EMERGENCE AND INSTITUTIONS IN AN EVOLUTIONARY AND COMPLEX APPROACH TO ECONOMICS

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Abstract
The twentieth century saw the ascension of new disciplines and technologies dealing with the idea of complex systems - like genetics and biotechnology - which gave support to replace old prejudices, motivating philosophers and social scientists to advance in new conjectures about the universality of the emergent metaphor. At the same time that evolutionary economics began to reflect on the issue of complexity emergence, a select group of institutional economists introduced new challenges to the debate (Foster, 2005).

The paper will advocate the view that Evolutionary and (neo)Institutional Economics may profit not only from integrating concepts of each other, but also from incorporating the insights and instruments of complex systems studies into their framework. Particularly, it will be explained how evolutionary thinking would gain in analytical strength if added to the complexity approach.

This paper also aims to indicate and develop the general framework through which an economic theory may be formulated conjugating three elements: Nelson and Winter’s (natural) selection reasoning, the complex adapting system (CAS) framework (Holland, 1995) and the institutional perspective on the resilience and evolution of rules, norms and behaviour as to promote coordination and resolve conflicts (Williamson, 1985).

It will be explained that, in the CAS approach, systems mechanisms can be synthesised by an internal model or schemata where agents rationalizes using internal subjective models of reality to generate conjectures about what should be an adequate behaviour, accordingly to the situation. Using their "natural" abilities and learned capabilities, agents have to find a way to perform properly in a new situation by composing a conjectural scene or a mental landscape for future actions. Schemas can be modelled with information transmitted through experience from already tested situations, i.e. creation of knowledge by learning through trial and error. More importantly, a collection of rules of behaviour is recorded in the agent memory or it is converted in blueprints, habits, norms, conventions etc. Needless to say that they are agents of bounded rationality (Simon, 1962).

By means of the complexity framework, a different perspective to the development of organisations and institutions can be also presented. Organization can be dynamically redefined to comprise sets of internal rules, rules that are modified as interaction takes place. The methodology presented in the paper seems just the right one to deal with those kinds of structures in which there is a complex array of interactions among agents and in which future decisions are adapted to past experiences (Noteboom, 2000). Even more important, it also makes possible to break an organisational setup down into parts using a wide variety of combination of rules that are neither arbitrary, nor deterministic and result from an objective process of search.
Observes that rules may be simple and even limited initially, but they can be enlarged with minor alterations, creating distinctive levels of aggregations to add more hierarchical heights. As we enlarge the scope of the rules, they reveal some recurrent pattern of interactions. Being more aggregated, they bring to light new behaviours and more sophisticated set of rules or strategies. From this, it follows that rules and procedures characterising behaviour, modes of behaviour and strategies are described to represent groups of agents and networks (Fonseca, 2002).

As the complex approach deals with the connections between agents, the comprehension of the entities that mediate and govern these relations are of the highest importance. Institutions and organization are instrumental in the process through which emergent patterns of conduct develop into business strategies, inducing co-ordination, co-operation and, at least temporarily, some steadiness. Therefore, institutional theory is of critical importance to promote a better understanding of the maintenance and emergence of rules and the dual feedback between individual behaviors and institutions.

At the end, and to summarize, the paper proposes that to achieve a deeper comprehension of micro behavior, evolutionary economists should incorporate a more dynamic perspective on the role of institutions in structural change maintaining, at the same time, its emphasis on the relational aspects of the economy life.

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**Key Words:**
Evolutionary; Institutions; Population thinking; Evolution; Complexity; Emergence; Complex Adaptive Systems;
Introduction

More than a century ago Veblen recognized the pervasive influence of innovation in the economy. He understood and educated us that the process of cumulative change was simply the order of change in the methods of doing things – in the methods of dealing with the material means of life. He was the first to call economics an evolutionary science, a quite dangerous idea at his time.

It was Marshall, however, in his Principles of Economics (1890), who wrote that the economist must acknowledge the epistemological limitations of physics as a great model for economics. Marshall urged us to turn to biology and understand that economics also deals subjects of which the inner nature and constitution, as well as the outer form, are constantly changing (Marshall, Chapter 8, from Book 4). Marshall also helped us understanding the evolutionary puzzle unveiling biological analogies, more complex than those inspired by the mechanism of classical physics.

The dramatic effects of novelties and innovations in the economic system were first fully described by Schumpeter in 1942. Searching for the cycle explanation, he established that innovation is the main force pushing the economy out of equilibrium. The impact of his analysis reverberated throughout the beginning of the 21st (twenty first) century, stressing the superiority of the capitalistic destructive-creative mechanism as a competitive weapon. Neither Marshall nor Schumpeter had however at that point, presented a complete analysis of an evolutionary discipline that would ‘breathe’ empirical content into generalized notions of inheritance and selection, as a truly evolutionary science (Winter, 1971 and 1987).

Later on, Alchian, inspired by the evolutionary metaphor, offered us in his 1950 seminal article, Uncertainty, Evolution and Economic Theory, a comprehensive analytical clarification of how competition activates the variation-selection mechanism. Alchian here was describing the same destructive-creative mechanism introduced earlier by Schumpeter. With that, he took the Marshallian analysis a little further stating that learning, innovation and (satisfaction with) positive profits, not maximization, are the economic counterparts of the evolutionary mechanisms of genetic inheritance, mutations and the process of selection. The reaction to Alchian’s ideas firstly appeared in a critical text written by Penrose published in the American Economic Review in 1952 culminating in Friedman’s recognition (in The Methodology of Positive Economics) that in a circumstance of huge competition, the outcome of the evolutionary
approach is necessarily validation of the general hypothesis of maximizations of expected returns (1953).

In defense of Alchian’s clairvoyance, one can recall his confrontations with the economic post-war economics mainstream, proposing the displacement of neoclassic microeconomic axioms of complete information and perfect anticipation. Alchian’s central idea was that the decision-making process is carried out by economic agents under incomplete information and imperfect anticipation. His object of analysis was a heterogeneous set of agents/firms, subjected to the process of selection, according to Andersen (1996). The decision-making process analyzed by Alchian can also be described as a rule-limited course of action taken by an agent (a firm, for example). This process includes a significant degree of randomness, (radical) uncertainty and myopic conduct by agents, configuring what could be compared with the Simon’s definition of bounded rationality (1987).

The natural selection approach was revisited in Nelson and winter’s influential book, *An Evolutionary Theory of Economic Change* published in 1982. Together, they made the most important synthesis of evolutionary thinking. This exegesis explained why the economic system is a non-equilibrium system. Furthermore, they expanded the notion of economic evolution presenting it as a cumulative, cultural, learning process oriented by variation, selection and retention. We also learned from Nelson and Winter that modern economies are always changing by continuing innovation and are prearranged by the co-evolution of institutions. In these economies, agents, such as firms, use satisfactory routines but skillfully continue to learn and innovate. In the words of Anderson (1994) Nelson and Winter wrote their synthesis of evolutionary theory by combining Simon's work on rules and satisfying behaviour, Nelson's and other Schumpeterian works on invention and innovation, and Alchian’s and Winter’s work on natural selection. With Nelson’s and Winter’s book, we have finally established the new evolutionary grounds of thinking about capitalism.

1. Where the evolutionary ideas come from?

At the end of the XIX and in the beginning of the XX century, the evolutionary ideas were extremely influential over culture affecting the products of eminent philosophers and social scientists. Physics has been completely transformed since then, but not the mainstream core assumptions in economics. Classical economists did not ignore that technological progress could
generate changes and that impersonal forces should drive the economy and neo-classical economists, in their turn, established the re-foundations of economics as a physics-like theory. Popper, in 1974, declared that the laws of physics might be inadequate to describe the properties of changing processes. In spite of the physics-like approach, he proposed that the natural selection should be used as the analytical model metaphor to different disciplines, including those from social sciences.

Popper also argued that the objective of social science is not to offer analogies, but rather a methodological device to comprehend the selective process as inherently deductive. Adaptation process should be taken as an analogous device to the trial and error learning process, in which mutations resulting from genetic misreading are subjected to constant testing and, with few exceptions, are proven to be "false" readings. At the end of the twentieth century, the scientific impetus of new disciplines has reinforced philosophers and social scientists to advance new conjectures about the universality of the emergent metaphor. Since then, it was generally recognised that analytical assumptions of evolutionary thinking and emergent operate in distinctive ways as we move from physic-chemical to the biological and into the social and economic domains (Foster, 1997).

Technological changes were not abandoned during the neo-classical economics era; nonetheless, economists are now focusing on the diffusion of innovations and on the impact of changes that have been reduced to marginal “shifts” in the production function. In spite of some of old institutional social scientists like Veblen, Barnard and Commons insights, economists took almost half a century to recognise the pervasive influence of innovations and emergence phenomena in the economy.

For all purposes, the dramatic effects of novelties and innovations were at last fully described by Schumpeter in 1942. Searching for the cycle explanation, he established that innovation is the main force pushing the economic system out of equilibrium. The impact of his analysis, transmitted at the end of the 20th century, showed the superiority of the capitalistic “destructive-creative” mechanism as competitive weapon. However, it was Sidney Winter that pointed out in

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3 Alfred Marshall admitted the importance of the evolutionary approach a long time ago but (un)fortunately he was bounded by his own marginal method. Therefore, the economic analysis had to wait until Hayeck and Schumpeter, in Austria, had incorporated the influence of structural changes and adaptation in economics.
his “Natural Selection and Evolution” paper, that neither Marshall nor Schumpeter had presented a complete analysis in order to interpret economic reality in terms of a system of equivalent relations that effectively breathes empirical content into generalised notions of inheritance and selection – a truly predictive evolutionary science.

One of the first economists to present an evolutionary explanation for structural change was Armen Alchian (1950). Instead of the unrealistic assumptions of microeconomics, he proposed both incomplete information and uncertain foresight as basic axioms. When asymmetry and uncertainty are the counterparts of an agent’s knowledge, the rationale of the adaptation process is not only a matter of ability but also of chance, a significant element to determine the selection.

Alchian, for the first time, presented learning, innovation and positive profits as the economic counterparts of the mechanisms of genetic heredity, mutations and selection in 1950. He was also the first economist to stress the importance of the rules of behaviour approach, several years before Nelson and Winter had launched their seminal concept of routine (Winter, 1971). On the other hand, randomness was presented as the extreme chance postulate, an economic version for population thinking. By this predicate stating that the decisions and criteria dictated by the economic system are more important than those made by solely individuals.

The natural selection approach in economics was reinforced by the Nelson and Winter’s seminal work (1982). Together, they made a synthesis of the evolutionary theory by combining Simon's work on rules and satisfying behaviour, Nelson’s and other Schumpeterian works on invention and innovation, and Alchian’s and Winter's work on "natural selection" (Andersen, 1994). Insights from the natural selection principles fit very well in the economic process of competition with its continuous and varied production and largely diverse necessity as well. In capitalism, the market works not only because there is an efficient allocation of resources, but also because a complex world of unexplored novelties and a massive potential of exploration exists (Fonseca, 2000).

For a long time economists have been referring to active elements without invoking specific contexts and using the rule approach – some familiar procedural definitions taken from the sciences of cognition. In 1971, Winter recognised Alchian as the first economist to use it.
At the core of Nelson and Winter’s model, a business unit of decision (firm) have more chances to survive and grow imposing itself upon its environment through absolute and relative competitive advantages. In this way, the firm goes on acquiring new capacities, distinguishing itself from its competitors and possibly gaining advantage. The successes of the firm in face of its competitors are dependent on the formers innovative abilities, and may produce changes not only in the organisations themselves, but also in the production processes - and in the advent of new processes.

However what are the main characteristics of evolutionary theories?

The objective of evolutionary theories, evolutionary economics included, should not be only to offer analogies, but rather to present the means of investigation to comprehend evolutionary selection processes as intrinsically analytical (Winter,1971) and methodological (Popper,1975). A synthetic account of evolutionary processes can be put on view through two mechanisms and one property, which are:

1) A transmission device of instructions, by which specific characteristics of individual entities could be transmitted over time;

2) A source of variation, a device by which members of a relevant population vary in characteristics that convey selective significance (Metcalfe,2000); this process is partially determined by chance revealing the way novelties (or innovations) are created and new combinations emerge in economic systems;

3) The principle of selection, that explains interaction between entities in a specific environment and implies that some individuals have sets of characteristics better suited to their survival and growth in the population. This is also the way by which patterns of behaviour amongst social actors are brought out.

Transmission, variation and selection, offer not only the analytical framework for the evolutionary thinking but also shed light on the presence of regularities in any level of structural changing circumstances, principally that type circumstances related to complex adaptive structures. In this sense, it is possible to say that the distinctive attribute of modern evolutionary
theory lies in the concept of differential retention of inherent variation. The paradox that variation mechanism creates disorder whereas selection creates order explains how, in dynamic and changing circumstances, mechanisms of variety and selection act in apparent divergence and yet, are aspects of the same process (Lewontin, 1995). However, the understanding that variability corroborated the requisite for a general theory of change was announced by neither Darwin nor Lamarck but it was properly established the modern synthesis authors. Since then, variety was not anymore considered as an interfering complication, or a noise. The understanding that deterministic processes give rise to statistical, dynamic change was the next accomplishment of evolutionary thinking, the Modern Synthesis.

This breakthrough was developed out of Fisher’s, Haldane’s and Wright’s work on population genetics. Mathematical models arose filling out and highlighting the natural selection general framework - expressed in a system of dynamical equations that satisfied evolutionary conditions of variability, retention and selection. Fisher developed the estimation of fitness, largely disseminated in present-day evolutionary models and simulation methodologies, including genetic algorithms and the family of agent-based models, now largely adopted by evolutionary economists.

The new evolutionary approach was presented by Mayr (1959) to distinguish the modern evolutionary synthesis from traditional Lamarckian selection theories and it was called population method or simply population thinking. The greatest advantage of the population method lies in the correct assimilation of the accomplishment of variability criterion endorsing the prerequisite for a theory of change. If diversity is not considered as an interfering complication, as in Lamarckian view, the dynamics of change in economic systems could be properly understood (Metcalf, 1998).

According Metcalfe, Fonseca and Ramlogam, the distinguishing characteristic of this evolutionary approach is associated with measures of evolution related to alteration in the

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2 As proposed by Lewontin (1995) the distinctive attribute of evolutionary thinking relates to differential retention of heritable variation.

3 Fisher’s and Haldane’s backgrounds were mostly in mathematics and statistics while Wright was a geneticist in the US Department of Agriculture.
statistical properties of populations as changing frequencies of individual behaviour⁴. More specifically, the performance of agents is related to change in the frequencies that reveal its characteristics and inherited characteristics of individuals or agents can be combined and dissociated in mathematically predictable ways. This is a significant observation as long as it stresses how successful agents can hold and transmit a few distinctive competitive advantages. The criteria by which agents – firms or business units - are to be considered statistically relevant into a group have the advantage of exhibiting emergent characteristics. These characteristics, however, are not specific to individuals; they are specific to groups or population of agents. According Langlois (1986) they are behavioural consequences that arise from interactions amongst them and such interactions cannot be idiosyncratic properties of those agents.

However, what is the necessary criterion to have agents included in the same pattern? What are the characteristics that agents must share? Is it possible to demarcate groups of agents? As mentioned before, members of these groups should be defined not according to their idiosyncrasy or individuality per se, but as entities subjected to the same selective, environmental, pressure.

It is the economic environment that evaluates the various entities and agents converting their relative characteristics into selective advantages. Furthermore, the competitive process unifies a group of individuals or agents into a relevant group, and makes their characteristics competitively relevant.

Additionally, the selection environment is defined independently of the agent. The environment evaluates entities and agents transforming their individual characteristics into selective advantage. Nevertheless, in evolutionary economics, agents should not only be classified according to their specific attributes, but mainly according to the fact that they are competing in the same environment, where they are subjected to the same competitive forces. In other words, competition unifies a group of individuals into a relevant population and makes their characteristics “selectively” relevant.

Initially, a group of agents can be represented by a set of rule rules. Though initially these rules should be simple, and even limited, they can be enlarged with minor alterations, creating distinctive levels of aggregations to add more hierarchical heights (Winter 1971). As we enlarge the scope of analyses, recurrent patterns of interactions are revealed. Using their best attributes,

⁴ See also Metcalfe, Fonseca and Ramlogam (2000)
and a repertoire of already tested rules and routines, agents continually interact and inspect the environment, while adapting to their surroundings. These agents explore its environment skilfully, using, their competitive advantages and capabilities.

In all emergent patterns, patterns that emerge from interactions, we can observe the existence of multiple agents, diverse in ability, adapting and reacting to the competitive pattern they, themselves, helped to create. Needless to say that every competitive position is open to challenge, while the generation of novelty becomes the means to mount those challenges (Metcalfe, Fonseca and Ramlogan, 2000).

Whenever interactions amongst agents become more complex, certain sets of rules will become more efficient. At these more hierarchical levels of interaction, the specific functional relationships between agents can constitute an organization, if they corroborate their continuous regeneration of rules and procedures. Hierarchy, in its turn, is an extremely important element in aggregating since it helps to maintain the web of social relations built in the past (Foster, 2000). If the components of an organization engage in interactions whose direct outcome is the construction of other elements and other associations this is called organized complexity (Durlauf, 1997).

Another important outcome of population thinking is exposed in the demarcation criteria between units of selection and in the selection environment. Units of selection are entities of whose selective characteristics keep relatively stable over time to preserve their identity. According Nelson and Winter (1982) these units are firms, not the representative Pigouvian firms but the Marshallian one. Therefore, the criteria by which an agent is to be assigned as statistically representative have the advantage of exhibit emergent characteristics. As mentioned before, characteristics are not specific to individuals; they are specific to dynamic structures or systems and arise from the interactions between individual agents, and such interactions cannot be properties of those agents (Langlois,1986; Blume and Durlauf,2000). Quoting Metcalfe, Fonseca and Ramlogam (2000) “representative behaviour in a population of agents can evolve even when the underlying individual behaviours are constant. In a world of uniform agents this would, of course, be impossible.”
As we shall see, in the presence of diverse micro behaviours what is representative in any given context depends upon the manner in which the individual behaviours are co-ordinated by markets and other institutions.

2. Introducing rules in the complex puzzle

A group of agents can be represented by their set of rules. Though initially the rules should be simple, and even limited, they can be enlarged with minor alterations, creating distinctive levels of aggregations to add more hierarchical heights. As we enlarge the scope of the rules, they reveal some recurrent patterns of interactions. At the core of the process that structural changes are explained displaying the mechanism of decision as propelled by the routine-search device. One of the hypotheses is that the search for innovation and new rules takes place at the same time that the decision-making process is going on. The selection mechanism is presented as bringing on alterations in the market structure throughout a group of variables that provoke changes in the behaviour of agents/firms. Economic activity within the firm is developed according to rules (Nelson’s routines) established in the previous practice and in methods of searching. The search for new rules is triggered by existing routines, and innovation, the outcome of this process, emerges from the comparison between the new and the old rules. While the decision-making process occurs within firms and other organisations, it is bounded to their current practices.

Nelson and Winter have employed the concept of routines or rules to illustrate not only the adherence to norms and conventions but also the emergence of new patterns of behaviour. Currently, the set of rules and routines which characterises the agenda of the firm is committed to continuity and regularity. These routines are static ones if they are connected to the reproductive capacity of tasks previously executed. The dynamic adjustments in routines emerge when firms search for new answers to changes in an external environment or try to adapt themselves to unpredicted circumstances. Emergence can be defined in the context of dynamic adjustments on the sets basis of internal rules that are modified and refined in the process of interaction.
Nevertheless, the starting point of complex evolving systems are agents which can be represented by their rules of conduct. These rules are likely bound to change through selection and adaptive mechanisms.\textsuperscript{5} According to Meltalfe, Fonseca and Ramlogam, 2000:

\begin{quote}
We begin from the premise that economy is an adaptive evolving system comprising with multiple agents, diverse in abilities and capabilities, interacting, adapting, reacting and constantly modifying the patterns and structures that they help to create.
\end{quote}

Following these arguments, it is possible to advance that in the study of inter-firm relations we have to take into account the complexities and path dependencies that may arise in the making and the breaking of relations between multiple agents (Noteboom, 2000). If interactions that give rise to a certain class of behaviour can be represented as non-linear, the collective conduct cannot be deduced by summing up the behaviours of isolated agents. Arthur, Durlaf and Lane (1997) suggest that the key concepts to understand complexity are continual adaptation, self organisation (without a guiding hand) perpetual novelty, the inter-linking of hierarchies at different levels, and out-of-equilibrium dynamics. Holland (1998) put more emphasis on the emergence of patterns of behaviour from a diverse collection of agents.

Consequently, common to all these complex systems, we can observe the existence of multiple agents, diverse in ability, adapting and reacting to the pattern they help to create. The rules should be simple and even limited initially, but they can be enlarged with minor alterations, creating distinctive levels of aggregations to add more hierarchical heights. As we enlarge the scope of the rules, they reveal some recurrent pattern of interactions. Being more aggregated, they bring to light new behaviours and more sophisticated set of rules or strategies. From this, it follows that rules and procedures characterising behaviour, modes of behaviour and strategies, are described to represent groups of agents. Initially a set of rules become a strategy if:

a) the rules specify a sequence of decisions;

b) they reveal some form of anticipations in the sense of what to do in a situation that might arise;\textsuperscript{6}

c) they are developing into organisations.

\textsuperscript{5} This is a system containing adaptive agents, networked so that the environment of each agent includes other agents in the systems (Noteboom, 2000)

\textsuperscript{6} Axelrod, 1994)
The strength of strategies depend upon the current rules and the experience obtained in the past, thus characterising an ex-post approach. As more complex interactions develop between agents, the rules became more efficient. At this level of complexity, the specific functional relationships between agents can also be defined as an organisation if they collectively confirm their continuous regeneration. If the constituent elements of an organisation engage in interactions whose direct outcome is the construction of other elements and other associations this is called organised complexity (Fontana & Buss, 1996). It consists in the explanation of how distinctive organisation structures form in a complex reality. Such system is not actively search for appropriate energy sources to create and maintain organised complexity necessary to produce goods and services – they also search for appropriate knowledge, embodied in the labour service, capital goods and in information flow that is accessible in the environment (Foster, 2000).

Complex systems might be associated with evolving market structures in which agents are described as firms following different competitive strategies. They are continually interacting and scrutinising the environment, using a repertoire of already tested rules and procedures, while adapting themselves to their surroundings. In this fashion, an individual agent is compelled to explore its environment competently, using its best attributes, advantages and capacities. Moreover, these systems show competitive abilities not only by virtue of their market structure but also by virtue of the fact that every economic competitive position is open to challenge, while the generation of novelty becomes the means to mount those challenges (Metcalf, Fonseca and Ramlogam, 2000). As a result, the system shows autonomous "natural" and self-ruling dynamics. When complex interactions are being developed between agents, the specific functional relationships between these agents can also be defined as organisational types. The necessary condition is that they must confirm collectively their continuous regeneration by searching for relevant knowledge, embodied in the labour service, capital goods and in information flow that is accessible in the environment (Foster, 2000). This is the way business organisations are shaping their capabilities (Foss, 1994).

The description above corresponds to the adapting, evolving systems presented by Holland (1998) and Arthur (1997). Holland’s building blocks mechanism improves our capacity to break

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7 An organised complexity exists if the constituent elements of an organisation engage in interactions whose direct outcome is the construction of other elements and other associations (Fontana & Buss, 1996).
a complex scene down into parts using a wide variety of combinations that are neither arbitrary, nor deterministic and result from an *objective process of search*. The building blocks mechanisms are based on four basic principles and mechanisms: aggregation, networking, tagging and diversity.

*Aggregation* is a chief “natural” technique for constructing models discerning what is relevant and which aspects of the problems must be ignored. The main difference with traditional approaches arrives from the categories which are re-employed and can be decomposed into familiar categories in a never end process. Additionally, we can create scenes never seen before by recombining. *Networking* is relevant whenever innovations emerge and put at risk long-rang predictions or when it is necessary to estimate the effect of some new resource in an evolutionary trajectory. The nodes of a network are processors and the connectors designate the possible interactions.

*Tagging* improves our capacity to manipulate *symmetries* as it permits to ignore certain details, focusing in others, making selective interactions easier and creating basis for specialisation and co-operation (Holland, 1998). Tagging also leads to the emergence of persistent hierarchical forms of organisations even when their internal parts are changing and evolving.

By denoting the necessity of dealing with the arrival of novelties and innovations *diversity* can be liked to the scope for variety (Fonseca, 2000). Diversity can also vindicate for some regular characteristics of the elements which are coherently supporting structural transformation. As a complex systems principle it helps to explain change in the way the components interact. If one of the elements disappears the pattern re-establishes itself. As a result, a new pattern differs completely from the older (Holland, 1995).

3. The place of Institutions in New Evolutionary Economics

**Complexity and Institutions: Some definitional and ontological issues**

In this section we aim to analyse which place can be ascribed to institutions in a “new evolutionary economics” framework (Potts, 2000), which incorporates the conceptual and analytical apparatus of complexity and system theories. The incorporation of complexity theory
to evolutionary economics does revive a series of questions, long neglected by the neoclassical mainstream economists, central to the institutional approach. Putting the emphasis in the interactions between entities that give rise to emergent properties of economic systems brings to the attention of the theorist the prominent role of institutions in mediating and structuring these interactions, and thus, to their relevance in any account of the evolution of the economic system.

Let us first recapitulate some of the central concepts definitions of complexity theory in a somewhat abstract formulation as to evidentiate some of its consequences for the role of institutions in a systems perspective to economic theory:

- A system is composed of elements determined by boundaries posed, to some extent, arbitrarily by the theorist in view to his purposes. As important as the elements composing the system are the connections and interactions between such elements, i.e. how elements are structured and relate to one another. Though emphasis is in the interactions between elements inside the system, external information fluxes and influences from the environment are also acknowledged.

- A system exhibits emergence when there are coherent emergent at the macro level that dynamically arise from the interaction between the parts at the micro level. Through the traits of the elements that composes the system and the array of connections and interactions established between them, emergent properties can be distinguished in the system (macro) level, although no determined role or causality for this emergence can be ascribed to any system individual (micro) element in isolation (“the whole is more than the sum of its parts”). The emergent properties are thus said to supervene on the micro level properties. Therefore, reductionism and strict methodological individualism are dismissed.

- If structure and the emergent properties of the system are subjected mainly to the control of elements inside the system, the system is considered to be self organising. This does not prohibit the influx of external information into the system, but its structure emerges without

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8 Methological point: stating that emergents are not captured by the behaviour of the parts is a serious misunderstanding. Radical novelty arises because the collective behaviour is not readily understood from the characteristics of the parts. The collective behaviour is, however, implicitly contained in the behaviour of the parts if they are studied in the context in which they are found. Emergent properties cannot be studied by phisically taking a system apart and looking at the parts (= reductionism). They can however, be studied by looking at each of the parts in the context of the system as a whole, that is, taking in consideration the institutional framework through which the parts interact.

9 Here we have social theory, specifically mainstream economics, in mind. More generally, we can say that emergence dismiss the metaphysical assumption of “ontological-level monism”(Goldstein, 1999).
explicit pressure or involvement from causal forces outside the system. In other words, the constraints on form, i.e. organization, highlighted are internal as they are (mainly) the result of the interactions among the components of the system (De Wolf and Holvoet, 2005).

- The system may be adaptive, that is, the structure of the system is influenced by a dynamic environment which select a subset of the system elements and constantly entails novel interactions between the micro components, generating evolution of the structure and emergent properties of the system through time.

Emergence, self-organisation and adaptation are held to be key defining features or characteristics of complex systems (Martin & Sunley, 2012). A synthetic explanation as to how these concepts may be utilized to illuminate the evolution of economic systems is put forward by Foster & Metcalfe:

“…evolutionary economists have always been concerned with economic emergence and how this enables economic systems to transform themselves from within (...) In evolutionary economics, economic agents are viewed as reducing the uncertainty that they face and achieving economic goals by adhering to bundles of rules. The formation of radically new bundles of rules is “genuine novelty” and can take the form of: capital goods (technological rules), productive networks (organizational rules), contracting systems (institutional rules) and human skills (procedural rules). Enacting new bundles of rules involves a process of ‘self-organization’ which is “unpredictable” with regard to the patterns of structure that ultimately form. Over time, such unpredictability is diminished by a process of ‘competitive selection’ whereby particular combinations of technologies, organizational structures, institutions and procedures come to dominate” (Foster and Metcalfe, 2012, p. 421)

The emergence of new “bundles of rules” and “unpredictable patterns of structure” is at the core of the process of economic evolution, and thus, it is the central preoccupation of evolutionary theorising. As we have seen, evolutionary processes can be broken down into three fundamental mechanisms/principles: variety or microdiversity of agent behaviours, selection processes that transform that diversity into patterns of economic change, and, development processes that generate and regenerate that behavioral variation (Metcalf, Fonseca and Ramlogan, 2002).

Prior to the incorporation of complexity and systems theory to the evolutionary approach to the economic domain, evolutionary economics focused on the diffusion and selection of unexplained novel rules through the competitive process. In this sense, evolutionary economics
theoretical strategy was somehow similar to the endeavours of Darwin himself in his classic work *On the Origins of Species by Means of Natural Selection* (1859). As Dennet (1995) pertinently highlights, Darwin “begins in the middle” (p. 43): parting from a given variety of species in the natural realm and describing the process of speciation to “explain” the “origin” of species, Darwin eludes the causes of their coming into being at the first place. Similarly, evolutionary economics described the processes of diffusion and competition selection often applying replicator dynamic models (cf. Andersen, 2004; Metcalfe, 2008), but did not explain the origin of innovation. Through the complexity framework, eminently the concept of emergence, an evolutionary account of novelty generation can be added to the competitive selection through differential growth of replicating entities (Foster and Metcalfe, 2012).

Before we turn to the account of the sources of, and motivations for, innovative behaviour, let us first elaborate on some features of the concept of emergence. The complexity approach permits a conceptualization of the distinction in evolutionary thinking, dating back to Schumpeter and Marshall, as regards the type of transformation engendered by innovation and the nature of the evolution of the economic system. Marshall and his celebrated analogy of the organic growing of trees in the forest, as well as in the motto *natura non facit saltum*, may be considered the forerunner of the analysis of incremental development in rules and organizations structures later developed in evolutionary economics and technological history studies through the formalization of the process of learning-by-doing. In turn, Schumpeter emphasized the radical transformation and perturbation of the system through a qualitative kind of innovation, which he imaginatively labelled “creative destruction”. Through the complexity framework a fruitful distinction may be proposed relating the former self-organizing organic Marshallian type of evolution as related to *weak emergence*, and the latter Schumpeterian qualitatively transformation through revolutionary disruptive innovation most likely to generate *strong emergence*. While the former, however its novel organisational character as regards the micro-structure, can be, at least in principle, reliably reduced to the micro-elements generating it, the latter is *non deductible* from, and *irreducible* to, the present configuration of micro-elements (Andersen 2004b).

Ontological issues may arise from the above statement on weak and strong emergence. Some complexity theorists are indeed reticent to the concept of *strong* emergence and its

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10 Weak and Strong emergence definitions are not consensual among complex systems theories, mostly due to the vast scope of utilization in both natural and social sciences. Here we take “weak” to mean that emergent entities can be deducible from the lower level elements where in “strong” emergence that is not possible. For a discussion see De Wolf and Hovoet (2005).
“mysterious” origins (Kubik, 2003; Bedau, 1997). However, it may be of use to appraise the view Tony Lawson (2012), for as some economic evolutionary theorists, he is also committed to the development of realist ontological basis for social theory. As can be seen from the quote below, Lawson adheres to strong emergence and manages to propose a defence of this position that still preserves an ontological naturalism, and thus realist, commitment:

“Emergence so understood however is not an explanatory term but rather one that marks the spots where (diachronic) explanatory work remains to be undertaken to reveal how the higher level entities do (or have) emerge(d). In particular, the above conception of emergence leaves open the precise nature of the relationship between higher level emergent causal powers and the powers of the lower level components. (...) I additionally hold to the notion that although any higher level emergent entity and its properties are conditioned by and dependent upon lower level elements or components, they are nevertheless synchronically both causally and ontologically (and not merely taxonomically and epistemologically) irreducible to them” (Lawson, 2012, p. 348, our emphasis).

A distinction between synchronic (at a point in time) and diachronic (over time) forms of reduction and explanation may disentangle some of these questions. Lawson denies synchronic reduction but does accept diachronic reduction. Micro elements give raise to the emergent phenomena due to the manner in which they are organised (arranged, structured or related) as parts of the whole. He further observes that “missing from the analysis is any account of the manner in which the lower level phenomena become organised (arranged, related or structured) in the process through which the higher order entities emerge” (ibid, p. 351). More importantly, the organisation of the lower level phenomena is in itself a novel phenomenon that emerges along with the emergent entity – of which it is a cause. It is the configuration or organizing relations that causes the emergence in system level. Thus, the emergent entity or system includes organising relations that are external to the lower-level elements, making the totality necessarily ontologically irreducible to the lower-level components alone.

Lawson remarks that there is a neglect of relational structures in theories of complex systems phenomena, for these structures are external to elements in the micro level; they are emergent properties requiring a diachronic explanation. A full understanding of any emergent form of reality requires diachronic causal accounts of emergent organisational order. (Social) Science has to provide explanations of the origins and persistence of the relational-organisational structures of lower-level phenomena. Emergent organisation is an encompassing feature of

reality, so in being continually reorganised, a major part of socio-economic phenomena is in process of transformation. Lawson suggests then that “a category such as entity is appropriately used just to express (or can be thought of as expressing) a relatively stable actualisation of a feasible emergent organisation or system of underlying processes”.

This brief philosophical and conceptual discussion searched to provide a basis for asserting the relevance of the mediating and structuring entities of social relations, “the organizational-relational arrangements or structures”, that is, Institutions, in bringing about emergent phenomena that is neither reducible, nor explicable, in terms of the micro entities composing the system (i.e. revolutionary Schumpeterian innovation). As these relational structures are emergent properties and thus, at least relatively, higher-level entities, at the same time they cause the original macro-level emergent phenomena and affect lower level elements: “emergent phenomenon is a system in which components are constrained to act within organising structures” (ibid, 353). Thus, a two-way relationship or linkage between lower level elements and emergent entities obtains: it allows for both upward causation, i.e. the phenomenon of emergence of higher level properties from lower level elements, and downward causation, i.e. emergent macro entities affect or have causal powers towards the elements from which it emerged (Hands, 2001; Hodgson, 2007; Lawson, 2005; 2012).

Furthermore, lower level system elements are subject to constant re-organisation through a process of uncovering novel connections between the parts, engendering different emergent organising structures (Hodgson, 2000; Potts, 2000; Potts and Nightingale, 2001). Due to these constant alterations in the organisational-relational architecture, emergent arrangements of lower level elements are seen as instantiations of an ongoing, open ended, evolutionary process of change and persistence in organisational forms and structures:

“…examine how this organisation, itself an emergent phenomenon, not only comes into being (morphogenesis) but, of especial significance to understanding, how it persists when in fact it does (morphostasis). An account of the mode of reproduction of social organisational structure, indeed, is a feature I believe to be vital to any sustainable account of social ontology” (Lawson, 2012, p. 359).

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12 Notice the resemblance with Dopfer (2004, p. 193) programmatic definition of Evolutionary Economics: “The research program of evolutionary economics differs from that of neoclassical economics in two essential ways. First, it starts expressly with dynamics and views coordination as a temporary stationary state of an evolving economic system. Second, the explanation of coordination and change takes place at the generic level defined as the locus of economic rules.”
Emergent entities such as institutions have both coordinating virtues, as they bring a degree of stability and coherence that may persist and reproduce a certain configuration of relational linkages, as well as (self) transformation over time, providing both fundamental evolutionary traits of change and retention. We can conceive economic organisation as having a distinctly institutional dimension, for organisations, as emergent entities, have (downward) causal powers over its constituents (organisational members) with possible self-enforcing dynamics. By creating shared models of cognition and providing a both restraining – through interlocking of components and path dependent evolution – and enabling framework – for it provides a coherent stable uncertainty-reduced space that incite coordination, organisations present a certain degree of institutionalization. (Coriat et Dosi, 1998a; ?).

Through this quick incursion in the complexity domain, the framework in which the new evolutionary economics is embedded, we have arrived to an ontological realist basis in which to ground evolutionary theory and vindicated the use of Institutions as real causative entities that play a structuring (literally) role in the evolution of both the economic theory and economic system. In addition, the “diachronic causal accounts” sounds quite near of a “unfolding sequence of cumulative causation” as proposed by Veblen (1898, p. 375-378), suggesting ontological and (at least some) explananda congruence between Institutional and Evolutionary Economics. We now turn to the analysis of a promising framework for conjugating these approaches.

**Final Remarks: on Institutions and The Micro-Meso-Macro Framework**

The micro-meso-macro framework (Dopfer et al., 2004; Dopfer and Potts, 2004; Foster, 2011; Foster and Potts, 2009) embodies most of the insights here advanced and provide an analytical apparatus for re-conceptualizations of evolutionary accounts of economic phenomena so as to better grasp its complexity and multi-level emergence (Dopfer et al., 2004). It is not our intention here to assert the merits and limitations of such a framework, but merely to point the means of incorporating broad institutional insights into the modified evolutionary framework.

The evolution of the economic system, a complex open adaptative system, is understood as “a massively complex structure of rules that have evolved over a long period of time” (ibid, p. 266). Neither micro nor macro can capture this fundamental aspect: the ontological domain where the rule is situated (taking into account its population of actualizations) is defined as the
**meso**. Therefore, a meso unit or meso rule\(^{13}\), consists of knowledge embodied in a generic rule that is instantiated with some variety (actual applications of the generic rules) by a population of firms/carriers – the micro aspect – and at the same time the rule relate to other meso units to form a higher level system, namely the macro.

The evolution of the economic system depends on the generation of novelty and the production-diffusion of knowledge (Dopfer and Potts 2004). It is through an evolutionary process of institutionalization that new knowledge comes into the system embodied in technologies, organisational architecture, markets, know-how, etc. The meso trajectories are thus the central phenomena to be accounted for by evolutionary theorists (Dopfer et al. 2004). Nevertheless, as acknowledging the coordination imperative in view of the de-organising propensities emerging in the meso domain, the approach is sensible and facilitates exchange between evolutionary and institutional economists. All innovations are de-organising (and re-organising) processes, where entities abilities toward community identity creation, designing of incentives, conflit resolution and the interaction and association with supporting institutions are decisive to the outcome of its “strictly productive competencies”. In fact, these characteristics of organisations-institutions and the rules in themselves are not completely separable, further complicating the outcome of evolutionary processes (due to multiple levels of selection; group - of rules – selection; etc).

The micro-meso-macro framework, indeed provide more explicit and clear distinctions permitting evaluate to what extent key explicative *explanans* have successfully been integrated into the theory. It makes the distinction between the two essential features of economic societies: change and coordination. Micro and Macro level are both views on the central meso evolution and diffusion (through the tools of population dynamics explored above) and the coordination problems that emerges from meso trajectories. Micro level analysis relates to how an agent carries and us the rules; Macro phenomena is the self-ordering emergent properties of the collection of meso units.

As tough the framework allows for an explicit recognition of the role of institutions the actual incorporation of operational concepts poses some difficulties. Partly, this stems from the theoretical preferences of evolutionary economists in dealing with market process, “self-organising” and self-ordering phenomena, cognitive aspects of entities, lock-in and technological path dependency, etc. Likewise, Institutional Economists often downplay the role of formal

\(^{13}\)Traditional evolutionary populational diffusion models – replicator dynamics – apply to to these meso rules
techniques, incur in methodological collectivism and provide near atheoretical descriptive accounts of phenomena.

It has already been put forward by several authors that, there must be full recognition of the double nature of institutions, routines and rules in general (Coriat and Dosi 1998a, Langlois and Foss, 1999; Potts and Nightingale, 2001). Even tough it is the same bundle of rules that agents instantiate, two dimensions can be distinguished: cognitive (learning, competence, mental models) and gouvernance (incitations, conflit mediation, enforcement). The challenge resides in the fact that both dimensions of routines co-evolve in a highly complex, open and undetermined system.

The micro-meso-macro framework is not a distinctly novel contribution in content. It is an architecture that provides clear ontological commitments and that can help draw more interest to incorporate insights from Institutional economics in the evolutionary research program. Only when a co-evolutionary account of the transformation of both the cognitive-competence dimension and the gouvernance-conflit dimension.

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