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THEORISING COMPLEXITY

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I – INTRODUCTION

This chapter addresses the issue of theorising complexity in its own right. The need for it originates from several sources. It seems to be especially relevant to evolutionary economics. Evolutionary theorising in economics seems to be divided in two perspectives. One places the emphasis on equilibrium (Krugman, 1999). The other gives a general priority to process (Nelson, 1995). The complexity of the subject matter of economics appears to be used by the proponents of both perspectives as a central reason for justifying their respective choices. This paper addresses the open ended, process oriented perspective and the role played by complexity in it. In his survey, Richard Nelson evokes abundantly a double role of complexity, first as a property of the subject matter of economic change, secondly as a property of evolutionary theory. In R. Nelson's words, complex theorising is the price "worth paying to buy the better ability to devise and work with a theory that rings right" and to make the intellectual bet "that evolutionary theory opens up a productive research program, to use Lakatos' idea…" (ibid. p.85).

It is worth comparing this statement with Alan Kirman's observation that economics has got locked into a particular paradigm or standard model but "what is now happening in what can loosely be described as complexity theory or the theory of complex adaptive systems, seems likely to have an important impact on the development of economic theory". (Kirman, 1997, p.102). To A. Kirman, the analysis of chaotically evolving economies indicates a movement in formal theory departing from the features incorporated in the current economic paradigm. But his view of non mainstream economics is rather negative: "However, various other currents [than marginal reasoning] have persisted in economics, although they have been regarded as being outside the mainstream frequently as a result of their lack of rigour. A particular example of this is the so-called "evolutionary school" of economics, which is typically regarded as having flourished since Schumpeter, although one can find much earlier traces of this sort of reasoning in the work of previous economists. The idea of an economy as an open, adapting and evolving system has always been present, but the failure of this point of view to generate any firm propositions about what one might expect to observe and at the same time its failure to construct any sort of axiomatic theoretical framework led to its marginalization". (ibid, p.103). These phrases express by and large a rather widely shared opinion in the economic academia. If evolutionary theory is to become a scientific research programme in Lakatos' sense, it seems necessary both to be fruitful and to rely on a systematic theoretical framework. Can the recourse to complexity help in this respect ? One may wonder if complexity does not resemble what Daniel Friedman says about bounded rationality, a Rorschach inkblot for economists. To a majority it is an opportunity to put aside standard formal models in favour of complex computational models "or simple verbal models or no models at all" (Friedman, 1998, p.366). To some other economists it is an empirical challenge to study the processes which unfold in the economy.

But complexity is also a theoretical challenge. Indeed it is a notion in search of a theory. The volume on *The Economy as an Evolving Complex System II* (Arthur et al, 1997) illustrates the uncertainties surrounding complexity notably on the question of "what counts as a problem and as a solution" which the editors evoke in their introduction.

Then there arises inevitably the question of the generality of the particular notions of complexity used in various studies. A plurality of forms, and relativity, characterize complexity, as will be shown here.

The contention of this chapter is to present in a very summarized way a theory of complexity elaborated as a solution to a problem encountered in an empirical research on the evolution of public expenditure in France and in international comparison. The central insight is that complexity is a property of both the world and of the process of enquiry into the world. This fundamental duality is hierarchised: the process of enquiry comes first. And four meanings of complexity emerge from this reasoning. This contrasts sharply with the common practice which consists of regarding complexity only as a property of observed or designed objects independently from the observer or designer.

We elaborate a behavioural setting through a self-referential extension of Herbert Simon's distinction between substantive and procedural rationality and through working out a conception of a situated satisficing derived from the standard of performance in a given field of activity. In our field, this standard pertains to abiding by rules of scientific practice.

After drawing some necessary distinctions in Section II, we show in Section III how a *second order complexity* can be a *satisficing* solution to an empirically based theorising problem and how it may have a more general bearing in section IV as a commitment to an open, but controlled, mode of knowing.

II – DRAWING DISTINCTIONS

1. General theory and local theory.

Reflecting on evolutionary economic theorising without further qualification leads inevitably to differentiate between a general level and a local level of theory. It is broadly analogous to the distinction introduced by Lakatos between a hard core and a periphery in scientific research programmes. We are addressing the issue primarily at the general or hard core level. One may reasonably claim that if evolutionary theorising in economics is to become a progressive research programme it will have to be both fruitful and cumulative at the local level, and systematized enough at the general level and in the articulation between the two levels. I study to what extent complexity has to do with this challenge to economic evolutionary theory. My argumentation is derived from my own experience on a local theorising issue. It is the problem of the evolution of public expenditure in the long run in France and other industrial countries. Time series and cross section analyses, notably the comparison between France and Germany, led to the identification of characteristic configurations of the relationships between the state and the economic sphere. These morphological formations vary over time and across countries and do not appear to be satisfactorily tractable with available analytical tools. They are thus indecomposable for the purpose at hand. This was the basis for attempting to theorise complexity. Complexity takes on varied forms as will be suggested below. Yet there are traits common to complexity as such. In this sense, this experience may have a general bearing and be relevant for evolutionary theorising whenever complexity plays a role in it. However, we attempt to show that all forms of complexity do not have the same implications, which necessitates to draw further distinctions.

2. Several steps in complexity.

Examination of the references to complexity in the literature suggests quite disparate contexts and meanings attached to this word. They can be ordered according to the consequences they entail for research, going from the merely casual to the most profound.

This ordering does not entail any idea of degrees of complexity, an issue which is not tackled here.

In a first step we find the idea of an important difficulty to know or to act upon a phenomenon, without further qualification. It is the common sense of a kind of casual complexity. Then comes the idea of complexity considered as a property of an object, of a subject matter. An example of it is choaos theory in non linear dynamics. In a third step, object based complexity is deemed to have consequences on the method of theorising whereas in the previous case there was no explicit integration of necessary changes of method. Such a kind of complexity is labelled “essential complexity” by F.A. Hayek (1967, 1989). Hayek borrows from Weaver (1948) the notion of organized complexity and regards it as a characteristic of social phenomena, notably in the economic domain. It reduces the scope for prediction to mere pattern prediction. A similar notion of complexity pervades in Nelson’s survey (Nelson, 1995) since the complexity of the subject matter of economic change becomes in his view reflected in the style of theorising appropriate to it: evolutionary theory is itself complex. Considering our interest in drawing differences in complexity, it seems appropriate to call this kind of complexity “reflexive”, to the extent that it is explicitly reflected in method, and to restrict “essential” complexity to a more profound, “essential” change in theorising[1]. Indeed a change of paradigm is called for. Examples of such claims can be found in the programmes initiated by T. Veblen, J-M. Keynes, W. Eucken, H.A. Simon and in the French Theory of Regulation (Delorme, 1999b).

Further steps are less familiar. They are self-referential complexity, second order complexity and meta complexity. They are introduced in the next sections. They arise in a bottom-up way as consequences of essential complexity. Indeed the motivation for exploring these steps came from a special difficulty encountered in the research on state-economy relationships evoked above. It was felt that none of the available theories could make possible to come to grips with the indecomposability problem in a satisfactory way. This absence of a satisfactory theory adds another degree of complexity to the complexity coming from indecomposability as such, ie from the substance of the subject matter, at a first order of investigation. Then this additional complexity is the complexity in dealing with a complex matter, it is a second order complexity.

3. The relativity of complexity.

W.R. Ashby, one of the founders of the first cybernetics takes complexity as the quantity of information required to describe a system, and compares the complexity of the brain of a sheep to a butcher and to a neurophysiologist. To a butcher, the brain is simple since it is easy to distinguish it from other “meats”. To the neurophysiologist the brain “as a feltwork of fibers and a soup of enzymes is certainly complex; and equally the transmission of a detailed description of it would require much time.” (Ashby, 1972, p.1). Here complexity becomes purely relative to a given observer. This method rejects the attempt to measure an absolute, or intrinsic, complexity. It conceives complexity as “something in the eye of the beholder” (ibid). Although one may discuss attributing complexity exclusively to the observer’s interest, the interest of this example is to point to three components: the actor’s purpose, the field of activity and the object, given an efficient actor and a state of knowledge in a field of activity. In Ashby’s example, the discriminating component is the field of

[1] Reflexivity in the former case is limited to method and brings a methodologically reflexive complexity. A more profound form is reflexivity affecting the observer and opening the way to self-referentiality. This reflexivity is introduced later in a behavioural setting underlying second order complexity.

activity. Different fields entail different depictions. Then complexity derives from the standard of satisfactory performance in a given field of activity.

We have no space to discuss Ashby's definition. We can nevertheless mention that "to describe a system" is vague. There is no consideration of what constitutes a satisfactory description. Indeed an implicit assumption is present according to which it is always possible to achieve a satisfactory description. If we admit that there exist cases in which it is very problematic to achieve a satisfactory description, then we can hardly avoid considering the conditions required for a satisfactory description and the ways available or not in order to fulfil them. In other words, it becomes necessary to take explicitly into account the observer's behaviour. And the observer's behaviour is connected to her/his level of aspiration. Indeed as we will suggest later, it is difficult to separate knowledge from action as soon as the observer is given an active role. This is what the theorising of complexity sketched out here proposes.

We can extend Ashby's example to the case of a butcher and a neurobiologist working on the same brain of a sheep. To a butcher, the main purpose is to prepare and display the brain in a way attractive to the customers. This is routine work. To a neurobiologist, if the purpose is to explain and understand the creation and circulation of information and knowledge in the brain, then it is a hypercomplex task. Then complexity is really in the actor's mind and know-how. It depends both on pure knowledge and on a capacity to act satisfactorily, given a goal, on a given object in a given activity. If we take a given activity, like economics, with a given goal, say predict, then the difficulty varies according to the object. But to define such an exclusively object based complexity, it is necessary to retain a unique purpose. And this unique purpose of prediction is itself the outcome of a purposeful agreement within a community. Hence it would seem difficult to deny that purpose remains the primary factor of complexity.

4. A plurality of forms of complexity with an invariant property.

A consequence of the relativity of complexity is that it can take different forms according to the respective purposes and domains of activity. But in all cases we find irreducibility as an invariant property of complexity. The indecomposability of an object or a system is such a form. It lies in the impossibility to reduce or decompose the object to a satisfactory level. The deterministic unpredictability of chaos theory is another example. Irreducibility is also present in probabilistic unpredictability represented by radical uncertainty. Another instance is uncompressibility in algorithmic information theory. This plurality suggests that there is a priori no reason to favour one form of complexity in the study of complex phenomena. The relevant notion of complexity depends on the purpose, the field of activity and the object. A whole situation or context – not only an object – is at stake here. This justifies that we examine the links between the complexity of objects and of situations.

5. From complex objects to complex situations.

Defining complexity as irreducibility is helpful at this stage. However it will be qualified and complemented in Section IV. Here it helps to differentiate complexity from non complexity. Non complexity is related to reducibility or achieving a satisfactory solution. This can be done either easily and rapidly, and it defines simplicity, or it is more difficult and requires more time, and it defines complication.

An object is cognitively complex if the knowledge an observer has of it remains insufficient with respect to the observer's purpose. It is a level of ignorance irreducible to a lower level associated with a given goal of knowledge. Physicist J-M. Lévy-Leblond notes that physical science is confronted with such a situation (the reality of nature is irreducibly complex) and yet it is possible to describe and predict the orbits of planets and to perform satisfactorily a number of operations because there exist methods or techniques of treatment allowing it (Lévy-Leblond, 1991). This suggests that it is the combination of the characteristics of an object (perceived as complex or not) with a technique of treatment of it (available or not) which defines whether a situation is complex or not. In this sense the three dimensions of the relativity of complexity render difficult to maintain a separation between knowledge and action.

Four configurations may arise, from simplicity to complexity of a situation. The complexity of an object does not entail the complexity of the situation when a satisfactory technique of treatment is available. Then the problem can be solved and the situation is only complicated. In economics, all theories which detect an essential complexity and consider that the methods designed by them are satisfactory end in a non complex situation according to the distinction we introduce. The interest for this distinction appears when no satisfactory technique of treatment is available. Then the situation created is complex. This is what we experienced on the state-economy relationships. The central question lies naturally in what is meant by "satisfactory". At this point an explicit behavioural setting is required.

6. A behavioural setting.

What to do or how to behave are questions which arise naturally in a complex situation. H.A. Simon's distinction between substantive and procedural rationality offers a useful insight.

Simon defines these notions in the following way : "Behavior is substantively rational when it is appropriate to the achievement of given goals within the limits imposed by given conditions and constraints [...]. Behavior is procedurally rational when it is the outcome of appropriate deliberation. Its procedural rationality depends on the process that generated it". (Simon, 1976, pp.130-131). Procedural rationality may be expected in situations that are not "sufficiently simple as to be transparent to [the] mind". Then "we must expect that the mind will use such imperfect information as it has, will simplify and represent the situation as it can, and will make such calculations as are within its powers". (Simon, ibid., p.144). Using the correct available algorithm is the usual way to operate in substantive rationality. There is no interference between the decision-maker and the way to solve a problem. No such thing is, by definition, available when radical uncertainty, ignorance or complexity prevail. In this case, decision embodies deliberation, search, the forms of representation the decision-maker considers to be appropriate. A solution is then constructed through a heuristic process in which it is reasonable to retain "an alternative that meets or exceeds specified criteria, but that is not guaranteed to be either unique or in any sense the best" which defines *satisficing*, a term introduced by Simon in 1956. A situation is satisficing when it is adequate to some aspiration level or, in short, good enough. This is the essence of procedural rationality.

Let us assume that the observer is facing the same problem as the Simonian decision maker. This assumption introduces self-reference, a thing Simon seems to have constantly avoided. It necessitates to distinguish an object level, at which complexity emerges, and a meta level at which designing a satisficing technique of treatment may be envisaged. It is at the meta level that the complexity of dealing with a complex situation, or second order complexity, appears. We discuss it in the next section.

III - SECOND ORDER COMPLEXITY.

Satisficing has no determinate substantive contents. And it may lead to subjectivism. Thus it needs to be controlled by submitting it to an external constraint. This constraint cannot but be related to the environment of the research process. Here, the relevant environment is scientific practice. The constraint consists of making compatible the three dimensions around which our argumentation has revolved until now. They are : scientific practice, inclusion of complexity and operationality. They define an aspiration level for which it is reasonable to consider that a wide agreement on the following global injunction may be obtained : *do science, embody complexity* and *be operational*. A theory will be appropriate if it meets these three constraints. Let us explore how it can be done.

1. Scientific practice.

Definition

Viewed from a basic, practical level, what distinguishes doing science from other cognitive or intellectual operations may be learnt from a commonly accepted definition of science. There seems to be a wide consensus on the combination of three elements. Doing science is to search for some explanation of some reality and systematically put it to the test (Granger, 1990). It seems reasonable to consider that this definition is the common reference to all scientific activity. It is the shared vision from which the divide between conceptions of science arises. This divide comes from the various ways of conceiving explanation, reality and testing.

Explanation is taken here, at this stage, in a broad, generic sense. It refers to the operation of producing knowledge. It can be causal explanation in a strict sense, but it can also be prediction, representation or understanding. For the purpose at hand, the main differentiation is between the goals of causal explanation and prediction of mainstream economics and the emphasis on representation common to most heterodox views.

The next divide occurs about what is considered as reality. The subject matter of science bears on the real world. But here there is a profound separation between two positions. One is ontological realism. It attempts at knowing the nature of reality, at discovering its laws, thus viewing it as objective, independent from the mind, the goal being to produce statements that will be scientific because they depict a reality independently from the observer's eye. According to another conception one would consider that the true reality is beyond reach and that we know it only through our experience of phenomena. This is phenomenological realism. Instead of being discovered, laws and other statements are invented. Scientific practice aims more at diminishing our ignorance than at establishing truths. It is a fallibilistic standpoint with which complexity fits well.

This brings us to the third feature, namely, testing. This is the key and most difficult question in economic science, for it lacks a final arbiter. The situation is incomparably better in natural science, where experimentation and controlled observation provide criteria for empirical validation. Insofar as we are interested in empirico-theoretic science, not in formal science, a final arbiter rests on controlled protocols of empirical validation. It is not indulging in catastrophism to acknowledge that standard economics is in a disastrous state in this regard. Exceptions can be found in simple, transparent enough problems such as those for which substantive rationality is relevant, at a micro level, or those which are simple enough at the macroeconomic level, thus enabling reasonably reliable prediction. This difficult state of affairs is widely admitted in the literature on economic methodology. Until now one must say that its influence has been almost nil on the way most economists work. The greatest part of economic theory consists mainly of conversation at a formal and abstract level. As a consequence, a final arbiter is avoided.

How to put scientific knowledge to the test ?

There are two other features that are closely linked to scientific practice. They pertain to the manner in which reasoning is conducted and is communicated. It needs a language. As any other language, it is made with signs, symbols and rules. The first feature has to do with the requirement contained in the triplet of communicability, systematicity and cumulativeness of science. Communication is the basis for diminishing confusion and establishing systematicity thanks to which some progress and cumulative knowledge may be envisaged. These notions point out to the importance of the way scientific knowledge is represented and communicated. It is the second feature.

At this stage it is necessary to emphasize a feature to which still only little attention seems to be paid in scientific practice. Every science embodies its statements and results in signs. Semiotics, the science of signs, comprises three fields of investigating languages (Carnap), also termed portions of semiotics (Morris) or levels of communication (Weaver, 1949). Syntax (Carnap), also called syntactics (Morris) or the technical level (Weaver), pertains to the relations of signs to one another independently of the relations of signs to objects or to interpreters. Semantics deals with the signification of signs understood as the relation of signs to the objects which they denote. Pragmatics designates the relation of signs to their interpreters, thus dealing with the origin, the uses and the effects of signs (Morris, 1971). Scientific practice may be expressed as covering necessarily these three fields, and symbolized by a triangle whose summits are these fields.

Within the economic discipline, perspectives can be differentiated according to the relative weights they give to these levels. The formal orientation focuses on syntax while most dissident perspectives emphasize the other summits of the triangle. The ideal is a balance. The standard perspective in economics gives a priority to syntax. Then, in the case of radical uncertainty or complexity, it is no surprise that primacy will be given to the method over the object of inquiry, ie to syntax over semantics. Exclusion of radical uncertainty, because it cannot be captured with the analytical toolkit, illustrates this point clearly. The tools are thus taken for granted and applied to situations which are made to adapt to them thanks to *ad hoc* assumptions. A different approach is to start from problematic situations and empirical facts and try to adjust the method and syntax applied to them, thus putting the bulk of adjustment on the pragmatic and syntaxic levels. Yet this procedure does not mean that facts can be taken *a priori* as granted. They are inevitably arbitrary. However we would find it difficult to express our experience of reality without relying on facts. Thus, it seems reasonable to admit that some adaptation of the facts is inevitable. Of course it does not mean that observation will be modified in order to fit the observer's own preferences ! Adjusting facts means making them relevant to the question addressed. In the research reported above, we found that it was impossible to address public spending in the long run independently from public finance. And we discovered that it would be quite difficult to investigate public finance over time and in international comparison independently of the other forms, both quantitative and qualitative, of interaction between the state and the economy. Thus, the facts investigated were initially public spending, then public finance, then quantitative and qualitative dimensions of the public sector (Delorme, 1984).

One would expect that in any empirical science consistency prevails not only in the manner the signs are used, in the way they are relevant and in the way they combine in syntax, but also in the overall consistency of the semiotic triangle. It is difficult here not to think of the discrepancy which exists in economics between professed and actual method. It is the price paid to preserve formalism. It illustrates how excessive formalism may constrain scientific practice either by preventing the study of empirical situations that do not fit with syntax or by asking the public at large, first, to accept that economics relies mainly on syntax and must be programmatic for the time being and, second, to believe that it will have empirically relevant results in an ever postponed unknown future. The alternative approach also has its own price: it is the weakness of its syntax, the evasiveness or the absence of a body of founding logical principles. Here we face once again the ongoing debate over the trade-offs of "well-derived" versus "empirically-relevant" theories.

2. Complexity.

The choice made in the trade-off discussed above is driven by the condition that it be consistent with complexity. It led to recursiveness. How can we ensure that a procedure is consistent with complexity ? How does it compare with the analytical perspective ? A condensed way to answer these questions consists in concentrating on the logical bases of each perspective. The contention is that complexity may be related to a set of founding principles which have the same status as those of the analytical perspective. This may answer a criticism often made against what may be called “heterodoxy”, namely that “heterodoxy” has no chain of basic principles ensuring its internal consistency in a way comparable to “orthodoxy”. Hence the presumed superiority of “orthodoxy”. That this seems to be no longer true, at least for complexity, can be shown through a comparison of axioms of classical logic with the progressively emerging axioms of complexity. They are naturally much less codified, communicated and known than the analytical axioms. It may thus make them appear quite abstract and strange. Yet, if we reflect on the rationale of the axioms which form the basis of analytical theorising, we would see that they are not more obvious than the complex ones. It is habituation which makes them look familiar and self evident to the point where we never refer to them explicitly, as if they were the unsaid basic consensus to be preserved from questioning.

Let it be clear at this stage that we do not contend that what may be called the analytical perspective pertains to only one system of logic. There is a plurality of logics. However it can hardly be denied that the debate within the economic discipline revolves mainly around the issue of consistency grounded in a set of axioms whose ultimate basis is found in classical logic. The lack of such a consistency is still the main criticism opposed to “heterodox” views. It is the reason why it has to be taken seriously. Yet we must acknowledge that the concern for establishing basic principles for complexity is recent and has consequently still not led to a well established and stabilized system of axioms. The presentation made below derives from our own enquiry and from the generalisation of its results. It does not contradict Le Moigne’s presentation though it differs from it (Le Moigne, 1990). In presenting what appear as basic principles, we stick to a heuristic strategy enabling the comparison with the axioms of analytical modelling envisaged here.

The classical axioms of analytical modelling

The reality to be modelled is perceived through three axioms. A and B stand for propositions or entities.

1	Identity :	A is A.
2	Non contradiction :	A cannot be simultaneously A and not-A.
3	Excluded middle :	There does not exist B such that B is simultaneously A and not-A.

Basic principles of complex modelling.

The phenomena to be modelled are perceived through four principles.

1 - Relationship : The basic phenomenon is a relationship between A and B, B being different from A.
2 - Identity : For a given relationship, A is A.
3 - Non negation : Given Principle 2, A cannot be simultaneously A and not-A.
4 - Included middle : Given A and not-A, there exists C such that C is simultaneously A and not-A.

3. Operationality

Until now we have remained at the logical and the methodological levels. The next task is to combine what has been stated about scientific practice and about complexity in an operational way, enabling us to apply these results to actual cases and to compare them with alternative theoretical perspectives. The satisficing principle has been fulfilled until now. But we still need to submit complexity to the test of its adequacy to the problem. In this sense complexity becomes controlled complexity. For such an operational control it seems necessary to rely on the three rules of consistency, of communicability and of relevance.

Consistency

Consistency is concerned with avoiding the discrepancy between professed and actual method and an imbalance between the three elements of the semiotic triangle. Although it is difficult to define substantively a balance between these elements, it can be defined procedurally as mutually adjusting semantics and syntax up to the point where the actually practised pragmatics meets the declared pragmatics – ie the professed method. It may be summarized as : preach what you can do, do what you preach. In the study of a phenomenon perceived as complex, for which there exists no available substantive theory or model, empirical investigation comes together with abduction and the attempt at theorising. Hence the priority given to the object of study and to the semantics over the syntax in the first step.

Communicability

It may look trivial to insist on *communicability* as a rule. Yet it conditions potential systematicity and cumulativeness. Above all it is a precondition for mutual criticism and the real exercise of control within and outside the scientific community. It implies transparency and voluntary exposure to criticism. It runs opposite to the immunization so often denounced by methodologists in economics (Caldwell, 1991). Even if it may look too idealistic to believe in the elimination of immunization, the least that can be done is to eliminate hidden immunization. This requires that when immunization is introduced, it be made explicit. One finds here an illustration that the proof of the pudding is sometimes more in the making than in the eating. A way to foster transparency is the comparison between theories for a given problem, in a meliorative strategy. It implies that statements be designed in a way that makes comparison possible.

Relevance

In line with the fallibilistic stance of the complex perspective, relevance amounts to reducing ignorance and arbitrariness in theorising. Emphasising the reduction of arbitrariness seems fruitful because of its generality and of its capacity to be used as a criterion for comparison and for assessment. We express this in the following proposition :

1. There is no non-arbitrary way of reasoning. There is no non-arbitrary ultimate foundation.
2. There are degrees of arbitrariness. They can be identified through comparison.
3. The aim is to reduce the degree of arbitrariness for a given problem.

4. Second order, anchored complexity

These conditions constitute the outcome of a process of reasoning developed at the meta level. This outcome translates into a generating principle at the object level. This generating principle is informed and constrained by the meta level. It is literally anchored to it. These conditions may be named "anchored complexity". It provides a solution to the problem of the unifying principle mentioned above : anchored complexity is a leading thread satisfying the conditions enumerated. The plurality of methods intrinsic to complexity is bounded by what is admissible for anchored complexity. Moreover, anchored complexity reduces *ipso facto* the degree of arbitrariness in comparison to the analytical approach, since it takes into account complexity.

Finally, anchored complexity may be considered as a generating principle whose product stimulated its own production. This sentence simply describes the recursive loop between an initial enquiry leading to an observed phenomenon transformed into an empirically based conjecture (characteristic configuration of the interaction between the state and the economy) and later into a theoretical notion (mode of interaction between the state and the economy : MISE) after having been informed by anchored complexity (symbolized as ACX in Fig. 1).

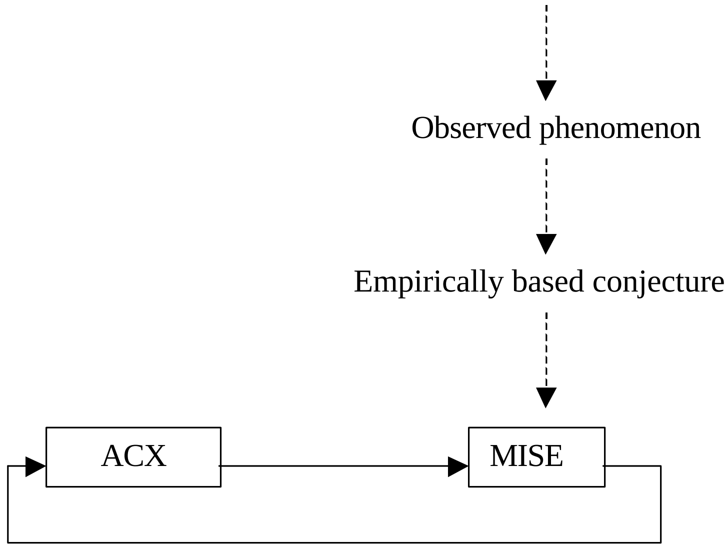

Figure 1 : Research on the case in point as a recursive loop.

It seems reasonable to think at this point that the above development is adequate to the purpose at hand and is thus a satisficing solution. However, it must be acknowledged that there is no external universal criterion to assess whether it is true or false. The only way is to expose it to criticism. But here, what is exposed to criticism is more accurate, more specified, more operational than what was available at the beginning.

IV - GENERALITY

Second order complexity was designed in order to conceive a solution to a specific problem. Can it be extended ? To what degree ? We attempt to answer these questions in this section. For this it proved necessary to work out several notions. They are the notions of chain of reasoning, of irreducibility, of non-separability, and of asymmetry and meta-complexity which are successively evoked below.

1. A chain of reasoning.

The arguments which have been incorporated in the previous section provide an array that is consistent and that offers a complete chain of reasoning. The central difference occurs with the principle of included middle which departs from its equivalent, the axiom of the excluded middle. Indeed this axiom is central to analytical reasoning. And the included middle is central to the complex way of reasoning. Putting together the pieces that would have to be introduced in a fully developed argument makes possible a comparison of the analytical and the complex perspectives (Table 1).

	ANALYSIS	COMPLEXITY
1 - General definition of scientific practice.	Common to both perspectives : some kind of explanation of reality, systematically put to the test.	
2 - Conception of scientific knowledge	Positivism	Constructivism and fallibilism
3 - Mode of reasoning	Analytical	Systemic
4 - Position on reality	Objective character of reality	Constructed character of reality
5 - Main purpose of scientific practice	Prediction	Active representation
6 - Logical core	Axioms of classical logic (notably excluded middle)	Principles of complex logic (notably included middle)
7 - Methodological stance	Deduction, induction Disjunction Discovery Universal norm	Abduction Conjunction Design, invention Satisficing
8 - Method	Taken as granted : "The scientific method"	Adjusted according to anchored complexity : built-in controlled pluralism.
9 - Theoretical perspective and theorizing	x, y, z, ...	a, b, c, ...
10 - End product (statements on the real world, policy prescriptions).	x', y', z', ...	a', b', c', ...

Table 1 : The analytical and the complex scientific perspectives compared.

The construction proposed here obeys a hierarchy covering ten levels. The first level is the one for which a divide occurs between the standard approach and the approach of complexity. We assume that the dictionary definition of scientific practice is considered relevant by proponents of both perspectives. The divide occurs about the conception of scientific knowledge and unfolds downwards until the end product layer.

The terms mentioned in each column indicate the primary focus of each perspective at each level. They do not describe all the ingredients. We simply contend that the terms retained here form the respective starting points, on which other features are dependent, in each approach. Considering the previous developments, the items in Table 1 do not seem to require further explanation, given the scope of this contribution. The exception to this is about the main purpose of scientific practice in the complex perspective at level 5. A common trait of complex reasoning is its representation of a reality that is itself perceived primarily through a process of construction. Representation is then active, not passive. In passive representation, knowledge is viewed as reflecting a world with intrinsic predefined properties leaving the scientist with the task of uncovering some hidden truth "already there". In active representation, design and invention play an important part.

Let us come back to the world view issue. Having a world view cannot be abolished. It is commonly understood in the economic discipline as pertaining to a set of basic statements shared by a scientific community, on how the economy functions. Neo-classical, Keynesian, Post-Keynesian, Austrian, Marxian world views, among others, illustrate this definition. The divide in the discipline is usually thought in terms of these world views. The conception presented here is different. We have attempted to show that introducing complexity displaces the issue from a matter of substantive preferences shared by respective communities to a matter of cognitive procedure. We introduced the conception of scientific knowledge as a basic criterion of choice independently of any preference on the substance of how the economy performs. Indeed it is only at level 9 that particular theoretical perspectives come in the picture. On the one hand, one may find at this level the theoretical perspectives mentioned at the beginning of this paper together with the particular theorizing derived from them (*x*,*y*,*z*...) and end statements (*x'*,*y'*,*z'*...). On the other hand, the MISE may appear as *a*, together with other theoretical notions and end statements likely to be developed along complex lines (*b*,*c*, *b'*,*c'*,...). The end statements will logically differ from one approach to another.

In view of the confusion and of the limitations attached to the substantive world views in case of complexity, we think that the cognitive conception developed here clarifies the issue and is more general.

The complex and the analytical perspectives are not symmetrical. At first sight, one might consider that the analytical perspective is warranted whenever we are in no-complexity. However, the analytical approach cannot accommodate complexity while the complex approach can accommodate the situations pertaining to the analytical approach. One finds the same asymmetry between substantive and procedural rationality : the former excludes consideration of the latter whereas the inverse is not true since procedural search allows by definition for the possibility of constructing situations locally relevant for substantive rationality (Delorme, 1998).

Thus complexity subsumes analysis. The situations relevant for analysis appear as particular cases. Whereas the trademark of analysis is exclusivism, complexity does not exclude *a priori* the analytical method. It excludes only analytical exclusivism. It subsumes the analytical approach thanks to its greater generality and relevance. It allows for the local relevance of analytical and positivist methods provided their relevance is established on every specific subject matter under consideration. This asymmetry supports the case for considering that the complex perspective offers a more general methodological stance than the analytical one. However, complexity does not reduce to methodology. We have attempted to show how designing a research strategy and putting it to work as anchored complexity makes sense. The analytical perspective can no longer base its strength on the absence of an alternative perspective which would meet similar standards of consistency and of operationality.

2. An irreducible cognitive gap.

A provisional definition.

Let D^i be the degree of difficulty in performing a task i or in solving a problem i and $\overline{D}$ be the degree of difficulty associated with a norm of validation or of performance in the activity or discipline in which i takes place. It is the difficulty of achieving a good enough, satisfactory or valid solution or outcome. Difficulty pertains to knowledge and action. The higher the difficulty is, the higher is the level (amount and quality) of knowledge required for performing satisfactorily the task. Complexity, defined as an irreducible lack of knowledge, depends on the norm of validation and on the level of difficulty D^i . It can be symbolized as :

$$CX=f(D^i, \overline{D})$$

D^i appears in our research on the state-economy relationships when one attempts at applying "normal", analytic standards to the objects uncovered. It emerges primarily as indecomposability and ultimately as unavailability of a method or technique enabling simultaneously to meet established standards in the economics discipline (it looks descriptive, non explanatory, it is not derived from a theoretical specification, it is even not framed in the hypothesis testing way) and integrate the hard facts that are observed. D^i and $\overline{D}$ are not measurable. This is not too bad since we are interested in definitions, and especially in making sense of the difference between D^i and $\overline{D}$. D^i greater than $\overline{D}$ means that the difficulty of solving a problem remains higher than the level of difficulty associated with a norm or standard of knowledge in a community, which amounts to what is considered valid or acceptable by the community. Although it may look surprising, it is a way to introduce a kind of cognitive irreducibility which will appear helpful later on. In order to clarify this way of defining irreducibility, we will have to come again to differentiating between a complex object and a complex situation.

Ignorance is unsufficient knowledge compared to a required level or a norm. It can be expressed by $D^i - \overline{D} > 0$ which means that the level of difficulty D^i is irreducibly larger than the level of difficulty attached to the norm : the norm cannot be achieved because of this lack of knowledge. Conversely, reducibility corresponds to the case in which available knowledge is larger than or equal to what is required. Complexity corresponds to the former. It is a degree of ignorance that is irreducible to a degree compatible with a norm of valid knowledge in a given activity or discipline. A further reflection on second order complexity will show that this definition is incomplete. It is however sufficient for the purpose at hand now. The latter case is reducibility. It may be called non complexity. Two cases may occur. First when D^i is inferior to $\overline{D}$. It is simplicity. Complication is the second case. It means that a satisfactory solution can be achieved whatever time and effort are needed to reach it : $D^i \leq \overline{D}$.

This can be summarized in the following way, with D^i and $\overline{D}$ >0.

Reducibility :

$D^i - \overline{D} \# 0$: simplicity $D^i - \overline{D} < 0$

complication $D^i - \overline{D} \leq 0$

Irreducibility :

$D^i - \overline{D} > 0$: complexity

It is a way to define complexity and non complexity and to distinguish complexity from complication. However this definition is provisional. It can be rendered more precise thanks to the distinctions between logical levels and between generating mechanism and outcome.

Different logical levels.

The solution that we designed as second order complexity was grounded in a self-referential use of the behavioural notions of procedural and substantive rationality systematised by H-A. Simon. We had to develop a procedure in order to obtain a satisficing outcome. This procedure belongs to a level of reasoning logically superior to the level at which the objects of inquiry are primarily considered, i.e. the object level. The level of this self referential procedure is the meta level. We named anchored complexity the particular solution that we obtained. Anchored complexity is the outcome (O) of this procedure at the meta level. The mechanism from which this outcome originates may be called a generative mechanism (GM).

The pair (GM,O) provides a fundamental representation for the working of complexity. Notice that I do not say "the working *on* complexity", as if the source of the working, the observer, were contemplating complexity from a separate, exterior standpoint. Indeed, a reasonable way of working is *with* complexity, meaning that the observer is part of the complex system, a thing Heinz von Foerster has repeatedly illustrated (1988, 1992). The pairs (*procedure, substance*), (*meta, object*), (*observer, observed*) may thus be considered to be to a large extent special instances of (GM,O) which takes in this way a status of generative complex pair. This property has rather far reaching consequences that we will evoke later.

At this point, it may be worth summarizing our pathway to a solution. It started with establishing the legitimacy so to speak of our object of investigation (the MISE, mode of interaction between the state and the economy) on grounds of observation, of empirical investigation, of comparison, of robustness and resistance of this object to different ways of addressing the issue. In the absence of a method enabling to theorise satisfactorily on this object according to the available theoretical systems playing the role of norms of validation, we attempted to conceive a generating mechanism abiding by a set of scientific rules of which the MISE would appear as a theoretical outcome. The chain of complex reasoning which was exposed constitutes the generating mechanism which was saught. Indeed it is a case in second order complexity. It provides a method validating the initial object of inquiry and a solution to the complex situation which was created.

The MISE is an outcome at the object level. It is generated by an empirical, comparative, contrastive investigation (T.Lawson, 1997) also developed at the object level. This result was obtained in a bottom-up way. Once it is obtained it can also be viewed the other way around in that the MISE is also the factor from which the generating mechanism was built. It remains to assess whether this is specific to this very case study or it can be extended. The answer will be the latter after an additional step in the reasoning is made. For the moment, the double way relationship mentioned above means that it is recursive or circular. This particular recursive loop operates at the object level. The generative mechanism at this level is reappraised as an outcome at the meta level. It is generated at this level by the chain of complex reasoning. Its generative mechanism is scientific practice and fallibilism. This meta level is itself the object level of a meta-meta level, etc. For the issue at stake, we stop when a satisficing outcome is achieved. Given that our goal was to provide a scientific theoretical status to the MISE, we were able to stop after having considered two consecutive loops, at the meta and object levels.

It is worth noticing an apparent paradox here. Having a solution means having achieved reducibility. And reducibility is non complexity. Then how can it be consistent with continuing to refer to second order complexity ? There is indeed no contradiction once the double level of complexity – meta and object – is aknowledged. Reduction is performed at the meta level only. Complexity remains at the object level. It must be added that it is a solution at the meta level. But there is no reason to believe that it is the one best solution. It is only satisficing. The possibility that it may be modified, improved or replaced cannot be ruled out. Hence potential recursion must be allowed at the meta level. It is symbolized by dots on the figure below.

Irreducibility is not eliminated at the object level but a way of dealing with it is defined at the meta level. Second order complexity is the conjunction of these two levels. These levels are not separated although they are distinct. In the same way, GM and O are not separated, at each level. Reducibility (meta level) and irreducibility (object level) are not separated. Second order complexity is the irreducibility (at a meta-meta level) of the (reducibility, irreducibility) pair.

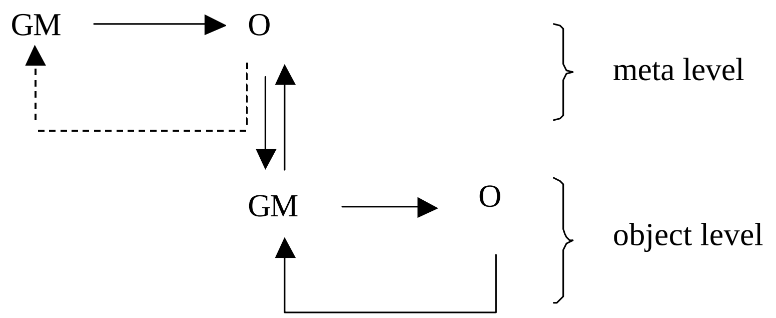

Figure 2 : Second order complexity illustrated

It must also be kept in mind that object based complexity, or first order complexity implies the existence of second order complexity only if a complex situation is created. And it will be shown that second order complexity does not entail necessarily first order complexity. There is no necessary general implication between these notions of complexity.

Second order complexity defined

We are now in a position to define complexity more precisely than at the beginning of this paper. We will base it on the distinctions between object and meta levels, and GM and O respectively. For the sake of simplicity, let us drop the i superscript of D^i and replace GM by *p* standing for procedure, and replace O by *s* standing for substance. Let us also symbolize the meta level by *m* and the object level by *o* subscripts. This avoids a possible confusion between O for outcome (in GM,O) and *o* for object level (in *m*, *o*). Replacing GM by *p* and O by *s* should not be a source of confusion since *p* and *s* (procedure and substance) are particular instances of GM and O. Here *p* is a method of treatment (validation, reduction) and *s* is the object. We start by expressing complexity at the object level and then at the meta level, and finally at both the meta and the object levels.

With *D* standing for a degree of difficulty and the bar (–) representing a standard or norm of validation, we now have to consider D_o^s, D_o^p, $\overline{D}_o^s$, $\overline{D}_o^p$, at the object level, and D_m^s, D_m^p, $\overline{D}_m^s$, $\overline{D}_m^p$ at the meta level.

1) Object level.
Reducibility :

$$D_o^s - \overline{D}_o^s \leq 0$$

$$\begin{cases} \text{simplicity} & D_o^s < \overline{D}_o^s \\ \text{complication} & D_o^s \leq \overline{D}_o^s \end{cases}$$

Irreducibility :

$D_o^s - \overline{D}_o^s > 0$ with two cases

[1] There exists *p* such that $D_o^p = \overline{D}_o^p$

[2] There is no *p* such that condition [1] is met : $D_o^p > \overline{D}_o^p$

In case [1] the object is complex but the situation is not complex
In case [2] the object and the situation are complex.

2) Meta level.

Given a complex situation (case [2] of irreducibility above) the problem is to find at the meta level

D_m^p such that $D_m^p = \overline{D}_m^p$

i.e. D_m^p such that the meta object is reducible :

$D_m^s = \overline{D}_m^s$

This is meta complication. D_m^s is produced by D_m^p. It is anchored complexity in our case. It is satisficing. It is the outcome of the operation “produce a satisficing generating mechanism” ($D_m^s = \overline{D}_m^s$). It is itself produced by a complex chain of reasoning D_m^p. This chain is satisficing ($D_m^p = \overline{D}_m^p$). In turn, D_m^p is produced by a meta-meta mechanism, etc. (Figure 3).

The requirement about $\overline{D}_m^s$ was to reduce the degree of arbitrariness through comparison with the available theories. The norm $\overline{D}_m^p$ was to abide by scientific practice. Both norms were defined in section 2.

3) Synthesis

The object level problem becomes the object or the substance of the meta level.

The object level problem is :
$$(D_o^p > \overline{D}_o^p, D_o^s > \overline{D}_o^s)$$

Irreducibility affects both the procedure and the substance : the situation is complex.

In carrying the issue up to the meta level, we seek a procedure D_m^p whose outcome D_m^s renders possible to have a satisficing procedure D_o^p at the object level.

This entails that D_m^p must itself be satisficing at its own, proper level :
$$D_m^p = \overline{D}_m^p$$

Its outcome is also satisficing :
$$D_m^s = \overline{D}_m^s$$

$\overline{D}_m^s$ informs D_o^p, the procedure at the object level, but $\overline{D}_m^s$ must not be equated with D_o^p. In our case, $\overline{D}_m^s$ is anchored complexity. It constrains D_o^p to the extent that D_o^p must be compatible with it. D_o^p is no longer restricted to being a generating mechanism produced by analytical reasoning. $\overline{D}_m^s$ does not eliminate irreducibility at the object level. But it enlarges the scope of potentially valid techniques of treatment.

We thus have at the object level :
$$(D_o^p \geq \overline{D}_o^p, D_o^s \geq \overline{D}_o^s)$$

If total equality is achieved it means that simplicity or complication are obtained.

If $D_o^s > \overline{D}_o^s$, we still have a complex object but the situation is not necessarily complex. It is complex only if $D_o^p > \overline{D}_o^p$.

This is synthesized in Figure 3 .

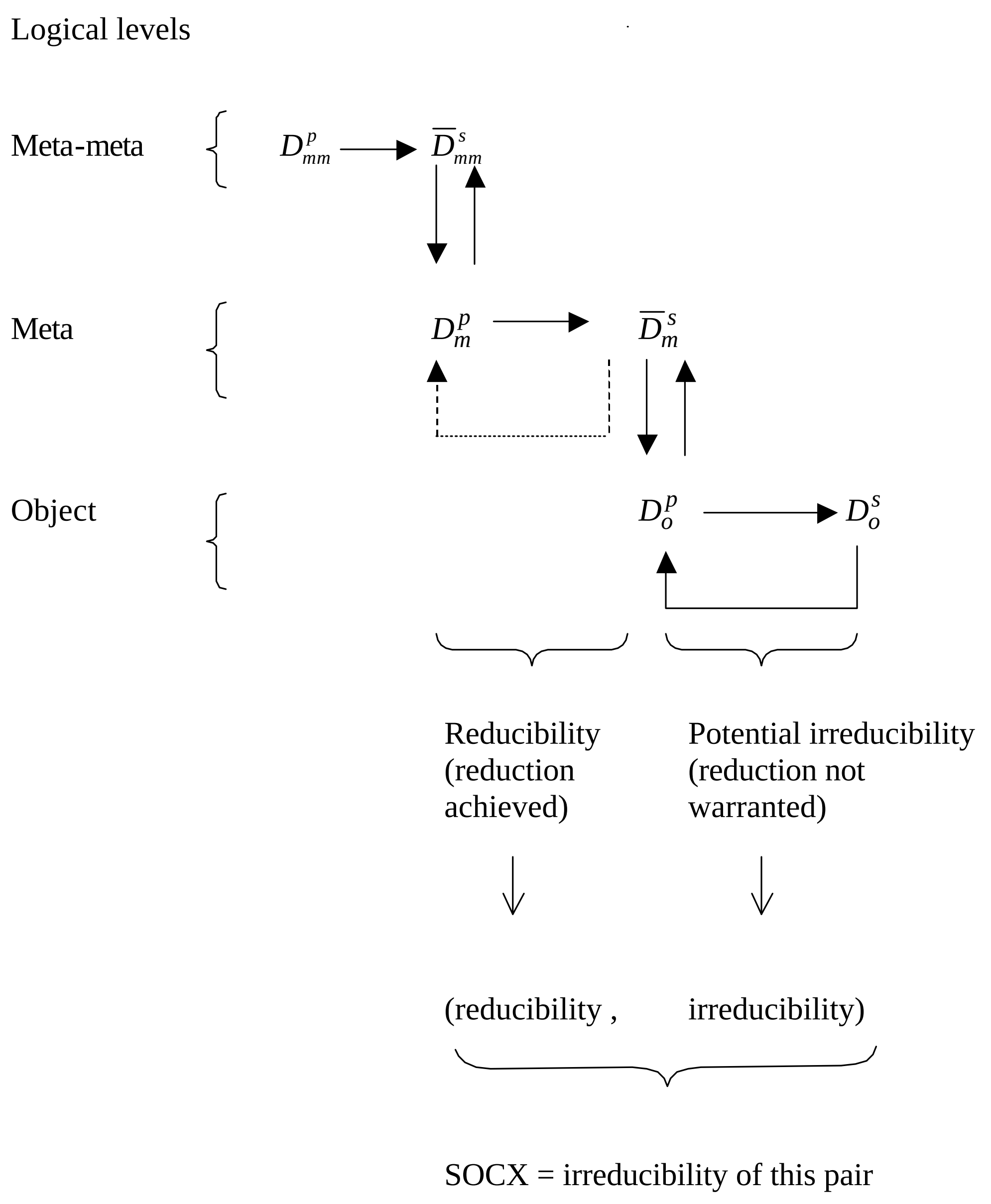

Figure 3 : Second order complexity (SOCX) defined

Since the potential irreducibility of the object *s* at the object level cannot be eliminated, the kind and level of difficulty that may arise cannot be known in advance. It can either be solvable through a satisficing procedure $\overline{D}_o^p$ available at the object level or it cannot. In the latter case, the situation is complex and necessitates to re-activate a meta level reasoning. Starting from the object level, the situation can be summarized as follows :

If reducibility : reduction to $\overline{D}_o^s$ achieved by means of a first order technique of treatment pertaining to analysis. Then D_o^p is neutralized and does not require to be re-activated.

If irreducibility : D_o^p is activated, it is informed by $\overline{D}_m^s$ which is itself informed by D_m^p, etc.

3. Essential non-separability.

Second order complexity appears as an outcome of cognitive irreducibility. In order to come to grips with it, we had to work out a way of reducing irreducibility. We did it through the distinction between meta and object levels. However this does not eliminate irreducibility. Indeed SOCX is based on the explicit recognition of the couple (reducibility, irreducibility). SOCX cannot be reduced to one of these terms. It is both of them simultaneously. We already came across such a paradoxical notion when we considered the subject or observer and the object (or observed world) couple. A similar paradox may arise in the notion of effective complexity and its measure presented by M. Gell-Mann (Gell-Mann, 1994) since complexity appears in a region which is neither total order nor total disorder but in-between. This intermediate situation may be considered in strictly quantitative terms : it is a degree of order or a degree of disorder. But we do not know how to measure it. The conception proposed here avoids this shortcoming of the quantitative definition. Complexity is irreducibly order and disorder. And we have worked out an operational way to hopefully make sense of it.

Non-separability defined.

Indeed it can be claimed that this dualistic conception offers a new definition of irreducibility. The irreducibility of an entity containing a number of components is the minimum variety below which it is impossible to further reduce without loosing or changing the defining character of the entity. The pair (order, disorder) illustrates this definition : it is impossible to reduce to less than these two components – ie either to order or to disorder – without loosing the very notion of complexity.

The same can be said by stating that it is impossible to reduce the entity under consideration to unity, to one single characteristic. The most that can be done is reduction to two components A and B:

$$CX = (A,B)$$

Moreover the relationship between A and B is particular : one component cannot be considered without considering the other. This is non-separability. Whenever non-separability vanishes, complexity disappears. This is also illustrated by the (order, disorder) pair. We cannot have both complexity and order alone or disorder alone. Complexity is order-and-disorder. Order alone or disorder alone pertain to non-complexity. This illustration operates at the object level. Second order complexity illustrates a meta level non separability from the start when the (subject, object) pair was emphasized. It is only in non complexity that the observed object can be analyzed as if the observing subject were neutralized and considered given. It was also demonstrated above that the essence of second order complexity lies in the apparently strange combination of reducibility (meta) and irreducibility (object level) which opens the way to stating that complexity thus understood is both an obstacle and a solution. These paradoxical or contradictory couples would hardly make sense in the absence of non separability. Complexity vanishes when separability appears. Non-separability is at the root of cognitive irreducibility. It is thus constitutive of complexity. Non-separability starts with two components. It renders possible to consider that the dualistic representation (A,B) is a basic, general representation of complexity.

A brief typology of non-separability.

The relationship between the two components of essential non-separability is varied. Indeed we came across three kinds of relationships.

First is paradoxical non-separability. It is grounded in paradox. The included middle, being both A and non A, is an instance of it. Other paradoxical pairs are (order, disorder), (reducibility, irreducibility), (obstacle, solution). A second kind is cognitive or epistemic non-separability. It is ubiquitous to the extent that complexity always entails making explicit the relationship between subject and object, thus underlying the non-separability of the pair (subject, object). Thirdly is hierarchised or generative non separability. It represents occurrences in which one component is the outcome of the other in the sense that it could not exist without the other operating. The latter operates as a condition of possibility of the former either explicitly or implicitly. Instances are the pairs (generating mechanism, outcome), (procedural rationality, substantive rationality), (meta level, object level).

One could argue that the (subject, object) pair is both epistemic and generative since it is also (meta, object). We prefer to maintain the distinction which avoids the risk of considering that the real (object) is generated by the subject although there seems to be some ground to the claim that reality and the subject are not totally separated. I Prigogine and I Stengers, commenting on a debate between A. Einstein and R. Tagore, express it nicely : “Whatever we call reality, it is revealed to us only through the active construction in which we participate” (Prigogine and Stengers, 1984, p.293).

Things would be made easier if we could reduce this diversity of non-separability to one representative pair. Such a pair should encompass both the meta and object levels. If we take generality as an additional criterion it seems that the (GM,O) pair is the most satisfactory: it is meta first, it leaves open the object level, including the (order, disorder) occurrence and is thus compatible with all the cases mentioned above. This (GM,O) pair framed our reasoning about second order complexity.

Indeed there are at least two reasons why the (order, disorder) pair is of the (GM,O) type. First if the pair (order, disorder) is considered at the object level, then it is necessarily viewed from a meta (GM) level. The (GM,O) structure is thus more general than the (order, disorder) one. Second, the pair (order, disorder) translates into the pair (reducibility, irreducibility) in the framing developed here. Then disorder denotes the irreducibility of the (reducibility, irreducibility) pair and order denotes reducibility at the meta level from which something is said about the (reducibility, irreducibility) pair. In this case order operates as a generating mechanism and disorder as an outcome.

Three additional remarks need to be made at this point. This way of conceiving complexity extends and systematises J. Von Neumann’s intuition about complexity : "[...] «complication» on its lower levels is probably degenerative, that is, that every automaton that can produce other automata will only be able to produce less complicated ones. There is, however, a certain minimum level where this degenerative characteristic ceases to be universal. At this point, automata which can reproduce themselves, or even construct higher entities, become possible. This fact, that complication, as well as organization, below a certain minimum level is degenerative, and beyond that level can become self-supporting and even increasing, will, clearly play an important role in any future theory of the subject" (Von Neumann, 1961, p.318). Our conception also provides a grounding for associating recursion with complexity, and thus complements H. Von Foerster and H.A. Simon's insights about self reference (Von Foerster, 1988, 1992) and behavioural rationality (Simon, 1976) respectively. Finally it introduces a hierarchy in the definition of complexity : there can be no outcome without a condition of possibility for it being explicitly dealt with. This hierarchical essential non-separability has a rather far reaching consequence. It creates an asymmetry which provides a strong case for generalising second order complexity from a solution of a particular problem to a mode of knowling.

4. Asymmetry and meta complexity.

We wish to show how non-separability provides an argument in favour of generalising complexity as a mode of knowling. Yet it is not the sole argument. There exist several other ones. We evoke them first and will come back to the non-separability argument in the end.

Generalising is related to asymmetry. The reason is that it is possible to model complexity and non-complexity with a complex model whereas it is not possible to model complexity with a non complex model. In the latter case, only non complex features can be modelled. It may be satisfactory in some cases but not in all.

We came across this asymmetry in the previous section when we compared the analytical and the complex chains of reasoning and found that they were complementary rather than mutually exclusive provided it is reckoned that complexity subsumes analytical non complexity. The consequence is the need to attribute a priority to complexity over non complexity. This whole argument can be developed in an equivalent manner in terms of cognitively open and closed systems. A system is cognitively closed if its constituent variables and relations are known or knowable according to available methods. It is open if not all them are known or knowable. This distinction, expressed in quasi similar terms, is at the root of transcendental or critical realism as exposed by R. Bhaskar and T. Lawson. It is the basis for the advocacy of openness of approach in social science by these authors (Delorme, 1999a).

Another argument comes from what resembles a principle of increasing cognitive gap to which we alluded at the beginning of this chapter. Put simply, it says that the more collective knowledge increases, the more specialization must increase, then the more relative ignorance extends, which is a way to say that the more complexity also enlarges. Given this trend the rationale for giving priority to consideration of complexity becomes compelling.

Finally a clearcut argument seems to arise from our presentation of complexity as non-separability. Under the (GM,O) configuration, non-separability is hierarchically asymmetric. If the starting point is O there is no way compelling to take GM into consideration, whereas the reverse is not true. The same occurs for (PR, SR) and (meta, object). The terms contained in these pairs are not on an equal footing : the order in which they are mutually considered is not indifferent and going from the more general, left hand side term to the less general, right hand side term, is superior to doing the opposite whenever the non complex character of the object of inquiry – which would allow to focus only on O, SR or object respectively – is not warranted. Staying at the level of O, SR or object may even induce ignorance of GM, PR or meta, or, for the least, induce to consider that their inclusion is not required.

This is a way to reject stepwise reasoning starting from non complexity when non complexity is not totally established. In all cases in which we are not sure, it is superior then to start from the GM standpoint. This argument can even be pushed a little further due to the open ended nature of this asymmetry. Let us admit that in scientific practice the world is not always complex. Indeed it is complex and non complex. This first order or object level property can be identified better by means of a sorting mechanism. This sorting mechanism is necessarily meta. We showed how second order complexity can be such a sorting mechanism. Then although the world is not always complex it is superior to act as if it were always complex by the means of second order complexity. This establishes second order complexity as a starting point. Moreover the cognitive behavioural grounding of second order complexity gives it a status of a mode of knowing and of action. "Inquire about both the non complex and the complex from the complex" instead of inquiring from the non complex.

Thus we obtain several pairs : (GM, O), (procedural rationality, substantive rationality), (meta level, object level), (subject, object) or (observer, observed). Their components are ordered in such a way that if the right hand side term can be considered independently of the left hand side term, then complexity vanishes and the situation is non complex. The reverse case defines complexity. Moreover, every pair can appear either at a meta or object level, including the (meta, object) pair. This pair is an object for a meta-meta level. The double loop structure is constitutive of complexity.

V – CONCLUSION.

In the theory developed here we have exploited the idea that complexity is fundamentally a property of the relation between an actor and an object. Purposefulness is central to it. Then complexity is both a property attributed to an object by an actor and a property of the process of enquiry itself. In the former sense it can be viewed as a property of the world. In the latter sense, complexity has three other meanings.

It is a relative ignorance or equivalently the amount of information required to describe satisfactorily an object. It is also a satisficing technique of treatment when it is considered at a second order, meta level, in a bottom-up procedure. Finally, this meaning can be extended to a mode of knowing and action, in a kind of top-down procedure.

Meta-complexity is this mode of knowing and action. It is the most general notion and tells that it is better to behave at the start as if the world were always complex, because of the asymmetry between complexity and analysis. Meta-complexity relies on the commitment to situated satisficing, it compels both to render explicit the convention on a satisficing practice and to transparency of scientific practice. It entails a systemic view of the world and notably the economy. This view accepts classical analysis as being locally relevant, in non complex situations. The only constraint is transparency of scientific practice. This leaves open the substance of enquiry. At a local theory level it does not entail any particular content of theorising, it constrains only the procedure. At a general theory level it is compatible with viewing the economy as a complex evolving system. But, to repeat, it emphasises transparency of complete scientific practice, not limited to syntax or speculation. It is the constraint which informs an otherwise open practice oriented towards empirical validation. It provides a systematised generative principle to a diversity of local theories or outcomes and renders possible to replace a current floating and ambiguous eclecticism by a more controlled one. In this way it might provide evolutionary theory with an opportunity to become more systematised while retaining its commitment to an open ended perception of economic life.

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