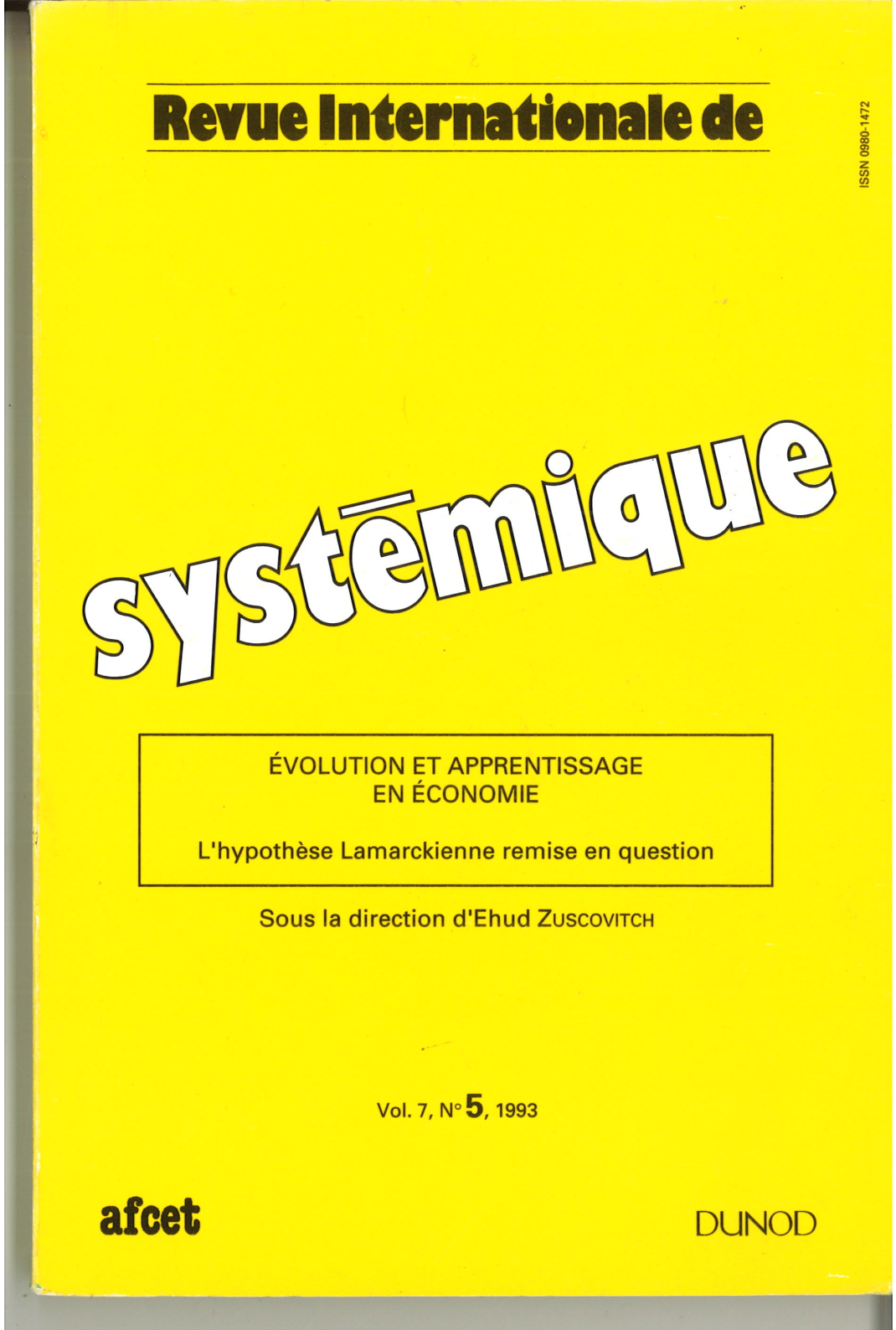

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EVOLUTIONARY ECONOMICS AND THE LAMARCKIAN HYPOTHESIS: TOWARDS A "SOCIAL IMPERFECT COMPETITION"?

Ehud ZUSCOVITCH[1]

Abstract
The Lamarckian Hypothesis is used in this paper as a metaphor to study the relationship between learning and evolution in economics. It is suggested here that the theory of imperfect competition should integrate social mechanisms of identification as a foundation to coalition behaviour.

Résumé
L'Hypothèse Lamarckienne est employée ici en tant que métaphore de l'analyse des relations entre apprentissage et évolution en théorie économique. Nous suggérons que la théorie de la concurrence imparfaite devrait inclure des mécanismes d'identification sociale pour expliquer le comportement coopératif et la formation de coalitions.

I. The scope of evolutionary economics

The emphasis of the verb "to have" rather on "to be" in reaction to optimisation behaviour is a way to make a distinction between the way economists deal with their subject as contrasted with the way biologists deal with evolution. While economic agents are assumed to maximise a utility function, species are "concerned" with maximum fitness. From an economic standpoint, to present maximal utility as an objective *per se* is a view most XIX^{e} century classical economists would reject since their approach to minimum wages was to sustain the working man conditions of reproduction. Renewal of vigour for tomorrow's labour and caring for one's family needs was viewed as

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reproduction of the worker's own forces and reproduction of his "species". *To have* was seen as an intermediate objective for *to be*. Later, when wages were not set at the mere subsistence level, the analytical concern shifted from a theory of survival to a theory of choice. But as we look for the fundamentals of our existence, the biological conditions of survival resurface, and we use evolutionary arguments. Economics has made, of course, a wider use of biological metaphors, some of them very famous as the analogy to the blood circulation in the construction of the economic system by the Physiocrats. Others are less well-known such as the epidemiological foundation for discussion theory or the role of self-organisation applications for the study of structures.

Evolutionary arguments have not altogether disappeared from the standard economics textbooks. When we deal with the long run they pop in quite naturally. What stabilises the long run equilibrium is a flux of firms entering markets to grab profits or those that are being eliminated when their cost conditions (or fitness) fail to meet the minimum requirements of survival. In industrial organisation, for example, the theory of contestable markets tends to apply these arguments even in explaining "shorter" run competition pressures. As a matter of fact whenever economists tend to explain changes in market structure and concentration in particular, they call upon processes that rely on a type of population dynamics. Concentration will rise for instance as economic agents increase in size, in relation to, or as a function of, the *relative* success and failure of their norms of behaviour. It remains unclear to what extent this is within the domain of "long-run" economics. I would certainly opt for the opposite view that the arguments for perfect competition arguments do belong to the long run realm as they assume a world without change.

The type of population dynamics mentioned above occurs indeed within "environmental" conditions that have very little to do with perfect competition. Indeed, they involve asymmetric information structures, uncertainties of all types, and scaling-up effects. This is the natural "swamp" for those who deal with technological change because innovative activities often present all these "anomalies" together. In such a framework, innovations appear either as re-combinations or as mutations. Markets forces stand for the selection mechanism that act upon the permanently emerging agent and asset diversity[1]. The relationship between diversity and economic dynamism is, by the way, a common perspective to most of the economists that deal with development and growth independently of their belonging to a particular school of thought. Inter-agent, inter-industry and international differences are used, through various mechanisms, to explain patterns of development, international competition and catching up by developing countries[2].

Evolutionary thinking also provides a natural framework for presenting issues such as the relationship between minor innovations, major innovations and paradigmatic shifts; issues of continuity vs discontinuity and the respective roles of routines and change. When the time dimension in added to the analysis, this tendency to adopt evolutionary way of reasoning gains further relevancy as past choice influences future choice through various reinforcement mechanisms such as positive feedback loops, increasing returns to adoption (see Arthur, 1988, for a recent example) and replicator dynamis. Irreversibility is a major concern for those interested in evolution as it introduces a strong historical dimension into the development process (David, 1992). For example, in the presence of oil shortageby the chemical industry it is highly improbable that the chemical industry will adopt coal-based process after being shelved for half a century. It is more practical to transform coal into hydro-carbons to be used by the modern oil transformation technology. This irreversibility results from the scarcity of resources and from the fact that all technological options, those in practice or the potential ones, are costly to maintain and upgrade. The performance of the technologies that were adopted at some point tends to increase due to intended efficiency investment. This will have an impact on the next stage of choice of techniques. This is not to say that choice is becoming necessarily more limited, as the branching of new options occurs both from the existing mature technologies and from new alternatives that are developed but the set of techniques, from which the choice is made at two different points in time will never be the same. This is a focal point of controversy with standard economics, as it often implicitly assumes that choice sets reproduce themselves costlessly (a view in which techniques are presented as a bookshelf from which to pick whenever necessary). This view of a free "total recall" is also a strange assumption on behalf of those interested in allocation of scarce resources.

Because of the strong relationship between history and irreversibility, historians of technology often adopt an evolutionary perspective (Rosenberg, 1982; Mokyr, 1990). In addition, many economists adopt of the evolutionary metaphor, as they like to express the non-linear dynamics of the economic system in competition and development alike, and which is very poorly taken into consideration by the neo-classical tradition (see Langlois, 1986). For all these economists, the evolutionary perspective is neither unique nor exclusive and they have, and still are, looking for relevant mechanisms in various fields as in thermodynamics[3] or, more recently, in chaos theory. These approaches should not be dissimed by being esoteric or marginal: that is what the famous "invisible hand" is just about that. All these approaches

have in common the research of the relations between the micro-properties (or schemes of behaviour), and the regularities (or patterns of organisation) in the industrial structure and at the macro level. The issue of how different economic orders emerge from some microeconomic norms of behaviour is one of the most fundamental questions in economics (as in all other sciences). It is being currently tackled by many economist of various schools of thought. We really experience a neo-institutional revival which aim to understand the functioning of markets within conventions, institutions and organisations. It is a unifying question for both types of species of economists; those who deal with economic change and those who explain economic order through the theory of competition and equilibrium.

II. Evolution and learning

As a matter of fact the representatives of both fields become increasingly aware of the need to deal with asymmetric information and uncertainty and their effect on rationality. The latter appear much more as being acquired through *learning* in a gradual process of *evolution*. While the convergence of research interests appears very clearly it is difficult to indicate a single reason which explains it alone. There is at the same time common subjects that are studied in different ways, an increased theoretical ability to deal with imperfect competition and perhaps, most of all, a reality of rapidly increasing content of knowledge and information in the economy that burdens the system complexity. Either way, the convergence among research programs is clear and stimulating. The need to better understand learning and evolution and their interaction, herein named the Lamarckian hypothesis, is a conviction shared by many.

The last decade has witnessed an increased penetration of evolutionary perspectives in the social sciences and particularly in economics in focusing on the study of rationality and change[4]. The traditional debate on the relationship between maximisation and selection involve radical positions. Milton Friedman used the natural selection argument as an empirical proof of the efficiency of decisions governed by maximisation behaviour. The opponent view, of Alchian and others held the selection argument to present some natural adjustement capability of the economic system in the absence of conditions for conscious optimisation. Recent works go beyond matters of the "theological" discussion of whether survival is a proof of the viability of behavioural rules by supporters of pure maximisation or of bounded

rationality. Both categories recognise that some imperfection of computational capabilities or memory is needed for the selection of outcomes to become gradually effective. Researchers now tackle, for example, questions about the formation of cognitive capabilities and about the role of memory and forgetfulness for the dynamics of learning[5]. This is not to say that these issues are now more technical and lack a fundamental dimension. On the contrary, recent inquiries and debates show the need for a more social pattern of behaviour. We depart from purely egoistic economic agents who seek to maximise their own utility and gradually open the horizon for co-operative behaviour and onwards to the question of altruism and more generally to the foundations of moral behaviour. We shall go to more detail about the logic of such an important theoretical development but it is worthwhile to notice already at this stage that the fundamental response for the imperfection of the competition is more sociable individuals...

The Lamarckian Hypothesis is the focus of the contributions of this special issue. Although I have originally opted for a more restrictive view about the interaction between evolution and learning, the contributions themselves offered a much wider perspective which underline the importance of the subject. I shall therefore indicate some of the narrower dimensions and then open up the larger perspective.

Mechanisms of learning include reaction to various stimuli in the changing economic environment. Behavioural theories underline the importance of different types of conditioning in creating artificial reflexes. The formation of routines and their impact on adaptive capacity is a very important subject *per se*. The automatic nature of routinised behaviour is not only a device to avoid thinking, but is an extremely efficient mechanism of response and learning. As response it is very efficient as it saves time and resources. As a learning device it creates a meter to evaluate the potential of novelty embedded in a new information. As routines themselves are subject to hierarchy according to the intensity of the repeated phenomena, it enables a quick recognition of the significance of a given change and the level of required adaptation. A naive representation of routines may lead us to oppose simple routines on one side of the rationality interval, to perfectly informed maximisation on the other. According to such a view the more we are rational the more we can adapt to change. Nothing is less certain. The more primitive and automatic is our routine, the more a change would trigger a response in the sense that something fundamental has occurred[6]. We should rather try fo fulfil this interval routines-rationality with different categories of routines according to their intensity (and complexity) and study how they screen novelty and make

us react to a change. Conscious rationality will probably be found to play a different role in relation to routines not by substituting them.

Another example for the dimensions that can be found in the strict intersection between learning and evolution is imitation behaviour. Imitation is represented in both evolution and learning[7]. From a pure evolutionary point of view imitation is an adaptation device, since the uninformed decision maker decides to observe the survival game play by others and then to pick the winners by replicating their behaviour. This way the frequency of the winners type of behaviour will be increased in the next generation among firms. This is a sort of external growth mechanism, for the relevant type of behaviour, that will add to the internal growth brought by the profits of those who have first introduced the new capital good for example. Imitation is also a learning device and in more than just one sense. Imitation of the other is a device for quicker learning as any parent with several children have noticed. Learning the environment is also a special type of replicator dynamics since it creates communication and group identification mechanisms. Many of those who adopt innovations do so not because or conscious cost-benefit calculation or by a conscious decision to pick winners but from the drive to go along with the new wave. From the argument we have just suggested they might do so in order to take advantage of network externalities... Imitation also represent another type of learning, in the sense of discovery. Learning the new requires, as we have said before, a comparison with the previous representation of the phenomena. So imitation can be looked upon as a screening device to associate the novelty with existing entities and categories and thus help us to formulate new ones as well.

Although the two topics are important enough by their own merit, it is now the time to dress the wider perspectives of the Lamarckian hypothesis. The use of evolutionary modelling and thinking in economics relied on Darwinian evolution mainly because it is the theoretical species that has survived the evolutionary process of scientific learning in biology. Genetics is now revolutionising the evolutionary world as it derives species and individual behaviour from the microscopic structure of the living matter. Still the difference of man from the pure Mutation-Selection logic of adaptation is in its ability to learn and to transmit knowledge. Whether the cognitive capabilities are the mere result of the evolutionary process itself or has some exogeneous character, is less important for our purpose. What does make a difference is the fact that the human being has both cognitive abilities, a social behaviour (perhaps even the economist does) and a strong interaction among these two.

III. Towards a social contribution to the theory of imperfect competition

Lamarck is remembered because his theory of evolution included learning inasmuch as it allowed for transmission of acquired characteristics[8]. It should also be mentioned that the modifications in biological features of species resulted also from some sort of learning, because unlike Darwinian evolution where mutations are "blind", Lamarck supported the idea that the intensity of the use, induced changes (something which relates the changes in the environment through a stimulus mechanism to the adjusting organism). Again, biologically speaking this theory was rejected and I am certainly not qualified to challenge it. Yet, some recent studies have shown that acquired knowledge through conditioning appears in the form of specific proteins in the brain. When creatures like worms swallow the remains of their predecessors who have "learned" something through conditioning, they seem to know what to do in the context of the original experience, as if they "remembered". So there is after all a rationale for eating the brain of your slaughtered enemy, it can greatly shorten the interactive process leading to a Nash equilibrium.

The Lamarckian hypothesis is therefore a metaphor to analyse the relationship between evolution and learning. The two aspects in which humans are different, at least to some extent, from other forms of life are related to their cognitive capabilities, to their social organisation and to their interaction. The ability to transmit acquired characteristics is certainly a strong feature of man. We learn, teach, and write records of our learning, in books, magnetic tapes and other media. Our ability to create artefacts is astonishing as can testify the suffering ecology. For some economists, like Kenneth Boulding, these artefacts belong to the same world of evolution so there is a continuity between the cro-magnon and the typewriter. It is an interesting perspective but we shall not go deeper into that. The question here is to what extent cognitive capabilities affect conscious learning and evolution thereafter. The ability to imagine is very important because it enables us to envisage worlds that are different from the present one. Conscious learning may appear as a kind of arbitrage between the present situation and the artificial world that is our perception of a different future[9]. It is also very clear that our creative capacities are related to this faculty of creating artificial worlds. Some theories suggest that innovative behaviour require social organisation as a precondition, because individual creativity requires saving that only social structures would be able to support. It is possible that this faculty was developed at the age of sedentary agriculture that regularly produced for surplus. A nomade society living on hunting would not be able to sustain creativity in that sense.

Closer to economics and our time this ability to learn and so the outcomes are systematic and not random like mutation in Darwin. The theory of induced innovations is a typical theory of learning isasmuch as innovations are generated in response to relative prices. How then to relate economic evolutionary modelling to this Lamarckian dimension? It is not very clear that there is a natural place for learning right now. Results from game theory tend to find the *same* results for human actors with perfect rationality and a blind game in nature[10]. But then how this conscious rationality is emerging? A more reasonable practice is to take a Darwinian selection mechanism in an environment of simple routines (or automata) as a starting point, inspect the outcomes of the game and then incorporate some heuristics and rules of learning. Then one can study how the distribution of outcomes is changed following this mechanism. It is possible through simulation to see what kind of organisation emerges from what type of learning[11]. The issue of what type of economic organisation comes from what learning mechanism is relevant to new theories of industrial organisation and the analysis of institutions.

The wider setting of the Lamarckian hypothesis is the societal one. To what extent utilitarian behaviour requires selfishness or is there a way to remain a rational economic agent while still preserving social norms? The traditional view economists offer of individuals seeking success is an egoistic pursuit of goals. Exchange activity, which is the first building block of most economic theories, ensures that an equivalent value is given and received at each and every trade (*quid pro quo*). The agent cannot obtain from society more than the value ofhis own contribution and on a spot basis. The first step towards socialisation is by including descendants to explain saving by individuals who will not benefit from them. Overlapping generations models can handle parents-children relationship. One can extend this logic but without particular interest. The more important question is about co-operative behaviour.

The interaction among agents the learning of social behaviour is particularly interesting when some repetition occurs. This is either expressed directly as a repeated game among the same individuals, or indirectly through reputation mechanism when the payoff or the reciprocity condition is fulfilled through multilateral trade (or club behaviour). Under such circumstances to behave in a "nice" and co-operative manner is an important signal for those familiar with Axelrod's discussion of the attributes of the "tit for tat" strategy[12]. It consists of playing co-operative in the first stage of the repeated prisoner dilemma and then strictly reciprocate to whatever the other is doing. This strategy is shown to give nearly always the best results when alternative strategies are tested one against each of the other strategies in computer simulations.

The issues of altruistic behaviour is more controversial and opens a whole set of questions that, at best, have some partial answers. Part of what may appear as altruistic behaviour could be explained as following a selfish pattern of behaviour on the part of a different definition of the ego: the genes. This is the main message of socio-biology. Although is looks quite far-fetched at first glance to endow genotypes with maximisation behaviour, it is an interesting "as if" assumption because it defines the individual as being guided very strongly by his social affiliation. Gene distributions are defined for species not for individuals. If individuals act through a strong group identification then one can explain actions whose purpose is not direct reciprocity. Such actions are taken on the basis of the individual belonging to a group (tribal, industrial, ethnic, etc.) and whose payment will be beneficial to the group. It is possible of course to interpret those acts in the name of group identification as being indirectly motivated by "selfish returns". I think however that social identification is a very strong component of human behaviour. We are social animals that would probably not survive without some-group-related actions. Group identification function as an enlargement of the definition of the individual. In nature the identification is one of the strongest reflexes. To mark a proximity relation for us too, is a way to trigger a reflex of altruistic behaviour in the other. Protectionism, club behaviour or patriotism are different ways to define proximity and signal friendliness. In this respect economics can indeed become more social. This does not exhaust the subject either. Social institutions as religions, moral codes and legal devices tend to protect the weak as an important norm of human behaviour. This is not exactly a Darwinian reflex. One can always retort that it is by selfish drive that we teach our children to respect the elders, but there is no harm in that as such. Another possible of interpretation of those who wish to push the selfish gene argument still further is to preserve apparently less adapted individuals as they may ensure group survival under different circumstances when the particular abilities or skills they develop, will prove useful. To endow genes with such an option-saving behaviour may be seen as hallucination, yet the very notion of group functioning through identification assumes already the preservation of diversity.

In summary, when we try to go beyond the over-simplified scheme of perfect information and competition and deal with a world of increasing information and rapidly changing tastes and technologies, we need to reformulate the conditions of decision making under various schemes of behaviour. This challenges the traditional isolation of economics within the social sciences because it brings into the picture types of human behaviour

that cannot be dealt with on a basis of the traditional strict definition of individuality. Social behaviour calls therefore for an extension of the "self" by the inclusion of group identification mechanisms that can fulfil, and probably does fulfil, an important role in the co-ordination of economic activity. This is a tremendous challenge for economics.

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Notes and References

1. Cf. Avadikian *et al.* in this volume on the role of asset diversity in an evolutionary approach in networks.
2. Cf. Metcalfe contribution on the relation between diversity and growth.
3. See Georgescu-Roegen (1971).
4. For an articulated evolutionary theory in economics see Nelson and Winter 1982.
5. We should mention that Enke (1953) tried already to bridge between *ex ante* and *ex post* rationality and were brought to suggest evolution through learning.
6. On the role of memory in such a context see Ancori, this volume.
7. For the discussion of mimetism, see Lemarie and Joly in this volume.
8. For a historical recall of the Darwin-Lamarck debate see EGE in this volume.
9. See Wechsler and Kursawe in this volume for the use of artificial intelligence, genetic algorithms and simulation in the study of our subject.
10. For a discussion of this similarity see Umbhauer in this volume.
11. See Marengo this volume.
12. R. Axelrod "The evolution of cooperation" 1984.

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