J. Teece. 2007. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal* **28**:10.1002/smj.v28:13, 1319-1350. [CrossRef]

150. Robert Scott Gassler. 2007. Political and Social Economics: Beyond Orthodoxy and Heterodoxy. *Forum for Social Economics* **36**, 109-125. [CrossRef]

151. Mingchun Zhou, Donghan Cai, Hua Chen. 2007. A Solow-Swan model with technological overflow and catch-up. *Wuhan University Journal of Natural Sciences* **12**, 975-978. [CrossRef]

152. Hermann Kuehnle. 2007. A system of models contribution to production network (PN) theory. *Journal of Intelligent Manufacturing* **18**, 543-551. [CrossRef]

153. P LI. 2007. Toward an integrated theory of multinational evolution: The evidence of Chinese multinational enterprises as latecomers. *Journal of International Management* **13**, 296-318. [CrossRef]

154. Jonathan Perraton, Iona Tarrant. 2007. What does tacit knowledge actually explain?. *Journal of Economic Methodology* **14**, 353-370. [CrossRef]

155. Muriel de Oliveira Gavira, Ruy QuadrosInnovation and Technology Management in Brazilian Subsidiaries in the Electro-Electronic Industry 680-690. [CrossRef]

156. Fulvio Castellacci. 2007. EVOLUTIONARY AND NEW GROWTH THEORIES. ARE THEY CONVERGING?. *Journal of Economic Surveys* **21**:10.1111/joes.2007.21.issue-3, 585-627. [CrossRef]

157. Giovanni Dosi, Luigi Marengo. 2007. Perspective—On the Evolutionary and Behavioral Theories of Organizations: A Tentative Roadmap. *Organization Science* **18**, 491-502. [CrossRef]

158. John F. Tomer. 2007. What is behavioral economics?. *The Journal of Socio-Economics* **36**, 463-479. [CrossRef]

159. Linda Argote, Henrich R. Greve. 2007. A Behavioral Theory of the Firm —40 Years and Counting: Introduction and Impact. *Organization Science* **18**, 337-349. [CrossRef]

160. Robin Douhan, Gunnar Eliasson, Magnus Henrekson. 2007. Israel M. Kirzner: An Outstanding Austrian Contributor to the Economics of Entrepreneurship. *Small Business Economics* **29**, 213-223. [CrossRef]

161. Nils Stieglitz, Klaus Heine. 2007. Innovations and the role of complementarities in a strategic theory of the firm. *Strategic Management Journal* **28**:10.1002/smj.v28:1, 1-15. [CrossRef]

162. Tom Kauko. 2006. Expressions of Housing Consumer Preferences: Proposition for a Research Agenda. *Housing, Theory and Society* **23**, 92-108. [CrossRef]

163. James Ronald Stanfield. 2006. From DIE and NIE toward EE. *Journal of Economic Issues* **40**, 249-259. [CrossRef]

164. Herbert DawidChapter 25 Agent-based Models of Innovation and Technological Change 1235-1272. [CrossRef]

165. Giovanni Gavetti. 2005. Cognition and Hierarchy: Rethinking the Microfoundations of Capabilities' Development. *Organization Science* **16**, 599-617. [CrossRef]

166. Jesús Zamora Bonilla. 2005. Science as a Persuasion Game: An Inferentialist Approach. *Episteme* **2**, 189-201. [CrossRef]

167. Sheri M. Markose. 2005. Computability and Evolutionary Complexity: Markets as Complex Adaptive Systems (CAS)*. *The Economic Journal* **115**:10.1111/ecoj.2005.115.issue-504, F159-F192. [CrossRef]

168. Fulvio Castellaci, Stine Grodal, Sandro Mendonca, Mona Wibe. 2005. Advances and Challenges in Innovation Studies. *Journal of Economic Issues* **39**, 91-121. [CrossRef]

169. James H. Fowler, Oleg Smirnov. 2005. Dynamic Parties and Social Turnout: An Agent-Based Model. *American Journal of Sociology* **110**:10.1086/ajs.2005.110.issue-4, 1070-1094. [CrossRef]

170. Arabella Mocciaro Li Destri, Giovanni Battista Dagnino. 2004. Time and strategy: towards a multitemporal view of the firm. *Journal of Managerial Psychology* **19**, 776-794. [CrossRef]

171. Giovanni. Gavetti, Daniel A. Levinthal. 2004. 50th Anniversay Article: The Strategy Field from the Perspective of Management Science : Divergent Strands and Possible Integration. *Management Science* **50**, 1309-1318. [CrossRef]

172. Lars-Erik Cederman, Kristian Skrede Gleditsch. 2004. Conquest and Regime Change: An Evolutionary Model of the Spread of Democracy and Peace. *International Studies Quarterly* **48**:10.1111/isqu.2004.48.issue-3, 603-629. [CrossRef]

173. Tiziano Raffaelli. 2004. Whatever happened to Marshall's industrial economics?. *European Journal of the History of Economic Thought* **11**, 209-229. [CrossRef]

174. Clem Tisdell. 2004. Economic Competition and Evolution: Are There Lessons from Ecology?. *Contemporary Economic Policy* **22**, 179-193. [CrossRef]

175. Eduardo Pol, Peter Carroll. 2004. Reviving and assessing the Kuznets law on innovation. *Economics of Innovation and New Technology* **13**, 127-140. [CrossRef]

176. Philippe Beaugrand. 2004. And Schumpeter Said, "This is How Thou Shalt Grow": Further Quest for Economic Growth in Poor Countries. *IMF Working Papers* **04**, 1. [CrossRef]

177. Ajit Singh. 2003. Competition, corporate governance and selection in emerging markets*. *The Economic Journal* **113**, F443-F464. [CrossRef]

178. Constance E. Helfat, Margaret A. Peteraf. 2003. The dynamic resource-based view: capability lifecycles. *Strategic Management Journal* **24**:10.1002/smj.v24:10, 997-1010. [CrossRef]

179. IAN WILLS. 2003. INFORMATIONAL BARRIERS TO POLLUTION REDUCTION IN SMALL BUSINESSES. *Economic Papers: A journal of applied economics and policy* **22**:10.1111/ecpa.2003.22.issue-2, 84-94. [CrossRef]

180. G Gong. 2003. Convergence and polarization in global income levels: a review of recent results on the role of international technology diffusion. *Research Policy* **32**, 1055-1079. [CrossRef]

181. Sidney G. Winter. 2003. Mistaken Perceptions: Cases and Consequences. *British Journal of Management* **14**:10.1111/bjom.2003.14.issue-1, 39-44. [CrossRef]

182. Michael J. Radzicki. 2003. Mr. Hamilton, Mr. Forrester, and a Foundation for Evolutionary Economics. *Journal of Economic Issues* **37**, 133-173. [CrossRef]

183. Steven CavaleriToward a More Pragmatic Knowledge Management 327-346. [CrossRef]

184. Luan Carlos Santos Silva, Carla Schwengber ten Caten, Silvia GaiaTechnological Forecasting of Sustainable Products: 174-192. [CrossRef]

185. SMEs, Institutions, and Performance 22-41. [CrossRef]