The Santa Fe approach to complexity: a Marshallian evaluation

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Abstract

The paper examines the characteristics of the ‘Santa Fe approach’ (hereafter SFA) to complexity and attempts its evaluation in terms of the Marshallian intellectual tradition. The paper is organised into three parts. The first part outlines the main features of the SFA. The second describes Marshall’s views on complexity and his appeal to common sense as a way to apply economic reasoning (on complex systems) in practice. The last part argues that Marshall’s views on complexity, rather than just being a historical precedent for the SFA, consist in an original illustration of the role of judgement in the use of economic theory. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

Current ideas on complex systems have been introduced into economics without paying attention to previous contributions to the concept of complexity in the history of the discipline. Yet, complexity is a familiar and well-known topic in the history of economics. Many current research themes on complexity, such as autopoiesis, nonlinearity, path-dependence and lock-in, were addressed previously — in different contexts — by economists interested in the complexities of real-life economies. Indeed, Charles Babbage’s treatment of increasing returns and endogenous aspects of technological change, Alfred Marshall’s famous appeal for ‘eco-
nomic biology’ as the ‘Mecca of the economist’, Friedrich Hayek’s belief in the self-organisation feature of complex systems, Maynard Keynes’s emphasis on the instability of equilibrium positions and the role of expectations, Guinard Myrdal’s views on cumulative causation and path-dependency, Nicholas Kaldor’s criticism of the partial equilibrium method due to the existence of increasing returns and nonlinearities in economic processes, and Ragnar Frisch’s views on chaos and complexity and the effects of non-linear specifications on economic models are just a few examples of the importance of the themes relating to complexity in the intellectual history of economics. The writings of many others, such as Joseph Schumpeter, George Shackle, and Richard Goodwin, could be mentioned as examples of the importance of the idea of complexity in the history of economics.

Research on complex systems has been largely influenced by work carried out at the Santa Fe Institute. The influence of this work on the doing of economics has been so pervasive that previous discussions on complexity have almost completely been ignored. In general lines, what has been called the ‘Santa Fe Approach’ to complexity (see Arthur et al., 1997) consists in an attempt to generate interdisciplinary knowledge from a synergetic effort between the realistic and the artificial-world approaches to science. Advocates of the SFA to complexity claim that an emphasis on complex systems might provide a new zeitgeist for the doing of science, the main relevance of which consists in expressing a dynamic picture of basic real world structures. The engine of research emphasises biology (rather than physics) as the main source of scientific analogies.

Although an investigation of the historical precedents to the contemporary discussions on the Santa Fe approach (SFA) would be of interest per se, the case for this investigation is stronger on the basis that any contextualisation of the future significance of the SFA must discuss the historical roots of complexity in economics. Because of the vastness of the task, we shall narrow the focus of the discussion in two ways: by focusing on Marshall’s views on complexity, and thus providing a concrete illustration of a historical precedent for the SFA; and by addressing the specific problem of context definition and context transition in complex systems, and thus isolating one of the central issues in the complexity literature through which a contextualisation of the SFA is attempted.

According to the SFA, complex systems are expected to represent processes where there are no attractors or where attractors may change. From this perspective, the main theoretical challenge raised by this approach concerns the definition of an idea of context (or cluster) and an explanation of how does the transition between different contexts take place. It is argued here that this issue is not discussed in any depth in the literature and that, when discussed, there is an almost uniform tendency to justify the context transition in terms of the biological metaphor of evolution, which not only may fail to provide a mechanism for transition but also ignores ethical aspects related to the definition of contexts in economics.

The aim of this essay is to examine how Alfred Marshall’s views on the practical aspects of economics and the specific problem of context definition in complex systems might help to illuminate the use of complexity theory in economics. The
essay focuses on Marshall’s references to the complexity of the economic systems rather than on an objective comparison between Marshall’s and SFA’s notions of complexity. The main point which this paper makes is that Marshall’s discussions of complexity may offer a good illustration of the importance of practical aspects for any synergistic effort in economics.

The paper is organised into three parts. The first part outlines the main features of the SFA, focusing on the issues of context definition/transition and ethical aspects. The second describes Marshall’s views on complexity and his appeal to common sense as a way to apply economic reasoning (on complex systems) in practice. The last part argues that Marshall’s views on complexity, rather than just being an historical precedent for the SFA, consist in an original illustration of the role of judgement in the use of economic theory. It suggests that the SFA should address some of the issues raised by Marshall concerning the conceptualisation of complex systems.

2. The Santa Fe approach to economics

As Arthur et al. (1997) point out, there is no single vision able to express the meaning and significance of complexity in economics. Yet, they identify a family resemblance among interrelated sets of themes that pervade the current meaning of complexity in economics or the SFA to economics. Among these themes we find: applications of non-linear dynamics to economics and data analysis, the theories of path-dependence and lock-in and the emergence and evolution of self-organised systems¹. The main purpose behind this approach is the study of what is called complex adaptive systems or adaptive nonlinear networks (ANN). These networks or systems — which might refer to proteins, ants or economic agents — are characterised by different properties which define a logical realm where many relatively independent parts are highly interconnected and interactive (Cowan, 1994). In its latest version (Arthur et al., 1997), these ANN are characterised by six properties:

1. Dispersed interaction: global results are produced by the interaction of many diverse and dispersed agents acting in anticipation of other agents. The property of diversity produces ‘perpetual novelty’ in aggregate behaviour;
2. No global controller: interactions among agents are produced by mechanisms of competition and coordination without the help of central mechanisms of control and coordination;

¹ Broadly speaking, the notion of nonlinearity means that we cannot deduce the aggregate behaviour by a mere summing of individual behaviours. Because agents are expected to interact, interaction is expected to influence the aggregate behaviour. The notion of path-dependence means that previous results influence the subsequent trajectory of the system and lock-in means that once individuals have adopted a certain strategy there are obstacles to leaving it. Finally, self-organisation means that systems present morphogenic properties, out of which order is produced from disorder. For more on these concepts see Anderson et al. (1988).
3. Cross-cutting hierarchical organisation: global organisation consists of many different levels. Units at any level may serve as ‘building blocks’ of units that are at a higher level;

4. Continual adaptation: internal states of agents change in response to changes in the environment, where individuals constantly adapt to their accumulated experience. There is scope for evolution and evolving processes where systems might be considered as responsive entities to environment dynamics;

5. Perpetual novelty: new behaviours and new structures may stimulate the creation of new behaviours and new structures, producing an ongoing state of perpetual novelty. Statics is replaced by dynamics;

6. Out-of-equilibrium dynamics: given the state of perpetual novelty, the economy does not operate close to any optimum equilibrium; instead, out-of-equilibrium is a pre-condition for the dynamics of complex systems.

The main relevance of complex systems is that they consist in an interdisciplinary attempt to work with theoretical structures which are expected to reflect the external and dynamic conditions of the world.

This means that because the networks are adaptive they are able to internalise empirical information from the world in terms of states of a system (see Martin, 1994, p. 266). Because the networks are subject to novelty they are able to reflect the dynamic nature of structures that emerge and evolve. In a way, one of the reasons for the appeal of this approach is its acknowledgement of the shortcomings of neoclassicism in economics. Arthur has provided a good illustration of the relevance of complex systems for the doing of economics. According to him,

The problem with all theory is that it tends to portray the system you are looking at — say, the economy, or the biosphere — in terms of the dominant zeitgeist metaphor of the time. For Adam Smith’s time, in 1776, for 50 years — or longer — the dominant metaphor was systems in stasis, systems that operate in a kind of clockwork fashion, that are highly deterministic, and are in some sort of equilibrium balance. That was the notion of the Enlightenment, partially inherited from Newton and others. We are entering a different zeitgeist at this stage in the twentieth century, where we’re more interested in things that are in process, and pattern change. So I’m hoping that new theories of economics can reflect that the economy is in process, that the economy is always developing. The development never necessarily stops. The question is how do we talk about that? How do we think about it? What are the mechanisms? And above all, does that give us a feeling that we’re closer to reality? (Arthur, 1994, p. 80)

Thus, it seems that the main relevance of the ANN for the doing of economics is that they are a motion picture or a metaphor of the basic dynamic real world economic structures. As noted before, because the changes in the internal modes are assumed to be a result of a reaction to environmental conditions, these systems are expected to learn from their interaction with reality. For this reason, as discussed by Anderson (1994, pp. 10–11), mathematical theory is not the best way to follow
in order to understand complex systems, due to the fact that its ‘lemma-theorem-proof’ structure is only concerned with exact unique solutions which do not provide good approximations for analysing real world complexities. This does not mean that mathematics must be avoided per se but that mathematics must be used only when it provides solutions that are coherent with the properties of real systems. For instance, standard mathematical approaches — based on equilibrium — cannot capture complex behaviour which is in ‘perpetual novelty’ and new mathematical tools, based on combinatorial analysis and population-level stochastic processes, need to be developed.

From this perspective, economics is not seen as an isolated discipline but as one more integrated entity embedded into a larger cultural system. To conceive of economics as an autopoietic system (Zeleny, 1996) is to say that the scientific strategy of looking for attractors is meaningless. The focus of attention in studying ANN must shift from the search for equilibrium points to ever-changing trajectories. Arthur (1994, p. 464), has argued that ‘all economics has been able to do for the last 50 or 100 years is to look at systems with very strong attractors, not even talk about how an equilibrium point is reached but simply point out that there is an equilibrium and that if we were there, there would be a tendency to stay there’. By contrast, the SFA argues for a representation of realistic and genuine processes of change, where perhaps there are no attractors or attractors may change, meaning that processes have no definable end states. Thus, the representation of the notion of change is at the core of the SFA.

The main alternatives discussed in the literature of complex systems and artificial intelligence point to two main organising concepts — schemata and histories — that provide a basic description of the relevant features or aspects of reality which are in permanent change. In so far as these concepts represent the idea of context (or cluster), that is, of tight connections within a certain group, they serve the purpose of individuating and identifying reality.

The first of these two organising concepts is that of schemata (Martin, 1994). In social sciences, schemata may represent a set of habits, customs, institutions, etc., or any other sort of regularities perceived by the elements of the system. According to Martin, schemata have two main characteristics: summarisation and internalisation. Summarisation means that one of the functions of schemata is to produce a reduced and organised description of the relevant aspects of an object or event. Internalisation means that schemata can internally represent external real-world features as states of a system. However, once the information is summarised and internalised, schemata become a representation of real processes that follow the organisational principles established by the particular system. Martin (1994, p. 276), remarks that, schemata ‘might provide the kind of probative guide to intuition that can always be of use in understanding the behavior of extremely complicated phenomena’.

Because the entire emphasis of the SFA is put on the dynamic aspects of complex systems, the main question to be asked here concerns the transition between different schemata (or contexts). How does transition take place? As indicated earlier, this point has not received the attention it deserves in the literature, and
when it is discussed there is a tendency to justify the schemata transition with evolutionary metaphors (see Khalil and Boulding, 1996). However, useful as tools for creative thought, biological metaphors must be handled with prudence. Louçã (1997) Chapter 5, provides a balanced assessment of the use of biological metaphors in economics. On the one hand, he shows how evolutionary metaphors based on Lamarckian biology and Darwinism have committed the obliquity error², because logical relations of causality cannot be translated from biology into economics. He points out that:

The balance sheet of the precise metaphors taken from biology is rather poor: for most of the cases, the metaphors amounted to extreme versions of the obliquity error, not only translating similarity into causality but also implying wrong relations of causality. (Louçã, 1997, p. 97)

On the other hand, he argues that biological metaphors constitute an invaluable source of creative thinking free from positivist vices. Evolutionary systems present characteristics, such as mutation, heredity and selection, which provide through the concepts of self-evolution, self-sustainability, autocatalytic development and self-reference better alternatives for the study of processes of change than the physicist metaphors of equilibrium, maximisation and conservation. His conclusion is that (p. 104) the ‘evolutionary metaphor is useful and necessary, but it is also limited’³. Evolutionary ideas may be transferred to economics but only if we respect the specificity of social and historical domains, where purposeful human action must be taken into account.

The upshot of this discussion is that schemata evolution and the transition between different contexts may be illuminated by biological metaphors, but one must exert prudence in the interpretation of the metaphors due to the idiosyncratic features of social systems. Indeed, the faculties of prudence, judgement, intuition and discrimination are the ultimate arbiters of the use of metaphors and hence, ethical aspects are an intrinsic part in the use of biological metaphors.

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² Louçã argues for Hesse’s criterion of validation of analogies for a realist model. It all depends upon the extension of the positive analogy compared to the negative analogy (the properties of the secondary subject not existent in the primary one). As defined by Louçã (1997, p. 66) the error of oblique transfer refers to ‘the illegitimate transposition of propositions defined in the space of the horizontal relations [formal or material analogies] to the space of the vertical relations [logical causal relations], causing an excessive inference which ignores the negative analogy’.

³ A full statement of Louçã’s argument is found in the Introduction of his book (Louçã, 1997, p. 4): ‘Darwinian evolution represents essentially an allegory for economics: it provides a new vision, escaping from the mechanistic prison, but the attempts to generate precise biological analogies orienting the research in economics are doomed to fail. No economic analogue exists for the replication unit in biology and the discrimination between genotype and phenotype is not relevant in society, neither is social evolution identifiable by natural selection processes. Indeed, an excessive expectation attributed to the metaphor the power of selection of specific hypotheses and of defining models for analysis, but the results were scarce. Yet, the evolutionary metaphor is not to be dropped. The argument of this book is that it is even more useful than ever, if its merits are considered’.
Bearing in mind the consequences of the use of physical and mathematical metaphors in economics, the issues of prudence and judgement in the use of biological metaphors acquire a double significance. What is at stake here is not merely the question of choosing the best type of metaphors for the doing of economics but also the question of how one exercises prudence and judgement in the choice and use of metaphors. With the development of the ‘lemma-theorem-proof’ way of doing science, economists’ concern with prudence and judgement in the doing and using of economics has virtually disappeared (see Krueger et al., 1991). Now, interest in complexity theory and evolutionary metaphors arises from the fact that they might provide not only a better metaphor through which to understand the processes of emergence, evolution and self-organisation of social systems but might also provide scope for a logical inversion of the way of doing economics: from a situation where theory determined the choice of the problems to be studied to a situation where the nature of the problems under study may determine the choice of the most appropriate theory, resulting in a more realistic economics.

The second organising concept put forward as a way of describing the features of reality is the concept of histories, elaborated in the literature of artificial intelligence. Hayes (1985) defines a history as a particular spatio-temporal entity ‘in which something happens’. In other words, a history is a spatio-temporal isolation of an event. It allows qualitative description of real-world phenomena since it provides factual descriptions of situations that are extended through time and are bounded spatially. A history is subdivided into episodes that are the expression of the different particular kinds of things that happen in that history. The basic criterion for determining the identity of histories is their spatio-temporal continuity. Some examples of histories would include a lecture, an economic recession or even a particular set of speculative acts on the financial market.

The concept of history results from the need for ‘conceptual closure’ when attempting to express a wide range of intuitive4 concepts in the description of certain phenomena. Because we want explanations of reality with breadth and depth we need to create clusters where we are able to relate a certain concept to many others. Hayes (1985, p. 15) argues that, ‘It is exactly this, being tightly caught in a dense web of inferential connections to other parts of the theory, which gives a token (i.e. a formal symbol) meaning, by cutting out unwanted implausible models’. Thus, the meaning of the representations depends on the circumstances (i.e. the nature of the boundaries) in which the heuristics of the problem is created. The transition between different histories or contexts may be subject, in addition, to a change in the circumstances but also to a change in the heuristics of the problem. This might generate histories that diverge among themselves because they are defined taking into account different dimensions. Then, the main question, known in the artificial intelligence literature as the frame problem (see McCarthy and

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4 Hayes (1985, p. 22) observes that: ‘Many mathematical intuitions at the basis of geometry and real analysis (from which topology is an abstraction) seem to be at odds with the way we think about everyday space’. For instance, he argues that we do not think in terms of infinite variables.
Hayes, 1969) is: how do we know which facts remain true and which facts change when something happens? Thus, the acknowledgement that there is no intrinsic mechanism able to explain the transition between different histories means that we are back to the same basic problem which we identified earlier when discussing the evolution of schemata. Now, the main conclusion to be drawn from an examination of the notions of schemata and histories is that it seems implausible that the rich variety of the everyday world could be represented without addressing the complexity involved in the comparison of different contexts.

The outcome of this argument is that the SFA’s use of evolutionary metaphors and complex systems — if meant to bring realistness into economics — needs to be complemented by an understanding of how economists conceptualise change in real social systems, because on this perception depends the prudent and proper use of complex systems in economics. This is the issue of prudence in the use of biological metaphors raised by Loucã. However, how does one define the economists’ notion of context definition/transition that is needed as ‘the ultimate arbiter in the use of metaphors’? It is argued here that this is itself a complex issue, the answer to which must be sought in the common sense reasoning involved in the practical affairs of ordinary life. Otherwise, the meaning of the SFA might be restricted to a mere substitution of a more useful for a less useful metaphor without discussion of the principles that regulate the use of the metaphor.

3. Marshall’s views on complexity

Marshall believed that economics was a discipline with a dual nature. On the one hand, he considered economics to be a fruitful field for intellectual and analytical speculations. On the other hand, he trusted economics to play an essential role in the betterment of the conditions of mankind. More specifically, the dual character of Marshall’s work was manifested in his concern with economics as a useful guide for practical issues. Because the theoretical and analytical aspects of economics were not the whole of economics for Marshall, he did not expect them to resemble the real world close enough (see his letter of 15 December, 1902 to J.B. Clark, in Pigou, 1925; Marshall, 1902a). This meant that the statical method was relevant for Marshall in so far as it was able to provide coherent and useful guidelines for subsequent application of the theory. From this perspective, the statical method, with its mechanical analogies, was as important to economics as the dynamic and biological analogies. Marshall’s (1898, p. 39), remark that ‘economic reasoning should start on methods analogous to those of physical statics, and should gradually become more biological in tone’ should not be understood as a statement of absolute superiority of biological metaphors over physical ones. Because of the dual nature of Marshall’s economics, the statical method might be as serviceable to practice as any other method.

As far as the use of biological metaphors is concerned, Marshall (1898, p. 43), introduces a conditional clause when he remarks that ‘biological analogies are to be preferred to mechanical, other things being equal’ but that ‘Other things may not
be equal'; and his advice is that (p. 43) ‘wherever helpful it [mechanical analogy] should be used’. Now, we are emphasising here the usefulness Marshall saw in the statical method, with its mechanical analogies, not because of the qualities of this method per se, but because of the attention its use demands. The idea behind it is that the stronger the limitations of a method, the more attention and prudence must be exercised in its application to wider contexts. From this perspective, both mechanical and biological analogies fall short of providing authoritative statements if not complemented by the human element of the problem. Consequently, even if Marshall had written a second volume of the Principles, based on biological analogies, he would still have had to contextualise those results within economics proper. The human element involved in science is intrinsic to the dual nature of Marshall’s economics. In The Present Position of Economics he writes,

It is vain to speak of the higher authority of a unified social science. No doubt if that existed Economics would gladly find shelter under its wing. But it does not exist; it shows no signs of coming into existence. There is no use in waiting idly for it; we must do what we can with our present resources.

The only resources we have for dealing with social problems as a whole lie in the judgement of common sense. For the present, and for a long time to come, that must be the final arbiter. Economic theory does not claim to displace it from its supreme authority, nor to interfere with the manner nor even the order of its work, but only to assist it in one part of its work. (Marshall, 1885, pp. 163–164)

Marshall believed that because the world of man’s actions as a whole is too wide and complex, it could not be analysed by an a priori unified intellectual effort. Indeed, the theme of complexity was pervasive in Marshall’s writings. It can be found, for instance, in his main books — such as the Principles, in its several editions, and Industry and Trade —, in papers — such as The Present Position of Economics (1885) and The Old Generation of Economists and the New (1897) — and in his correspondence with other economists — such as Edgeworth (see Pigou, 1925). To start with, it should be mentioned that Marshall argued that the aim of the work of economists was ‘to disentangle the interwoven effects of complex causes’ (Marshall, 1902b, p. 437). Complexity for Marshall was found not only in the object of study — the natural and social processes — but also in the knowledge used to analyse those processes. He puts considerable emphasis on the way through which the progress of knowledge might become more complex in itself. He observes that more complex studies are bound to be more realistic (Marshall, 1920, vol. 2, p. 175), and that ‘Every year economic problems become complex’ because they are studied from many different perspectives (Marshall, 1920, vol. 2, p. 291). However, complexity and variety of knowledge are, according to Marshall, best handled with simplicity. Complexity was an important feature of economic systems for the Marshall of the Principles (Marshall, 1920). This importance is manifested in (i) his references to the complex nature of some economic phenomena, (ii) his direct statements concerning the complexity of economic systems, and (iii) his use of some categories currently employed in the study of complex systems.
Marshall’s acknowledgement of the complexity of economic systems might be illustrated by statements such as that ‘Nature’s action is complex: and nothing is gained in the long run by pretending that it is simple, and trying to describe it in a series of elementary propositions’ (p. x); that ‘The science of man is complex and its laws are inexact’ (p. 32); that our economic problem ‘is too complex to be focused in a single view’ (p. 545) and that ‘the socio-economic organism is more delicate and complex than at first sight appears’ (p. 712). Moreover, Marshall develops in his analysis several elements that refer to concepts current in today’s complexity theory. Based on his perception of ‘the variety of human nature’, Marshall (p. 14) argues that ‘economics cannot be compared with the exact physical sciences: for it deals with the ever changing and subtle forces of human nature’; more precisely, as he discusses in Ch. VIII, Book IV, these forces are not only ‘changing’ but they are ‘evolving’. Meaningful changes are the ones that are ‘appropriate’ in the sense that they potentiate ‘progress’ (self-organisation). As observed by Viner (1941) p. 250, Marshall got from biology ‘a live sense of the complexity and variability of the interrelations between economic phenomena’. Drawing heavily on Darwinian biology, Marshall puts forth a stylised form of autopoietic\(^5\) and morphogenetic\(^6\) argument in order to justify the evolution of industrial organisation:

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\begin{align*}
\text{the development of the organism, whether social or physical, involves an increasing subdivision of functions between its separate parts on the one hand, and on the other a more intimate connection between them. Each part gets to be less and less-sufficient, to depend for its well-being more and more on other parts, so that any disorder in any part of a highly-developed organism will affect other parts also. This increased subdivision of functions, or ‘differentiation,’ as it is called, manifests itself with regard to industry in such forms as the division of labour, and the development of specialised skill, knowledge and machinery: while ‘integration,’ that is, a growing intimacy and firmness of the connections between the separate parts of the industrial organism, shows itself in such forms as the increase of security of commercial credit, and of the means and habits of communication by sea and road, by railway and telegraph, by post and printing-press. (Marshall, 1961, Principles, p. 241)
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Individuals are seen as members of the social organism and it is within this context that their actions should be interpreted (p. 25). He also discusses the possibility of nonlinearities resulting from the presence of increasing returns which

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\(^5\)Autopoietic systems are those in which each of their elements can emerge, persist and reproduce only within a complex of relations and networks. For a discussion on the social nature of autopoietic systems see Zeleny (1996).

\(^6\)Morphogenetic processes concern the development of form and structure in an organism which happens through the emergence of formation and differentiation of basic elements.
affect the use of the ceteris paribus clause. It seems that as long as there are no cumulative effects one can use short-period analysis to represent economic phenomena, but that when these effects are allowed to operate then the method needs to be changed. Marshall (1892, p. 379), n.1f, points out that, ‘violence is required for keeping broad forces in the pound of Ceteris paribus during, say, a whole generation, on the ground that they have only an indirect bearing on the question in hand. For even indirect influences may produce great effects in the course of a generation, if they happen to act cumulatively; and it is not safe to ignore them even provisionally in a practical problem without special study’. When discussing the peculiarities in the action of demand and supply with regard to labour, he remarks that cumulative effects, such as the indirect effects of custom (p. 560), ‘exert a deep and controlling influence over the history of the world’. It might be argued that his logical division between short and long-period analyses respects the differences between linear and non-linear effects. However, Marshall’s views on complexity go beyond what was described above as similarities with the SFA’s main properties because they address the question of how economists’ sense of reality is associated with the conceptualisation of change in real social systems. Thus, Marshall’s views constitute a very particular ‘whole’, the examination of which must include three important interrelated features of his economic analysis: his appeal to common sense as a way of applying economic reasoning (on complex systems) to the real-world; his notion of ‘normal’ as an expression of tendencies in complex systems; and his answer to the context problem. These features follow a logical sequence which defines the framework for the analysis of complexity which Marshall bequeathed to later economists.

3.1. The role of common sense

The substance of economics was for Marshall intrinsically related to human conduct in the ordinary affairs of life and to the practice of ordinary discourse. As Marshall put it in the Principles (p. 1), ‘Economics is a study of mankind in the ordinary business of life’. Implicit in this definition is the existence of two distinct realms: the real-world realm of ordinary business of life and the theoretical realm representing the ordinary business of life. Thus, present in Marshall’s discussions is the notion that economics is a representation, an expression of a ‘sense of reality’ already available — at least for the economist. Marshall reiterates this view many times in the Principles and in his Lectures to Women (Marshall, 1873, pp. 87–88). The restrictions Marshall imposes on this very generous principle — which allows economists to use their own experiences and judgement as part of the scientific activities — is that economists must be concerned with those aspects of life that can be observed and can be verified by results. Also, it could be said that because economic systems are complex, economists might use their common sense as a way to approximate their theories to realistic economic processes and applying economics. Marshall argues that:
The work to be done is so various that much of it must be left to be dealt with by trained common sense, which is the ultimate arbiter in every practical problem. Economic science is but the working of common sense aided by appliances of organized analysis and general reasoning, which facilitate the task of collecting, arranging, and drawing inferences from particular facts. Though its scope is always limited, though its work without the aid of common sense is vain, yet it enables common sense to go further in difficult problems than would otherwise be possible. (Marshall, Principles, p. 38)

It is worth noting here that for Marshall not all notions of common sense qualify as trained common sense. Rather, what he calls untutored common sense or public opinion (Marshall, 1885, p. 164), is most likely to produce the wrong consideration. Untutored common sense is for him that body of knowledge based on surface phenomena, unconcerned with the complexity of the manifold mutual determination of actions, that denies a careful and thoughtful investigation of experience. Yet, a most interesting point in Marshall’s references to common sense is that he saw untutored common sense as a knowledge in progress, evolving from errors and containing the right ‘seeds’ for future extension of the boundaries of knowledge. Therefore, what Marshall called trained common sense might be seen as a middle ground between untutored common sense and reasoning on strict logical lines (Marshall, 1897, p. 297); a knowledge that becomes more complex as it evolves. As argued here, common sense is important for Marshall not only because it enables economists to handle complexity but also because it incorporates the faculties of reason and judgement that are needed for organising facts, developing theories and applying them to practical issues.

According to Marshall, an important role of common sense is dealing with a complex problem by breaking it up into its (simple) several parts and later, gathering them back together (see Marshall, 1885, p. 164). Here, the key to complexity seems to be the flexibility with which a particular problem might be broken up (see Viner, 1941, p. 251). Then, by gathering all parts relevant to a particular situation, common sense allows a great variability in the explanation of the economic phenomena. This role of common sense was translated by Marshall into the principle of the one in the many, the many in the one. In his Industry and Trade (Marshall, 1923, pp. 5–6), Marshall explains that on the one hand, what might be seen as a unique phenomenon is, in reality, a combination of many influences — the one in the many — and on the other hand, what is realised as the product of a variety of factors is indeed based on very few principles — the many in the one. This last half of the principle also assumes that there is a concept of normality represented by the confluence of different tendencies (discussed below). The idea behind Marshall’s support for the use of familiar terms of everyday life in economics, is that a knowledge that may not be understood is not of much use or, perhaps more importantly, a knowledge that is not flexible enough is not a knowledge that can be applied to a variety of particular situations. Because, according to Marshall, no practical problems can be settled by appeal to pure and general theories, there is a need for translating pure into applied theory, or in other
words, a need for contextualising economics within different particular social settings. Having this relation between familiar terms ('the didactic style') and the use of economic theory in perspective, it might, thus, be explained why Marshall (1897, p. 297), argued that ‘the growing perfection of scientific machinery in economics, so far from lessening the responsibilities of common sense, increases those responsibilities’. The argument is that an increase in the technicalities and authority that accompanies the growth of scientific knowledge puts increasing pressure upon the economist’s abilities to translate those pure aspects into practical guidance to particular situations.

In order to handle complexity, Marshall argues in the *Principles* that common sense appeals to vagueness (pp. 394 and 638), to context (discussed below) and to practical conveniences (pp. 39 and 53 n.1). A tacit assumption behind this reasoning is that the degree of complexity involved in ordinary affairs of life is higher than the degree of complexity of theoretical problems (pp. 628 and 722). Coherent with his view is that diverse activities generate different intuitions and distinct levels of apprehension of the complexities of the real-world.

As mentioned above, another tacit assumption behind Marshall’s use of the doctrine of common sense is that there are notions of normality to be discovered by the investigation of facts. As he has proposed (Marshall, 1893, vol. 2, pp. 501–502), ‘Science must study facts, ascertain which of them are representative and normal, and then analyse, and reason about normal conditions, at first within a narrow range; and afterwards, as knowledge increases, giving a wider range to these normal conditions, and thus becoming at once more complex and nearer the actual facts of life’. It thus seems that there are two senses in which the notion of normality is associated to common sense and complexity.

3.2. The concept of ‘normal’

The idea that there are concepts such as normal values, normal profits, normal wages, normal efficiency, long-period normal values, is central to Marshall’s theories of value and distribution (see Harcourt, 1981, p. 253). Whereas the presence of these ‘normal’ values in Marshall’s theory has been justified as a result of the influence of the classic economists on his work (O’Brien, 1990), not much attention has been given to the relation between normal values and ordinary people’s notion of the ‘normal’ — interpreted as a pre-condition to conduct in the ordinary affairs of life.

There is a close link between Marshall’s theory of normal prices and his theory of long-period equilibrium prices. Guillebaud tells us, as reported by Robertson (1956, p. 16), that Marshall had in mind two different concepts of ‘the long period’, ‘one in which it stands realistically for any period in which there is time for substantial alterations to be made in the size of the plant, and one in which it stands conceptually for the Never-never land of unrealised tendency’. Marshall’s definition of the term ‘normal’ and ‘normal action’ has two sides. The first side is associated with the concepts of tendency and context. Because the normal action is that course of action (p. 34) ‘which may be expected under certain conditions’, it is
related to a statement of tendencies that are inexact and faulty. Normal is what is to be expected given the complexity of a certain situation. It is the result of a probable judgement based on the evidence provided by the context in which the situation or action takes place (Principles, p. 34). The point is that there is no absolute a-historical standard of normality in this use of the term ‘normal’. It is a relative term (relative to the context in which it is used) which merely expresses the balance of tendencies that might be expected for a given context.

The second side of Marshall’s notion of ‘normal’ refers to it as an analytical concept. According to this notion, all particular features are ignored in order to emphasise the broad (and analytical) aspects that are shared by most elements of the problem. This does not mean that the particular aspects are eliminated from the problem, only that the notion of ‘normal’ does not detect or address their presence (p. 619, 844). In this more restricted sense, the notion of ‘normal’ needs ultimately to be complemented by those particular features that are non-stationary (p. 347). He is well aware that situations of ‘equilibrium’ are unable to represent ‘normal’ situations in the first sense of the term. This is an analytical device — one with many limitations — used to examine the complexity of the real world.

These two sides of Marshall’s notion of ‘normal’ might be called, in the absence of better terminology, ‘c-normal’ to designate the first sense, related to the expression of tendencies within complex systems, and ‘a-normal’ to indicate the second sense, associated with the analytical demands of theoretical systems. This classification corresponds to Harcourt’s (1991) distinction between ‘period’ and ‘run’. Whereas ‘period’ represented for Marshall an analytical concept, ‘run’ corresponded to actual (historical) calendar time. The important point is that ultimately a-normal concepts need to be interpreted in terms of c-normal concepts, which are dependent on the meaning of context.

Time is one of the most important elements in Marshall’s determination of context. The idea is that different periods of time allow the manifestation of different sets of causes, defining different concepts of normality, which characterise different contexts. Thus, by dividing the periods of time between short and long Marshall is expressing a context-clause:

In this case, as in others, the economist merely brings to light difficulties that are latent in the common discourse of life, so that by being frankly faced they may be thoroughly overcome. For in ordinary life it is customary to use the word Normal in different senses, with reference to different periods of time; and to leave the context to explain the transition from one to another. The economist follows this practice of every-day life: but, by taking pains to indicate the transition, he sometimes seems to have created a complication which in fact he has only revealed. (Marshall, Principles, p. 363)

It is the elasticity and flexibility presented by the notion of c-normal that turns this notion into an expression of tendencies for a given context in complex systems. It is then of fundamental relevance to discuss the determinants of context in Marshall’s systems.
3.3. The context problem

Defining context is the crucial epistemological device used by individuals in their ordinary affairs to cope with the complexity of facts of life. Context might differ according to variations in the area of space, and/or in the period of time, and/or in the particularities resulting from different circumstances. Marshall’s point is that if economists want to see their science producing results useful for (applicable to) complex economic systems, they must follow the practice of context definition/transition -as ordinary people do in their everyday affairs in life. Now, it is on this basis that Marshall defines the use of ceteris paribus in economics, because for him,

This scientific device is a great deal older than science: it is the method by which, consciously or unconsciously, sensible men have dealt from time immemorial with every difficult problem of ordinary life. (Marshall, Principles, p. xiv)

Ceteris paribus is interpreted and used by Marshall as an ordinary language device, an epistemological mechanism of apprehension of a particular reality. It says nothing about how the world really is — indeed Marshall emphasises that a system cannot be studied in isolation from the rest — but rather, it deals with how individuals understand the world. It follows that the use of ceteris paribus clauses is coherent with the use of c-normal concepts and with a realist principle about how individuals use common sense to cope with real life complexities.

In the structure of Marshall’s method, context was not defined at an analytical level. There is no scope for discussing the influence of contextual diversity within the stationary state technique. However, context was defined at a practical level and was seen by Marshall as a ‘correction device’ to be used ‘in order to bring these [theoretical] results into harmony with the actual conditions of life and work’ (p. 505). That meant, for Marshall, that the practical importance of different real-life elements determines the ‘context condition’ to be set in the application of different theories. It is important to note that context — related to practical aims — implied for Marshall (i) an isolation of a particular situation and (ii) a conjunction of all the different aspects related to that situation. He argues that (p. 39) ‘the direct pursuit of practical aims leads us to group together bits of all sorts of knowledge, which have no connection with one another except for the immediate purposes of the moment’. Context definition is then explained by Marshall as part of the individuals’ practical reason: it is a transitory characteristic of action.

The issue here is how the practical nature of context definition influences the analytical side of economics. Marshall argues that those economic studies must not be ‘planned’ with reference to their practical uses. However, this should not be understood as a denial of the influence of practice on theory. It is part of the tradition started by Marshall that these two different logical domains (the theoretical and the practical) must coexist and coevolve in a symbiotic way. In theory, economists are expected to break down complex questions and to achieve more precise results. In practice, economists are expected to combine isolated and narrow issues and to achieve more general results. When combined, both activities are expected to produce more reliable results because while theory helps elimination of mistakes, practice makes results less abstract and therefore more applicable (p.
Therefore, simplicity in theory coexists with complexity in practice and any attempt at inverting these relations will cause confusion and misunderstanding (p. 459 n. 1). In the real world simple analytic statements may be of no use and misleading.

Simplicity is needed (i) to give definiteness to our ideas and (ii) to make the problem manageable. For this reason simplicity (and the statical theory of equilibrium) must be seen as an introduction to the discussion of complex economic problems (pp. 460–461). To a certain extent Marshall allowed the common sense and practical notions of real life to influence his theoretical framework. Keeping theory at the service of practice provided Marshall with a reason for a sense of proportion in his arguments (p. 770) and introduction of time in economic analysis. It also provided a justification for avoiding ‘long chains of deductive reasoning’ in science because (p. 771) ‘they are seldom a sufficient guide for dealing with the heterogeneous materials and the complex and uncertain combination of the forces of the real world’.

It is interesting to note that the complimentarity between theory and practice and deduction and induction advocated by Marshall is also conceived by him as a characteristic of ordinary life in which (p. 778) ‘every thoughtful and observant man is always obtaining, from conversation and current literature, a knowledge of the economic facts of his own time’. Common sense is the product of experience and reasoning, facts and thought, because only by combining all information available may individuals cope with the complexity of the real world. Economists must then be careful when interpreting empirical information because ‘the test of experience’ does not produce clear-cut results. An economics of complex systems cannot rely on simple and direct examination of factual evidence. It has to be based on more general and widely accepted knowledge. To the extent that this knowledge corresponds to common sense it qualifies as a flexible and useful knowledge, already in use by individuals dealing with the complexities of ordinary affairs of life.

Summarising the previous arguments, the two questions to be answered are: First, how does the above discussion illuminate the issue of context definition/transition? Secondly, how can Marshall’s legacy to the issue of complexity be summarised?

Marshall maintained that the notion of context definition is a practical issue. It is related to the practical circumstances (all different aspects) of a particular problem. Because theory and practice are closely related for Marshall, context should influence (at least indirectly) the analytical side of economics through e.g. short chains of reasoning, flexible and vague concepts and prudence in the use of mathematics. The notion of context transition is basically an epistemological problem to which the answer for Marshall is common sense. In other words, it is through (trained) common sense that individuals answer the frame problem and exercise their reasoning and judgement powers. But again this is a practical issue that only indirectly influences the ‘science of economics’. Because economic systems are complex, economists are subject to epistemological constraints similar to those faced by individuals in their ordinary affairs. Marshall’s legacy on the issue of complexity may be summarised in five interrelated points:
1. complexity is an important feature of economic systems. Economic forces evolve, are cumulative, present nonlinearities and are time irreversible;
2. complexity is a problem closely associated with the practical usefulness of economic reasoning, it belongs to the realm of economics proper;
3. complexity can be handled by trained common sense;
4. complexity and common sense can be concretely related through e.g. (4.1) contextualisation of economic problems within the wider frame of everyday life, (4.2) respect for historical and geographical differences in the use of economics, (4.3) careful examination of the role of empirical evidence in testing theories;
5. complexity cannot be understood through long chains of deductive reasoning or purely formal analyses of economic processes.

Although tailored to Marshall’s particular methodological needs, this list also provides a basic framework for subsequent contributions related to Marshall’s work. It identifies the problem of complexity, relates it to the practical aspects of economic reasoning and focuses on the role of common sense in the handling of complex systems.

4. Concluding remarks

The principal argument of this essay is that Marshall’s views on complexity, rather than just setting an historical precedent for the SFA, provide useful insights into complexity in economics. The first part of the paper outlined the main characteristics of the SFA and related them to the representation of the notion of context. The aim was to highlight the importance of the role of judgement in the selection of metaphors, that is, that ultimately the relevance of the SFA depends on its correspondence with the economists’ sense of reality about economic processes. If this — so-called — synergism between theory and reality is not actually undertaken, the SFA could become merely another excuse for doing sophisticated mathematics. In general lines, the economists’ sense of reality depends (among other things) on how economists conceptualise change in real social systems. It was then noted that economists, like everybody else, conceptualise change through contextualisation of meaning. The second part of the paper — concerned with Marshall’s contribution — attempted to provide answers to the questions related to the role of judgement in combining theory and practice, and the problems of context definition/transition. It started arguing that complexity was an important issue for Marshall and that in order to solve the problems associated with it he appealed to an elaborated notion of common sense — what he called trained common sense.

The dual nature of Marshall’s economics, with its distinction between its theoretical and applied aspects, puts in evidence the need for the human element of the problem — which in his case takes the form of common sense — in contextualising theory within concrete economic situations. It suggests, then, that we turn to the SFA in search of its ‘human element’, or its ethical doctrine, which might help promoting the synergetic effort that is so heralded by its advocates. By doing so, we would be using Marshall’s insights to contextualise the SFA.
To re-emphasise, Marshall’s emphasis on the use of theory, so as to provide guide for action, focuses on complexity as a characteristic of systems as they are perceived by individuals. This epistemological emphasis on the complexity problem provides scope for understanding how individuals realise change in their ordinary affairs of life. As a result of his preoccupation with the practical dimension of economics, Marshall organises scientific devices, such as ceteris paribus, or advocates principles, such as the one in the many and the many in the one, on the basis of common sense procedures adopted by individuals to cope with complexity in the real world. By contrast, the SFA puts forward a concept of complexity in which characteristics are defined as properties of ANN and only indirectly related to the real world. SFA’s theories have been much influenced by the new mathematical tools available, such as non-linear dynamics, and there has not been much discussion on whether theories on complex systems have developed as a result of mathematical innovations or of a legitimate synergetic effort to provide more realistic accounts of economic processes. Should the SFA become a new zeitgeist for the doing of economics, it must address some of the issues raised by Marshall, in particular, the issue of the role of judgement in the use of economic theory and the choice of economic metaphors.

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