Finnish Economic Papers – Volume 7 – Number 1 – Spring 1994

EVOLUTIONARY METAPHORS AND THE JUSTIFICATION OF ECONOMIC EFFICIENCY*

MARINA BIANCHI

Department of Economics and Environment, University of Cassino, Via M. Mazzaroppi, s.n., I-03043 Cassino (Fr), Italy

The selection principle of evolutionary biology seems to save the economist from having to specify all the complexities of individual optimizing choices. But concentrating exclusively on the outcomes of evolutionary processes as efficient states does not carry us very far. Either the achievement of efficiency has to be restated using the individual optimization rule, which deprives the evolutionary process of any special explanatory role; or, given that optimization provides insufficient guidance in a world of uncertainty, then it remains unclear just how the efficient social outcome is obtained. The alternative proposed and illustrated here is to break the link between selection and efficiency and to enlarge the sense of efficiency to include innovation and learning. (JEL A1)

1. *Introduction*

The last two decades have seen a fresh deployment of evolutionary notions towards explaining economic phenomena. The growing literature on technological change and organizational forms, the new-institutionalist analyses of firm behavior, work on evolutionary games, even certain dynamic models in macro-economics, are all examples of the progressive extension of biological-evolutionary explanations into the economic field. This widespread use of the analogy has been thought to provide an alternative framework for addressing problems that the traditional theory was unable to address or silently overlooked. In particular, how rules of behavior, conventions and institutions are supposed to emerge and prevail, how strategic players interact over time, how agents are supposed to respond innovatively in specific problem situations, represent some of the new analytical domains in which this different explanatory framework is engaged and »tested».

The problem of efficiency enters in two ways in these different research domains. Firstly, all these new problems arise because the conditions under which perfectly informed agents interact optimally are in one sense or another suspended. If, for example, the use of purely market transactions involves some costs, due to the presence of uncertainty, or of opportunistic behavior, perfectly competitive markets no longer guarantee the optimal allocation of resources. How alternative transaction forms can arise and solve this problem is the topic of new-institutionalist analyses of the firm, such as those of Williamson and Coase.

Secondly, if we abandon the world of perfectly optimizing agents and costless information and replace it with a process of evolution that tentatively selects behavior and organizational forms, can we still assume that the result of this process is »efficient»? In other words,

* *I would like to thank Neil de Marchi, Maarten Janssen, Viktor Vanberg, and two anonymous referees, for their helpful suggestions. The financial support of the Italian National Research Council (Consiglio Nazionale delle Ricerche), MURST 40 %, is gratefully aknowledged.*

can we say that, by virtue of selection, the surviving social structure are more »efficient» than the ones they replaced? The attempts, openly or latently practised, to answer »yes» to this question, are very many in the new economic literature. Evolution is seen as that process which guarantees the efficient result that the strong or patently false assumptions of traditional theory prevented. The Panglossian paradigm which, to anticipate the criticism of Gould and Lewontin (1979), informs much of the adaptionist program in evolutionary biology, may in this way simply be transferred to economics. However, as in evolutionary biology, this is not the only and inevitable outcome of the use of evolutionary processes.

This paper is concerned with the analysis of some of the difficulties, challenges, and alternative solutions that the use of evolutionary metaphors has introduced into economics. The paper is organized as follows.

I start by looking at an earlier and very instructive debate, in which many of the issues later reintroduced were raised.[1] This is the debate which took place in the early fifties and involved Armen Alchian (1950), Stephen Enke (1951), and Edith Penrose (1952). The idea, first suggested by Alchian in an article published in the *Journal of Political Economy,* was to »solve» the difficulty of optimizing behavior in the presence of uncertainty by introducing selective processes. »Natural selection is substituted for purposive profit maximization behavior» is how Edith Penrose (1952: 812) synthetically conveyed Alchian's notion. The debate which followed mainly shows that Alchian's attempt was a failure. The analogies were in fact mechanical, the effective steps governing selection processes left obscure. The maximizing principle was modified in order to include uncertainty but operated in an imprecise way, thus making the reference to evolution merely rhetorical. Still, it is the merit of Alchian's paper that he posed the question at all, as to what sort of mechanism or process can replace the simple individual efficiency rule in a world of uncertainty and change.

A second phase of this debate can be traced to those attempts which apply evolutionary arguments to explain the endogenous emergence of social rules and norms. Though new analytical tools (such as game theory) are offered to help reconstruct the process of how social outcomes are selected and stabilized, in these new contributions the problem of efficiency continues to be problematic and the tendency simply to identify the origin and persistence of an institution with its efficiency may empty the process of any explanatory potential.

In the final part of the paper I try to suggest that the efficacy and role of evolutionary processes lie more in their ability to produce change and self-correcting systems than in the selection of optimal outcomes. The meaning of efficiency and »fitness» of rules of behavior and norms must be modified in the direction of flexibility, adaptability, and the ability to experiment with new options. Is this change of framework of any help in economic analysis? Some economic examples in the field of the theory of the firm and competitive markets suggest some of the directions these developments might take.

2. *Selective processes as unplanned optimization*

Alchian's reference to biological analogies was meant to dispense with the assumption that firms maximize in a world of incomplete information and less than perfect foresight. When uncertainty over future events exists, says Alchian (1950: 212), firms cannot foresee the result of their actions. They can attach different probability distributions to different potential outcomes and then select those plans that have a subjective optimal distribution. But this cannot involve any maximizing procedure because it is impossible to maximize a distribution (ibid.: 212). Take the example of an entrepreneur who faces two possible alternatives, one with a lower, another with a higher expected mean profit, but with the two frequency distributions having different dispersions. The first may imply very low gains and very low losses; the second, on the other hand, may imply very high gains but very high losses. No optimizing ability can help us to choose between these two alternatives. Things being this way, should we abandon any attempt to explain and predict firms' market behavior?

It is at this point that, in Alchian's view, the evolutionary metaphor may prove helpful. To

[1] *I take as given here the evolutionary metaphors that one may find in Marshall and even in Smith (see Houthakker 1956).*

succeed and survive firms must make positive profits: firms which make positive profits are selected as survivors, those which suffer losses disappear (ibid.: 213). Even if firms' choices were purely random, still the environment would select or »adopt» those firms which happen to be efficient or make positive profits. »Realized positive profits, not maximum profits are the mark of success and viability» (ibid.: 213). Whatever the wisdom, perspicacity and motivation of the individual firm, the economist, knowing the general requisites for survival, can still predict, for alternative potential situations, the types of firms that would more likely be viable or adopted.

Stephen Enke, in an article published in 1951, extended Alchian's idea to the *conditions* under which selective processes become operative. As with Alchian, in the face of future uncertainty, the profit-maximizing *motive* does not provide the entrepreneur with a clear and unique criterion of behavior (1951: 567).[2] The economist therefore cannot predict entrepreneurs' choices and courses of actions in the short run.[3] But it does not follow that he can never predict *aggregate* firm behavior in the *long run*. In this case, if there is no competition, »a great many policies, all good, but only one best», will permit an isolated monopoly to survive. But if there is *intense competition*, natural selection will tend to select only those firms that »either through good luck, or great skill» have been able to optimize their behavior and realize the profits necessary for survival. »In these instances the economist can make aggregate predictions *as if* each and every firm knew how to secure maximum long-run profits» (ibid.: 567, emphasis added). In the presence of intense competition therefore the »as if» approach and the viability analysis are interchangeable; even if, for Enke, the viability analysis is superior because it does not burden entrepreneurs with an unrealistic degree of omniscience (ibid.: 573).

3. Competitive selection and the problem of knowledge

Edith Penrose's analysis and critique of the viability thesis as developed by Alchian and Enke follow two lines of reasoning. The characteristic of the biological analogy, she argues (1952: 812), is to provide »an explanation of human affairs that does not depend on human motives». The outcome is determined not »by the individual participants, but by an environment beyond their control» (ibid.: 812). However, she adds, if we eliminate purposive profit maximization from individual firm behavior, we cannot explain competition and the »excessive entry» that would ensure that only the best adapted firms would survive. The occurrence of competition depends on the constant creation of new firms, but without a motivation such as optimization it is hard to see why new firms should be created at all. If firms are presumed to act randomly, in fact, nothing in the reproductive process of the firms can ensure that more firms would be created than can survive (a mechanism that would parallel Darwin's proposition that organisms tend to increase at a geometrical rate) (1952: 812).[4] Penrose concludes that Alchian's model is therefore unable to explain the existence of competition (1953: 605).

The second, and even more relevant, line of criticism refers to the treatment of knowledge implied in the viability analysis. Penrose developed this more extensively in a rejoinder to Alchian (1953: 603–608). The selection, from among all competitive firms of the most appropriate ones as survivors, can only refer to those optimal conditions that are part of the economist's advance knowledge of the general

[2] *To show that the simple motivation of maximizing does not provide any simple matching criterion of choice in presence of uncertainty, Enke offers the following example (Enke 1951: 568). Two roulette players are given one hundred dollars each, but one is told to maximize profits while the other is told to maximize losses. Despite their opposite motivations, both will choose a number (rather than a color).*

[3] *The various assumptions advanced to solve this problem do not offer, in Enke's view, a way of escaping the difficulty. The assumption of perfect knowledge, for example, simply overlooks the impact of a changing environment. The assumption of the law of averages in the presence of repetitions of the game, simply ignores that some choices, like investments, involve often unique decisions. The expected utility theory represents only one of the many possible criteria governing entrepreneurs' choices.*

[4] *Though Alchian and Enke probably would not deny that firms are motivated to maximize profits, they would argue that this motivation is not a practicable criterion of choice when uncertainty is present. But the criticism still holds: without any specific criterion of choice, how does selection operate?*

conditions of production and demand functions. »Were it in fact otherwise, Alchian's model would be reduced to a circular proposition that only the most appropriate firms survive because those that survive are the most appropriate» (ibid.: 604). But if the »omniscience» of the economist extends in advance to the type of firm that can survive, why deny the same knowledge (or its transmission) to the firm? (ibid.: 608). »The proposition that uncertainty makes it impossible for businessmen to form reasonably accurate ideas as to how profits might be made, yet, on the other hand, does not interfere with the economist's ability to know what type of firm or activity can make profits, seems to me to be simply inconsistent» (ibid.: 608).

As Hirshleifer later noted (1977), Alchian's model, though subjectively indeterminate because of individual uncertainty, seems to be objectively deterministic, so that the problem that exists at the level of individual behavior is removed when aggregative behavior is treated. But, things being this way, it is easy to transform the model into a completely deterministic one. If an optimal course of actions for the firms actually exists, even if firms singly might not know it, this course can be either discovered by the firms themselves, or taught by the economist who is assumed to know it.[5] Alchian's and Enke's argument seems to lead to two alternatives, both theoretically poor. Either they simply identify the conditions of survival with the definition of survival, thus reducing the argument to a tautology, or, in order to avoid this alternative, they are forced to reconfirm the individual optimizing criterion which, however, was held to be unreasonable, given uncertainty.

In fact, the possibility of turning evolutionary arguments in favor of the validity of individual optimization rules, and making them predictive at the aggregate level, is the interesting twist introduced by Friedman to the debate. In using his »as if» argument, Friedman (1953) follows Alchian and Enke. Whatever a firm's behavior happens to be – habitual reaction or random chance – so long as it is consistent with rational and informed maximization of returns the business will prosper and expand, and, if it is not, the business will tend to lose resources (1953: 22). But this shows that, despite the unrealism or untestability of an individual optimization rule, this remains the only rule able to explain and predict how firms in the aggregate react to changing market conditions.[6]

However, just as evolutionary arguments did not help in avoiding the logical difficulty of individual optimization under uncertainty, so they do not seem to work when used in support of its validity, at any level, individual or aggregate. Winter clearly shows this point, following a line of reasoning similar to that of Penrose (Winter 1964: 240; see also 1971). Firms acquire and expand resources, says Winter, not instantaneously but over time. This means that firms which happen to be profit maximizers at one time will not necessarily continue to be consistent maximizers over time.[7] Therefore there is no reason to assume that these firms will be able to grow and overcome those firms which do not maximize. Take the case of firms behaving randomly. Here market forces cannot select profit maximizing firms for survival for the simple reason that there is no consistent profit maximizing behavior to be selected. Alternatively, if firms follow a routine which at a particular time is consistent with profit maximization, these firms will tend to expand and market prices to change. But in this altered environment why should the same firms still be closer to maximizing than others? Evolutionary arguments, Winter notes, cannot be used to rescue the efficiency assumption. This stands or falls on its own merits.

The first conclusion we can draw from this early debate is that the attempt to invoke selection arguments to justify market competitive efficiency despite possible individual inefficiency, was ineffectual. Not only is the effective dynamic process of the selection not reconstructed, and the end result simply as-

[5] *This is the assumption made by the Rational Expectations Hypothesis, where no distinction exists between agents and the model.*

[6] *See on this point the interesting observation made by Winter (1964: 232), that if strong evidence could be found in favor of the effective maximization procedures, such evidence would be enthusiastically received as a supporting proof of the traditional analysis. Friedman's auxiliary hypotheses are simply ex post amendments to the theory, ruling out tests considered appropriate ex ante.*

[7] *See the same argument in Popper (1972: 69): »...we also know that some of the most successful animals have disappeared, and that past success is far from ensuring future success.» See also Gould 1989.*

sumed, but the only »process» or behavioral assumption that seems to lend support to the aggregate competitive efficient outcome is the individual optimization rule. This reaffirms the same rule whose weakness the new analogy was invoked to amend. But if this is the conclusion, no new insight is added to the already existing theory and the analogy is superfluous.[8]

The result is that the evolutionary analogies have either to be abandoned or to be used in a different framework where the process is carefully specified and the role and meaning of the efficiency rule clarified. Nelson and Winter's analysis of technological change was an attempt in this direction. Their analysis is based on a combination of evolutionary selection processes, behavioral rules formed on the hypothesis of bounded rationality, and Schumpeter's ideas on innovative change. Firms are seen as reducing the complexity of their decision problem to routines, norms of behavior and organization forms which diffuse through imitation and through »genetic» inheritance. As in the biological counterpart, routines here represent self-replicating genotypes, firms are the organisms that, by interacting with the environment, cause the replication of relevant genes to be differential, and profitability measures relative fitness (for the distinction between interactors and replicators, see Hull 1981). But, as Alex Rosenberg convincingly shows (1992: 24), in this model the firm is the organism, the unit of evolution, *and* the lineage, the entity that actually evolves and is responsible for intergenerational changes. Through the searching out of routines, and selection, the firm grows in size and evolves. This means that, for the evolutionary analogy to count, the firm's improved fitness must transmit to its descendants. One can imagine the firm becoming so well adapted as to transform into a natural monopoly, so that at the end of a period of evolution only one individual is left, more vulnerable to extinction because of exogenous changes. In order to avoid this conclusion one can invoke a Lamarkian approach. But that amounts to a surrender, since »anything can evolve into anything by any means» (ibid.: 24). Rosenberg tries to avoid treating the firm as both interactor and lineage, thereby reformulating Nelson and Winter's analysis in terms of organization theory. This, however, deeply modifies their original theoretical modelling structure.[9]

Despite these and other problems, the important contribution of Nelson and Winter and of similar attempts (see for example Nathan Rosenberg 1982) is to have linked evolutionary processes to the *institutional* character of economic structures. The firm exists as an organizational form in which the specific environment plays a role. But if firms are one of the multiple organizational structures which populate the economic environment, how did these structures emerge? How do they interact and outcompete each other? It is to this larger framework of institutional structures that I want now to turn.

4. *The emergence of economic structures*

In the earlier debate, firms' selection and their growth, were the object of study, but the existence of firms, their markets and the competitive structures within which they interact, were all taken as given, as the original units. Still, all these structures are institutional forms that have emerged and prevailed over time.[10]

The new-institutionalist literature adopts an enlarged evolutionary metaphor to investigate how institutional forms arise, which are stable and why (for a detailed analysis of the recent developments and problems see Langlois 1989, Vanberg 1989, Rutherford 1989). Within this framework the reference to evolution involves not simply the competitive process which should select the efficient firms, but

---

[8] *As Alchian, strangely, seems to imply when he says that his analysis holds independently of the biological analogy (1953: 601).*

[9] *In the biologist's discipline, as in organization theory, the »purely theoretical modelling comes much later, and has little additional explanatory or predictive power» Rosenberg 1992, 26. For an analysis of the distinction between replicators and interactors, and a discussion of their role, see Brandon 1990.*

[10] *A famous defender of the necessity of shaping economics in terms of a »cumulative growth of habits of thought» is Veblen (1930 [1898]: 78), who strongly emphasizes the endless process of growth and change of economic life, and opposes it to the static state of marginalist analysis. Yet, how Veblen's evolutionary view remains contradictorily mechanical, is shown in detail by Langlois 1989. A comparison between Veblen's analysis of routines and the new-institutionalist individualistic approach is made by Hodgson 1989.*

more extensively what kind of social structures, institutions and norms may be able to prevail and favor a coordinated social outcome.

Interest in these problems can be traced back to Hayek (and before him to Menger and to the pre-Darwinian analyses of the Scottish philosophers of the eighteenth century) who represented the emergence of orderly economic structures such as markets, competition and prices as the unintended result of individual intentional actions. With a starting point very similar to that of the debate just analysed, the social, aggregate outcome turns out to be different from individual intentions and drives. For Hayek, in the complex structure of modern society where knowledge is dispersed and fragmented among different and self-interested individuals, no common plan or omniscient legislator can solve the problem of connecting the individual fragments of information, or create order where only private interests exist (Hayek 1948, 1978). But if not in conscious design, where can the coordinating principle be found? Hayek's solution, as it was Smith's, relies upon what have rightly been called »invisible hand» explanations (Ullmann-Margalit 1978, Elster 1979, Vanberg 1986), where a gradual and complex process of evolution allows the hidden connection of separate plans to emerge and prevail. Within this approach evolution is thought of as a process of trial and error, of experimentation with alternative, competing solutions to repeated social problems. Over time new conventions, rules of conduct, institutions, are selectively adopted and imitated. The inconveniencies of their violation, once experienced, reinforce them and enable them to persist (Sugden 1989).

The relevance ascribed to the *process* of rule emergence, and the analysis of its experimental evolution is one of the major contributions and the distinguishing feature of the new-institutionalist explanations (for an analysis of this point see the vast array of contributions in the volume edited by Langlois, 1986, which represents the first systematic reflections on the topic). But what types of rules do in fact emerge as a result of this process and what are their characteristics?

The leading idea here is that institutions develop by a process of elimination of those less effective in reconciling divergent interests (Hayek 1967: 100, and 1988: 46). Rules of conduct which prove to be beneficial to the members of society will tend to evolve, displacing those which are less beneficial. As the biological analogy suggests, and as the previous discussion has confirmed the outcome of the process of evolution is associated with the emergence of those forms of social structures that are more »fit». When a more precise analytical structure is given to this idea, as in works such as Schotter's, »organic» institutions are viewed as the optimal response to a repeated problem of cooperation among uncooperative players (Schotter 1982, also Axelrod 1986). Despite the fact that we cannot »see» the evolution occurring, selection of the fittest nonetheless provides the invisible mechanism.[11] How can this end result be sustained, and what are its implications?

5. *The artificer bias and the efficiency bias*

In a well known paper by Ullmann-Margalit (1978) on invisible hand explanations, often quoted to underline the complexity of these kinds of explanations (Vanberg 1986, Langlois 1989), there is an interesting and instructive point made, which it is worth taking time to reflect on. Structured social patterns, which we explain by invoking the invisible hand, actually *look* as though they are consciously designed (ibid.: 268 ff.). When the social activities of dispersed individuals present pattern, regularity and coordination, we »naturally» infer an intentional planner, an omniscient artificer standing behind it all. What Ullmann-Margalit calls the »artificer bias» characterizes these as »visible-hand» explanations: well-patterned social structures are modelled *as if* they were intentionally designed. A great merit of invisible hand explanations, by contrast, is that they offer a counter model to explain these seemingly planned social structures and to reverse the artificer bias (ibid.: 268).

Explanations based on the view that institutions are the unintended outcomes of intentional actions, however, are vulnerable to another kind of bias. They describe institutions

11 »The whole purpose of optimality as a heuristic is to avoid the problem of measuring the Darwinian fitness of different types and of treating the full dynamical problem of changes in population composition by selection» (Lewontin 1987: 153).

and social patterns which perform socially useful functions, which are »beneficial» to the members of society, providing positive externalities. Moreover, where such institutions and patterns persist, they represent a form of stability, which also suggests that they fill a positive role. *Therefore,* it is inferred, they (must) have tentatively emerged and selectively won from among alternative solutions *because* of their efficiency. However, as Ullmann-Margalit notes, this form of functionalist argument provides no logical clue to an account of the genesis of an institution. In these explanations function ascribing simply substitutes for the process of the emergence of an institution. This important point is very similar to criticisms by others of this kind of explanation (Elster 1979, Vanberg 1986, Rowe 1989) and it is echoed in some of the more sceptical writers in evolutionary biology.[12] I shall refer explicity to these criticisms in a moment. However, we can immediately notice that, if selection processes systematically adopt the best institutional forms, the social outcome, though independent of individual plans, ends up obeying an overall rational plan (the mechanical analogy of Smith and the natural analogy of Hayek: see Sugden 1990). As in the previous discussion, the end result of the process seems to imply the very assumption – an omniscient artificer – which it was denied could be operative. In both cases this assumption makes the process itself redundant.

6. *Strategic interaction and social order*

I have just argued that the idea of justifying the emergence of progressively more efficient forms of institutions rests upon a form of (circular) backward induction, where the existence of social institutions is inferred from the positive externalities they provide and which would not be enjoyed without them. As Ullmann-Margalit remarks, efficiency can explain also the genetic account of an institution, »why it is there» (Ullmann-Margalit 1978: 280). However, that the efficiency argument *does not* in fact suffice as an explanation of the origin of an institution may be – and has been – shown in numerous ways.

The Panglossian trap which undermines many of the selection explanations has been repeatedly emphasized in evolutionary biology (for example, Gould and Lewontin 1979). For instance, once a morphological feature has been identified, »sufficient ingenuity» can always provide several plausible hypotheses to justify its selective advantage (Duprè 1987: 3). But the amount of knowledge which is required to identify the specific constraints that define a particular selection problem (Rosenberg 1992), on the one hand, and the difficulty of abstracting a functional character from a set of integrated characters in an organism (Lewontin 1987), on the other, will render these optimality hypotheses very difficult to test. For the validity of the optimality argument the outlook is not very positive. (A whole range of positions on this topic is in Duprè 1987).[13]

Recent developments in the analysis of the emergence of social institutions have added new insights to the ones just mentioned. In large parts of this literature institutions are seen as a solution to recurrent problems of social interaction represented as strategic games. The game situations used are of the non-cooperative type. These situations, by not allowing players to communicate or to form binding contracts, are seen as more appropriate for representing the emergence of »unplanned» institutions. (For a discussion of this literature see Bianchi 1993).

To take an example, consider a state of the world where a system of property rights exists with another which is in every respect similar to the first, but with no property rights and with socially costly »stealing» or »transfer» activity (see Rowe 1989). In this situation it is easy to argue that the first state of the world, being Pareto superior to the second, will eventually prevail: self-seeking, rational individuals will obviously prefer the more efficient

---

[12] *See for example Gould and Lewontin: »One should not confuse the fact that a structure is used in some way... with the primary evolutionary reason for its existence and conformation» (1979: 587). Or see Lewontin (1987: 157) when he says that optimization theory regards what exists »as defining the domain of the possible». See also Sober and Lewontin 1982.*

[13] *See for example Lewontin's conclusions. Since optimization makes sense only if it is optimization over constraints, these constraints must be specified. If we allow for a larger set of constraints which include historical accidents and genetic drifts, the theory becomes vacuous. If we do not, the theory is bound to be false (1987: 159).*

state and will select it through a repeated process of trials against the less efficient one. But this argument simply forgets that socially beneficial outcomes, even if they exist, may *not* be achievable by individuals (ibid: 68). This is the case, of course, of Prisoners' Dilemma (PD), where every individual's dominant strategy in a single game is to play against a socially preferred outcome, cooperation (see Axelrod 1986, Tuomela 1991).[14] In the Hobbesian state of nature depicted by the example, this means that conflict will rationally prevail against a system of laws. Simply to assume the emergence of the socially desirable outcome, as in functionalist-genetic explanations, is, as Rowe notes, to violate the individualistic rule and to fall into a fallacy of composition in reverse (Rowe 1989: 69).

In somewhat similar manner it can be shown that the reverse is also true. Even if some form of efficient cooperative outcome is achieved as a result of a repeated antagonistic situation of PD type and appears to be stable over time, this outcome may not be the most efficient available option. The temptation to infer from the persistence of an institution that ist selected traits are efficient is the trap which some New Economic History analyses fall into in trying to deal with the problem of the origin of institutions. An articulate analysis and criticism of this kind of explanation is made by Binger and Hoffman (1989) and I shall borrow their main results.

The institution to be explained in this case is the open field system and the scattering of strips which characterized the system of agricultural organization in England and much of continental Europe from the eighth to the thirteenth century. Many different explanations have been advanced for explaining the origin and persistence of the open field system, but these converge on showing that the form adopted was the long run equilibrium solution to a problem of allocating a public good. The retention of scattered but intermingled strips of land held by the members of a community is rationalized as a form of crop insurance (McCloskey 1972) or as a case of scale economies (Fenoaltea 1975). Their joint use, it is suggested, is efficient, given the public goods problems associated with there being no fences. A cooperative solution avoids the costs associated with fencing and the losses from not fencing.[15] However, from the point of view of modern agricultural techniques, as Binger and Hoffman note, the open field was not an efficient institution, because a system of grain and fodder crops used in rotation would yield higher outputs and result in fewer crop failures. Moreover, this latter system was already known at the time, but not adopted. To justify the persistence of what looks like an inefficient institution the authors refer to the incidence of coalition voting cycles, to the costs of shifting to a different public good, and to the multiple equilibria of repeated PD games. Whatever the specific reason(s) for the persistence of this institution, the lesson is that in the New Economic History explanations »each author is assuming the existence and possibility of an efficient cooperative solution. However, just because an institution appears, *ex post,* to solve some Prisoner's Dilemma problem, it does not mean that other, more efficient, institutions existed but were not realized [adopted]» (Binger and Hoffman 1989: 77). A similar conclusion is reached by Ostrom (1989), again in an analysis of the problem of providing public goods.

These conclusions are not confined to those non-cooperative repeated game situations which, like the ones just analysed, involve some conflict among players. Game situations of the »coordination» type, where the players share a common interest, and no temptation to defect exists, but where no prior communication or agreement is allowed, may be thought most likely to yield solutions in the form of the spontaneous emergence of mutually beneficial conventions and rules. However, as has been now repeatedly shown (Schelling 1960, Sugden 1989), these situations may imply multi-

[14] *For the biological version of the free-rider problem here described, see the mathematical models of selection developed by Maynard Smith (1982). Some aspects of the longlasting debate about group selection, and the problem of identifying the units of evolution, can be found in the discussion between Sober and Maynard Smith in Dupre' 1987. A critical analysis of Sober's position is in Brandon 1990. Further discussion on this topic is provided in Hodgson 1991a. Selten 1991 contains interesting hints on how evolutionary analogies might be incorporated into game theory.*

[15] *Alternative accounts stress the scarcity of grazing land and availability of fodder crops or population growth and the expansion of arable production, as the social problems whose solution was provided by the common field system (see Binger and Hoffman 1989).*

ple equilibrium outcomes or an equilibrium outcome which is not necessarily the most efficient (see the examples given by Elster 1989, and by Hodgson 1991b).[16] In all these cases how to discriminate among equally optimal plans, or how to shift towards more efficient social rules, is not made clear by the simple efficiency rule. But if we reject any easy identification between efficiency and the result of evolution, the question remains: if it is not efficiency, what is the outcome of the evolutionary process?

7. *The ability to learn*

We have seen that the result of the evolutionary process leading to institutional forms is an unplanned result, independent of private actions. That is, it is somewhat new, unexpected; it is something like a surprise. Alchian's intuition about efficiency was right: individual optimizing is not enough if the social outcome of individual efforts is in some degree unpredictable. But he was wrong in thinking that for the same reason pure chance or good skills would work equally effectively. I have also argued that the social outcome, though unintented, is the result of intentional actions, of purposeful efforts. It is not simply chaotic, lawless, unstructured. It is a surprise, but a surprise that can be anticipated, expected, not least because it reflects, and is channeled by, individual plans and abilities (see Bianchi 1992). But what do these abilities represent?

If it is also granted that the process of evolution is a process of trial and error, of experimentation, then individual plans and actions represent exactly this experimental behavior. They represent an ability to try, to detect and correct errors, an ability to look for »surprise» and to incorporate it into action; to solve problems, to explore alternative solutions. In brief, evolution reflects an *ability to learn*. In this different framework, social order and institutions emerge as a result of this learning activity, of this *innovative* behavior. In fact, all the problem situations I have mentioned, including coordination problems and Prisoner's Dilemma problems, arise just because the simple maximization rule is not enough. Their solution cannot be found *within* the rules of the game; something *more*, something *new*, has to be introduced.

In PD problems, for example, the individual rationality rule prescribes that players should not deviate from the equilibrium solution, once this is reached. But these same situations, when repeated over time, without (a known) end, allow for a multiplicity of equilibrium solutions, including defection. How to select among them? This requires an ability which is not provided by the individual maximizing rule. Moreover, when we start from the »unsocial» solution, the equilibrium of defection, and seek a shift to the Pareto improving outcome of a cooperation solution, we find that this is rationally forbidden by the game. Within the structure of the game, the cooperation answer is a »mistake» and therefore is not pursued or experimented with any further. Only a change of the rules might involve the emergence and persistence of a new solution (see the discussion of this point in Rowe 1989 and in Bianchi 1993).

But this implies the experiment of trying out different new strategies which, within the specific game, are not efficient, but which, like the cooperative strategy, might *become* efficient through the experiencing of their effects and their gradual adoption.[17] The trick of many equilibrium solutions in game theory consists in *exogenously* changing the structure of the game to allow for the new solution to appear. But by this means the original problem is changed, by fiat as it were. This occurs, for example, in the case of »trembling hand» solutions, where the Pareto improving outcome,

---

[16] *Hodgson (1991b: 527–8) shows how the situation of a system locked into given paths is very similar to the biological idea of »hyperselection», where some positive feedback has the effect to »freeze» some given structure despite its possible initial inefficiencies. Similar situations arise also in the cases of frequency dependencies, or of multiple and shifting adaptive peaks, which may condemn organizational forms to suboptimal configurations. Conclusively, no automatic, »beneficent journey» towards efficiency frees us from the need of conscious intervention (ibid.: 521).*

[17] *In the specific case of PD situations players must learn to cooperate and to punish defection; in other words they must transform cooperation from an undominated (non-rational) strategy into a dominant one. These situations therefore »call for» learning, for new rules to be experimented with and discovered. A model of social learning applied to a frequency dependent evolution of cooperation is given by Witt 1986.*

cooperation, is reached simply by relaxing the hypothesis of players' rationality.[18]

An analogous example is the case of coordination problems, where the efficiency rule cannot be relied upon to explain selection from among multiple equilibrium solutions. Once one solution prevails, it is efficient to observe the rule; but its selection is *not* due to individuals pursuing efficiency (see Sugden 1989). The concept of »salience» or focal points, has been invoked to explain how the selection is made (see Schelling 1961, and Sugden 1986). What makes a rule emerge as the outcome of a coordination problem is that the rule has some kind of prominence that acts as a point of attraction for the players who therefore choose it as a solution. But the emergence of salient rules can coherently be explained and we can avoid an infinite regress explanation only if the rules are the result of a learning process.[19]

As these examples show, the unplanned result of the process of evolution is therefore channelled by the learning process. And an ability to learn is structured by the specific problem situation (e.g. how to *invent* the cooperative solution; how to *signal* the coordination outcome). The ability to experiment does not happen in vacuo, but within patterned structures, problems whose trial solutions amount to a specific social history. This is the same as saying that generalized functionalist explanations should be replaced by contingent explanations, exactly as Gould maintains against biological optimization explanations.[20]

As a result of this brief discussion we are led to conclude that the efficiency attribute is simply not enough to explain the emergence and persistence of social structures. It has to be enlarged to include learning and endogenous change. New tentative strategies are due to learning. Their partial success may stimulate their adoption and diffusion. The repetition of this success may give rise to norms which solidify and reinforce the change. Adaptiveness and flexibility may enable certain norms to persist. To go back to our initial discussion, attempts such as those of Nelson and Winter, though they enlarge the analysis of evolution to embrace the process, still restrict change to *exogenous* change and behavioral attitudes to maximization under some form of informational constraint (on this point, see Bianchi 1990). In fact efficiency has also, and probably mainly, to *include* innovativeness, i.e. the ability to create new boundaries and new rules when the old ones reveal themselves to be ineffective. In this different vision institutions do not simply constrain behavior, but enlarge its possibilities.

This result is not new. The recent literature on technological change has systematically pointed to the role of innovation in leading evolutionary processes (see, for example, Dosi et al. 1988 on path dependency). Less stressed is the point that innovation is not prior to but is the result of a learning activity.[21] However, the attention paid to the role of innovative behavior has suggested new uses and interpretations of the evolutive process. For example the

---

18 *It is interesting to note that the problem, when so formulated, raises a puzzle opposite to that which we encountered with Alchian's formulation. In Alchian the evolutionary process should guarantee the emergence of the fittest firms despite their individual inefficiency. Here the social outcome is suboptimal even if, or because of, individual efficiency. Paradoxically, the repetition of the game should here select some irrationality rule to guarantee a better outcome. This is in fact what is suggested by solutions of »trembling hand» type.*

19 *What still remains unanswered by this kind of argument is how salience becomes such. Sugden (1989 and 1991), for example, uses evolutionary games and Maynard Smith's concept of evolutionarily-stable equilibrium to explain the emergence of conventions, but he does not explain why some new experimental actions are started. His appeal to the role of Schelling's »focal point» simply refers to the presence of other forms of convention which therefore have to be explained regressively. Only if we allow players to be able to learn, to introduce new rules, can the selection of salient rules be explained. In this case players must learn not only to coordinate but also to signal their commitment to coordination.*

20 *In defence of historical contingent explanations, Gould says: »...both ends of the usual dichotomy – the inevitable and the truly random – usually make less impact on our emotions» (1989: 284). Rather than on emotions, one can think to their impact on learning. One learns the strictly deterministic once for all, and one can never learn the truly random. In both cases learning is superfluous.*

21 *For an analysis and criticism of those evolutionary explanations which overlook innovative behavior and treat it as pure »random variation», see Hallpike 1986, pp. 48 ff. Similarly, in much of the biological evolutionary literature we have referred to, optimality arguments are often criticized for their (un)testability, but nothing is said about their inability to incorporate innovativeness. For a different view, see the representation of markets as a creative process in Buchanan and Vanberg 1992.*

thesis that evolution is activated by a process of experimental trials finds new supporting evidence in recent experiments such as those of Allen (1988) and Allen and McGlade (1987). Here evolution is mainly due to non-average values, which give rise to dissipative structures and selforganizing systems, and to microscopic diversity and errormaking. Similar conclusions stressing the relevence of diversity and variation are reached by the biologist E. Mayr 1982. (For a discussion of this point see Buchanan and Vanberg 1992, and Hodgson 1991b). Simple ecological models of competitive reproduction, in particular, show that it is the error-maker who can eventually outcompete a perfectly reproducing rival. And this, despite the fact that at every instant it would be better *not* to make errors. These results show moreover that »evolution does not lead to optimal behavior, because evolution concerns not only 'efficient performance', but also the constant need for new discoveries» (Allen 1988: 107). Variability is part of the evolutionary strategy of survivors. In short, evolution is a continuing process, with selection favouring those individuals and social structures which have the ability to adapt and to learn. (ibid.: 109).[22]

Several economic examples can be provided to support the positive effects of this shift of interpretation.

Money is one. Money is the institution most often referred to as a solution to a problem of social coordination among independent actors (since the well known analysis of Menger, for which see Vanberg 1986). Money is analogous to the emergence of language, of codes of communication, of conventions and, like these kinds of institutions, provides positive externalities. But we may think that money acquires its selective strength because it is a solution which allows for an increase in flexibility of choice. Through money, decisions can be deferred till better conditions prevail. Money breaks the time constraint of decision problems, thus allowing for a measure of control over uncertainty, or for a reduction of information costs (Shackle 1972, Loasby 1991). Money therefore increases individual ability to learn and to translate anticipated change into choice.

The second example is represented by competitive markets. The way competition has been traditionally represented implies a set of assumptions – negligibility, the presence of an auctioneer, for example – under which coordination failures are simply excluded. In Alchian's and Enke's evolutionary view, competition can take over the job of eroding rents, above-normal profits and similar inefficiencies, by simply enlarging the number of homogeneous firms. In both cases interdependencies and conflicts of interest are absent. But, if competition is seen as a process of mutual interaction and contest, where agents' actions and choices mix and influence each other, there is always the possibility of others making new and better moves. How to prevent, how to outcompete, or to develop precautionary moves against this possibility, is the role that competition has to perform (see Bianchi 1993). Competition is the institutional setting which produces differentiation, comparative advantage, innovation, as much of the literature on New Industrial Organization tends to show (see Jacquemin 1987, Friedman 1983). Through competition, adaptability and learning become part of the evolutionary strategy of survivors and a reason for their adaptive success.

The third example is the firm as organizational form. All those specific problem situations linked to the environment of a strategically competitive world, like intertemporalities, market opportunities, product quality differentiation, necessitate the development of specific organizational structures. Firms can be seen as the organizational answer to these problem situations. But under the hypothesis of full optimization all such problems are absent, thus making the existence of firms unnecessary. This marks a major difference between the old (optimality) approach and the expanded evolutionary concept explored here. What is not even problematic to the optimality approach is, by contrast, basic to the structure of the firm (as should have been clear since Coase's 1937 article). Firms become learning structures whose internal organization permits flexible and sequential adaptation to change (on this originally »Schumpeterian» point see Penrose 1959, and among recent contributions, Best 1990, Morgan 1986, Baden-Fuller and Stopford 1992).

[22] *See Popper (1972: 70): »Only if the organisms produce mutations... and thus involve mutability, can they survive:... If the process of adjustment has gone on long enough, then the speed, finesse and complexity of the adjustment may strike us as miraculous» (thus it seems as if they were responding to a rule of efficiency).*

8. Conclusions

Many recent analyses in economics tend to borrow from evolutionary biology. By analogy, selection relieves us of the effort – assuming it to be possible at all – of specifying all the complexities of individual optimizing choices. The implied argument is that selection spontaneously achieves what is beyond any individual optimization.

What the paper shows is that these attempts to concentrate exclusively on the outcomes of evolutionary processes as efficient states does not carry us very far. Either the achievement of efficiency has to be restated using the individual optimization rule, which, however, deprives the evolutionary process of any special explanatory role; or, if this solution is rejected, because optimization is not seen as occurring in a competitive (contest) framework, then it remains unclear just how the efficient social outcome is obtained. Two alternatives have been suggested here. One is to break the link between selection and efficiency and to explore the specific complexity of problem situations and the trial solutions that emerge. The second, building on this, is to enlarge the sense of efficiency to include innovation and change. This raises the possibility that the allocation decision is expanded into a process of learning. Nothing ensures the result that this process selects the best outcome, or the socially most beneficial rules, but maybe the process ensures that the outcome, if not efficient, can at least be corrected and changed. In a world in which maintaining a competitive position requires constant change, »efficiency» as a static end result, loses its relevance, to be superseded by learning and flexiblity. As Penrose said, in the midst of the original debate: »After all, one of the more powerful effects of uncertainty is to stimulate firms to take steps to reduce it by operating directly on the environmental conditions that cause it and men have greater power consciously to change their environment than has any other organism» (Penrose 1952: 816).

References

Axelrod, R. (1986). »The Emergence of Cooperation among Egoists.» *The American Political Science Review*, 75, 306–18.

Alchian, A. (1950). »Uncertainty, Evolution and Economic Theory.» *Journal of Political Economy*, 58, 211–222.

Allen, P.M. (1988). »Evolution, Innovation and Economics.» In Dosi et al., eds. (1988), 95–119.

Allen, P.M., and J. McGlade (1987). »Evolutionary Drive: the Effects of Microscopic Diversity, Error-making and Noise.» *Foundations of Physics*, 17, No. 7, 723–38.

Baden-Fuller, C., and J.M. Stopford (1992). Rejuvenation: The Competitive Challenge to Maturity. London: Routledge.

Best, H.M. (1990). *The New Competition: Institutions of Industrial Restructuring*. Cambridge, Ma.: Harvard University Press.

Bianchi, M. (1990). »The Unsatisfactoriness of Satisficing: from Bounded Rationality to Innovative Rationality.» *Review of Political Economy*, 2, 149–167.

— (1992). »Knowledge as Expected Surprise. A Framework for Introducing Learning in Economic Choice.» *Research in the History of Economic Thought and Methodology*, 10, 43–58.

— (1993). »How to learn Sociality: True and False Solutions to Mandeville's Problem.» *History of Political Economy*, 25, No. 2, 209–241.

Binger, B.R., and Hoffman (1989). »Institution Persistence and Change: the Question of Efficiency.» *Journal of Economic Organization and Theoretical Economics*, 145, 1, 67–84.

Brandon, R.N. (1990). *Adaptation and the Environment*. Princeton: Princeton University Press.

Buchanan, J.N., and V.J. Vanberg (1992). »The Market as a Creative Process.» *Economics and Philosophy*, forthcoming.

Coase, R.H. (1937). »The Nature of the Firm.» *Economica*, 386–405.

Dosi, G., C. Freeman, R. Nelson, G. Silverberg, and L. Soete, eds. (1988). *Technical Change and Economic Theory*. London: Pinter.

Duprè, J., ed. (1987). *The Latest on the Best. Essays on Evolution and Optimality*. Cambridge, Mass.: MIT Press.

Elster, J. (1979). *Ulysses and the Syrens. Studies in Rationality and Irrationality*. Cambridge: Cambridge University Press.

— (1989). »Social Norms and Economic Theory.» *Journal of Economic Perspectives*, 4, 99–117.

Enke, S. (1951). »On maximizing profits: A distinction between Chamberlin and Robinson.» *American Economic Review*, 41, 566–578.

Fenoaltea, S. (1975). »Authority, Efficiency and Agricultural Organization in Medieval England and Beyond: A Hypothesis.» *Journal of Economic History*, 4, 693–718.

Friedman, M. (1953). *Essays in Positive Economics*. Chicago: Chicago University Press.

Friedman, J. (1983). *Oligopoly Theory*. Cambridge: Cambridge University Press.

Gould, S.J. (1989). *Wonderful Life. The Burgess Shale and the Nature of History*. New York: Norton & Company.

Gould, S.J., and R.C. Lewontin (1979). »The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme.» *Proc. Roy. Soc. Lond.* B, 205, 581–598.

Hallpike, C.R. (1986). *The Principles of Social Evolution*. Oxford: Clarendon Press.

Hirshleifer, J. (1977). »Economics from a Biological Point of View.» *Journal of Law and Economics*, 20, No. 1, 1–52.

Houthakker, H.S. (1956). »Economics and Biology: Specialization and Speciation.» *Kyklos*, 9, 180–200.

Hodgson, G.M. (1989). »Institutional Economic Theory: the Old versus the New.» *Review of Political Economy,* 1, No. 3, 249–269.
— (1991a). »Hayek's Theory of Cultural Evolution: An Evaluation in the Light of Vanberg Critique.» *Economics and Philosophy,* 7, No. 1, 67–82.
— (1991b). »Economic Evolution: Intervention Contra Pangloss.» *Journal of Economic Issues,* 25, No. 2, 519–533.
Hull, D. (1980). »Individuality and Selection.» *Annual Review of Ecology and Systematics,* 11, 311–332.
Jacquemin, A. (1987). *The New Industrial Organization.* Oxford: Oxford University Press.
Langlois, R.N., ed. (1986). *Economic as a Process. Essays in the New Institutional Economics.* Cambridge. Cambridge University Press.
— (1989). »What is Wrong with the Old Institutional Economics (and What is still Wrong with the New)?» *Review of Political Economy,* 1, No. 3, 270–298.
Loasby, B.J. (1991). »Efficient Institutions.» *Quaderni di Storia dell'Economia Politica,* IX, 2–3, Vol. I, 115–132. (Alfred Marshall International Centenary Conference, Florence, Dec. 1990).
Lewontin, R.C. (1987). »The Shape of Optimality.» In Duprè, ed., 151–159.
McCloskey, D.N. (1972). »The Enclosure of Open Fields: Preface to a Study of Its Impact on the Efficiency of English Agriculture in the Eighteen Century.» *Journal of Economic History,* 1, 15–35.
Maynard Smith, J. (1982). *Evolution and the Theory of Games.* Cambridge: Cambridge University Press.
— (1987). »How to Model Evolution.» In Duprè, ed., 119–131.
Mayr, E. (1982). *The Growth of Biological Thought. Diversity, Evolution, and Inheritance.* Cambridge, Mass.: Harvard University Press.
Menger, K. (1892). »On the Origin of Money.» *Economic Journal,* 239–255.
Morgan, G. (1986). *Images of Organization.* Beverly Hills: Sage.
Nelson, R.R., and S.G. Winter (1982). *An Evolutionary Theory of Economic Change.* Cambridge, Mass.: Belknap Press.
Ostrom, E. (1989). Governing the Commons. The Evolution of Institutions for Collective Action. Indiana University, mimeo.
Penrose, E. (1952). »Biological Analogies in the Theory of the Firm.» *American Economic Review,* 5, 804–819.
— (1953). »Rejoinder.» *American Economic Review,* 4, 603–609.
— (1959). *The Theory of the Growth of the Firm.* Oxford: Oxford University Press.
Popper, K.R. (1972). *Objective knowledge. An Evolutionary Approach.* Oxford: Clarendon Press.
Rosenberg, A. (1992). Does Economic Theory Give Comfort or Inspiration to Economics? University of California, Riverside, mimeo.
Rosenberg, N. (1982). *Inside the Black Box: Technology and Economics.* Cambridge: Cambridge University Press.
Rowe, N. (1989). *Rules and Institutions.* Hemel Hempstead: Philip Allan.
Rutherford, M. (1989). »What is Wrong with the New Institutional Economics (and What is still Wrong with the Old)?» *Review of Political Economy,* 1, No. 3, 298–318.
Schackle, G.L.S. (1972). *Epistemics and Economics.* Cambridge, Cambridge University Press.
Schelling, T.C. (1960). *The Strategy of Conflict.* Cambridge, Mass.: Harvard University Press.
Schotter, A. (1981). *The Economic Theory of Social Institutions.* Cambridge, Cambridge University Press.
Selten, R. (1991). »Evolution, Learning and Economic Behavior.» *Journal of Economic Literature,* 3, No. 1, 3–23.
Sober, E. (1987). »What is Adaptationism?» In Duprè, ed., 105–118.
Sober, E., and R.C. Lewontin (1982). »Artifact, Cause, and Genic Selection.» *Philosophy of Science,* 49, 157–180.
Sugden, R. (1989). »Spontaneous Order.» *Journal of Economic Perspectives,* 3, No. 4, 85–97.
— (1990). Naturalness and the Spontaneous Order of the Market. University of East Anglia, mimeo.
— (1991). »Rational Choice: A Survey of Contributions from Economics and Philosophy.» *Economic Journal,* 407, 751–785.
Tuomela, R. (1991). »On the Structural Aspects of Collective Action and Free-Riding.» *Theory and Decision,* 32, No. 2, 165–202.
Ullmann-Margalit, E. (1977). »Invisible-Hand Explanations.» *Synthese,* 39, 263–291.
Vanberg, V. (1986). »Spontaneous Market Order and Social Rules.» *Economics and Philosophy,* 2, 75–100.
— (1989). »Carl Menger's Evolutionary and John R. Commons' Collective Action Approach to Institutions: a Comparison.» *Review of Political Economy,* 1, No. 3, 334–360.
— (1990). Innovation, Cultural Evolution and Economic Growth. George Mason University, mimeo.
Veblen, T. (1989). »Why is Economics not an Evolutionary Science?» *Quarterly Journal of Economics,* July; repr. in T. Veblen (1930). *The Place of Science in Modern Civilization, and Other Essays.* New York: The Viking Press.
Williamson, O.E. (1975). *Markets and Hierarchies. Analysis and Antitrust Implications.* New York: The Free Press.
Winter, S.G. (1964). »Economic Natural Selection and the Theory of the Firm.» *Yale Economic Essays,* 4, 255–272.
— (1971). »Satisficing, Selection and the Innovating Remnant.» *Quarterly Journal of Economics,* 85, No. 2, 237–261.
Witt, U. (1986). »Evolution and Stability of Cooperation without Enforceable Contracts» *Kyklos,* 2, 245–266.