

On the Logically Vivid System

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***Abstract.** The paper represents an excerpt from an ambitious research program concerning the economic epistemology rebuilding (including, especially, new conjectures upon the subject – the subject-object package). It is aimed to propose and operate a logical approach and assessment of six crucial concepts used in modeling of a pseudo-natural process like the economic (or social) process: system, optimal economic process, sustainable economic process, logically vivid system, network, and emergence. Firstly, all these concepts are identified, described and characterized by a set of sufficient, respectively necessary predicates, in an attempt to define them logically. Secondly, based on the mentioned predicates, six theorems (and their converses) are formulated and demonstrated among the concepts concerned. This non-orthodox approach could open a road to recuperate the possibility for economic science (or economic theory?) to be rebuilt by new philosophical and logical bases.*

Keywords: logically vivid system; network; emergence; system; sustainability; economic process.

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1. Preamble

The goal of the paper is to reevaluate the logic and epistemological bases of the economic science with the purpose to overpass several incoherencies or inconsistencies of the veridical, or at least verisimilar, modelling of the economic process.

The economic progress⁽¹⁾ has been considered (and still is) as an extension of the natural process, which is why both the economic science (or theory⁽²⁾) and the methodology and instruments associated to this science are of Newtonian origin, dreaming to describe this process in a dynamic, Laplacean manner.

In our opinion this situation caused a paradigm stalemate in what we call modelling⁽³⁾ of the economic process, with obvious failures in all directions, including (and particularly) the macroeconomic forecast.

Given the quasi-impossibility to test⁽⁴⁾ the theoretical-methodological hypotheses of the economic science, these hypotheses are fatally “theoretically closed”, i.e. their veridicity is generated by the acceptance (in a way, based on ... faith) of the theory or of the theoretical model.

Therefore, a possible critique or evaluation of the veridicity of some hypotheses substantiating the modelling of the economic process must address the original theory or theoretical model. This is the method to be used in this paper.

2. System

By system we will understand a clipping of reality (either objective, or subjective, or a mix of the two) which verifies the following sufficient predicates:

a. It has a *membrane*, which distinguished the particular clipping from its environment; we note this sufficient predicate with M_S ;

b. It contains a multitude (countable or not) of *composing elements* (discernible or not between them); we note this sufficient predicate with C_S ;

c. It is “fitted” with a multitude of *connexions* (of any kind: material – substantial or energetic –, informational, entropic etc.) between the composing elements, and between them and the environment; we note this sufficient predicate with X_S .

One can notice immediately that the sufficient predicates of the system are independent and consistent with each other.

The sufficient predicates (which also are required, once we can identify empirically at least one system), generate, once they are verified, the following two, new, necessary predicates:

d. It has *metabolism*⁽⁵⁾; we note this new, required, predicate with S_S ; the logic formula of generation is: $(M_S \wedge \Phi_S) \rightarrow S_S$, where Φ_S is the structure of the clipping of reality, i.e. $\Phi_S = C_S \wedge X_S$;

e. It has *qualitative identity*; which means that the system has a set of invariants (their nature is of no relevance) which are reproduced by the metabolism and which provide for the logic continuity of the system. Obviously, a system may undergo, in principle, evolutions (irreversible transformations) but the set of invariant parameters is required logically, to be able to speak of a significant time interval, of a system distinct from the environment (we

may give this set the name of set of identity parameters) and indistinct from itself.

Evidently, the two new predicates are independent and consistent with each other.

Therefore, noting with Σ_S the multitude of predicates sufficient for a system, with Σ_N^n the multitude of new, required, predicates and with Σ_N the multitude of necessary predicates, we will write sequentially:

$$\begin{aligned}\Sigma_S &= \{M_S, C_S, X_S\}, \Sigma_N^n = \{S_S, I_S\}, \\ \Sigma_N &= \{M_S, C_S, X_S, S_S, I_S\} = \\ &= \{M_S, C_S, X_S\} \cup \{S_S, I_S\} = \Sigma_S \cup \Sigma_N^n, \\ \Sigma_S \cap \Sigma_N^n &= \phi, \Sigma_S \cap \Sigma_N = \Sigma_S, \\ \Sigma_N^n \cap \Sigma_N &= \Sigma_N^n.\end{aligned}$$

Therefore, by system (Σ) we understand that clipping of reality which verifies the predicates from the multitude Σ_N .

3. Optimal economic process

The optimal economic process is what we call an artefact, which is an entity whose appearance, although can be emergent⁽⁶⁾ in nature, is generated in principle by an ad hoc deliberative decision. The optimal economic process is not just a simple effect of the natural process, but it maintains a permanent and continuous structural (thus causal⁽⁷⁾) connexion with the latter. The sufficient predicates of an optimal economic process which will therefore make the specific difference between it and the natural process (in other words, predicates which, once verified, qualify an original natural process as an optimal economic process) are the following:

a. It involves a *natural process*⁽⁸⁾: we note this sufficient predicate with N_{PEO} ; the economic optimal process can only exist if

the natural process exists (everything man could invent as far as possible from the nature, as will be shown below, the informational process or even more, the informatics process, also depend ultimately in the nature);

b. It involves the *presence of the human subject*: we note this sufficient predicate with U_{PEO} ; of course, the presence of the human subject must not be necessarily actual, it can be, for instance, integrated in the computer software running at the level of the process. The total absence of the human factor (or of its impact of any kind) disqualifies a process from the status of economic process;

One can notice immediately that the sufficient predicates are independent and consistent with each other. We consider therefore that a real process which verifies simultaneously the two sufficient predicates is an economic process.

These sufficient predicates (which obviously also are necessary predicates⁽⁹⁾) further generate two new, necessary predicates. Thus, we can say that the economic process:

c. Generate a *system*; the progress of the economic process based on the rational optimality can only take place within a system because both the objective-function and the restrictions (the two components of the optimisation model) must be “anchored” on a structure and delimited in a given modality in the real world (they have to verify the sufficient predicates of a system); we note this new necessary predicate with Σ_{PEO} ; the logic formula for its generation is:

$$N_{PEO} \rightarrow \Sigma_{PEO};$$

d. Generate an *optimal purpose*⁽¹⁰⁾; the optimal purpose (therefore, the purpose in

the nature of a rationality based on optimality⁽¹¹⁾, i.e. generally on unsustainable⁽¹²⁾ interventions on the nature is the effect of the human factor); we note this predicate with O_{PEO} ; the logic formula for its generation is: $U_{PEO} \rightarrow O_{PEO}$.

In our opinion, the fundamental difference between the natural process and the economic process⁽¹³⁾ lies just in the existence of the final cause (the purpose) of the economic process and the inexistence of the final cause in the natural process.

Therefore, noting with PEO_S the multitude of predicates sufficient for an economic process, with PEO_N^n the multitude of new sufficient predicates and with PEO_N the multitude of necessary predicates, we will write successively:

$$\begin{aligned} PEO_S &= \{N_{PEO}, U_{PEO}\}, \\ PEO_N^n &= \{\Sigma_{PEO}, O_{PEO}\}, \\ PEO_N &= \{N_{PEO}, U_{PEO}, \Sigma_{PEO}, O_{PEO}\} = \\ &= \{N_{PEO}, U_{PEO}\} \cup \{\Sigma_{PEO}, O_{PEO}\} = \\ &= PEO_S \cup PEO_N^n, \\ PEO_S \cap PEO_N^n &= \phi, \\ PEO_S \cap PEO_N &= PEO_S, \\ PEO_N^n \cap PEO_N &= PEO_N^n. \end{aligned}$$

Therefore, by an optimal economic process we understand that real process which verifies the predicates from the multitude PEO_N .

A few self-addressed *clarifying questions*:

(1) should any material exchange between the components of the inanimate nature form what we call an economic process?

answer: *no*, because the mentioned material exchange is an exchange which doesn't imply a purpose; we remain therefore within the framework of a natural process;

(2) furthermore, should the material exchange between the biologically living components of the nature and its inanimate components be termed as an economic process?

answer: the reply is no longer categorical, rather hypothetical: if we do not accept consciousness⁽¹⁴⁾ in the non-human biologically living entities, than the answer is *negative*; otherwise, the answer is *positive* (not to further complicate the life of economists – who should elaborate again the entire economic theory –, we will accept subsequently that the non-human biologically living entities don't have consciousness); the answer, therefore, is also *negative*;

(3) in the modern societies there is a material exchange between men without involving directly nature or an identifiable natural process as such (for instance, stock exchange trading of shares); do we still have here an economic process observing the definition given above?

answer: *yes*, because the said material exchange is an exchange which relies ultimately also on the material exchange with the nature; therefore, this question allows us to show what a material exchange between man and nature means: it means a material exchange which can *ultimately* make the connexion with a natural process⁽¹⁵⁾;

(4) is this minimal distinction – at the level of the final cause – between the natural process and the economic process, sufficient to allow sophisticated analyses of the economic processes?

answer: *yes*, because man is not a non-natural entity. Man acquired, indeed, in time cultural distinction in relation with the nature

(cultural distinction which is the fundament of the fourth Aristotelian distinctive cause), which cause him to make severe mistake in its relation with nature⁽¹⁶⁾, but, after all, it is a natural entity. In other words, although with different shapes (and manifestations) from the nature, may still is natural, after all⁽¹⁷⁾.

4. Sustainable economic process

The sustainable economic process is the next driving paradigm which will characterise the relations between man/society and nature. Sustainability, which seems to be the “paradigm” invented by the natural process, is imposed by the process of globalization, sustainability being, concomitantly, a response to the question raised by the process of globalization. The sufficient predicates of a sustainable economic process are the following:

a. it involves an *optimal economic process*⁽¹⁸⁾: we note this sufficient predicate with PEO_{PES} ; the sustainable economic process can only exist together with the original economic process, as shown before, optimal economic process;

b. it involves a *moral cod*: we note this sufficient predicate with M_{PES} ; the moral code must be understood here in all its generality⁽¹⁹⁾, meaning a moral code which is trans-generation (which takes into accounts the “right” to living of the future generations, trans-local (which takes into accounts the integrality of the earth as a common good of all mankind) and trans-economic (which takes into accounts not just the meritocracy in distributing the economic product of the society, but also the natural rights of all the people);

One can notice immediately that the sufficient predicates are independent and consistent among them. We consider therefore, than an optimal economic process which is “endowed” with a moral code is a sustainable economic process.

These sufficient predicates generate a new necessary predicate. With this meaning, we can say that the economic process is sustainable:

c. it generates *sustainability*; the progress of the economic process based on the rationality of sustainability will verify therefore the moral code in all its characteristics (as described above) and for an unlimited period (the only limitation can come exclusively from breaching the moral code); we note this new, required sufficient predicate with S_{PES} ; the logic formula for its generation is: $(PEO_{PES} \wedge M_{PES}) \rightarrow S_{PES}$.

Therefore, noting with PES_S the multitude of the predicates sufficient for an economic process, with PES_N^n the multitude of the new, necessary predicates and with PES_N the multitude of the necessary predicates, we will be able to write successively:

$$PES_S = \{PEO_{PES}, M_{PE}\}, \quad PES_N^n = \{S_{PES}\},$$

$$\begin{aligned} PES_N &= \{PEO_{PES}, M_{PES}, S_{PES}\} = \\ &= \{PEO_{PES}, M_{PES}\} \cup \{S_{PES}\} = \\ &= PES_S \cup PES_N^n \end{aligned}$$

$$PES_S \cap PES_N^n = \phi,$$

$$PES_S \cap PES_N = PES_S,$$

$$PES_N^n \cap PES_N = PES_N^n.$$

Therefore, by sustainable economic process we understand that real process which verifies the predicates from the multitude PES_N .

5. Logically vivid system

The real praxiological process within society is a mixed process in which we have an ineffable “mixture” of natural process and economic process. This is the reason why the distinction economic process – natural process plays only a conceptual and generally methodological function. This distinction helps us clarify our manner of thinking and even to be cognizant of the explicative theories (paradigms) which we accept, but a veridical description of reality involves certain indiscernibleness between the two categories of processes. This indiscernibleness is not related just to our capacity of observing/measuring but is, most probably, of ontological type. When the man (and the human society) appeared, reality witnessed such mixed processes: the natural process “lent” the economic process its three own causes, but also “borrowed” from the economic process, via the vivid logical system, the fourth cause – the purpose. Therefore, the typical processes which are taking place in the praxiological reality existing on our planet also are mixed processes.

Within this context, we consider that the vector (generating) difficulties existing in the economic knowledge and action arise just from ignoring this ontological indiscernibleness, i.e. because the subject (both the epistemic subject and the driving subject) has been removed from the “world”, from the systems which are object of knowledge⁽²⁰⁾. Therefore, to be able to restore in discussion the logical and ontological bases of the Orthodox economic models, we will introduce the concept of *logically vivid system* (SLV).

By SLV we will understand a mixed system (with the meaning discussed above) which verifies the following sufficient predicates:

a. *there is a system*; we note this sufficient predicate with Σ_{SLV} ;

b. it has a *dissipative character* (evolution far away from equilibrium), i.e. it maintains (or even decreases) the entropy within its membrane at the expense of speeding up the entropy within its environment⁽²¹⁾; we note this sufficient predicate with D_{SLV} .

The debates on the sufficient predicates of a living system (with no specification concerning the “matrix” of the living – based on carbon, silicon, metal etc.) are heated and not yet settled. The pertinent ones (as alternative to our proposal) seem to be the positions which set self-reproduction as sufficient predicate (while others propose self-reparation; symmetrical arguments may say that self-reproduction is a species of self-reparation, and that self-reparation is a species of self-reproduction). In our opinion, the dissipative character of the clipping of reality, subject of our discussion, also contains logically these “ingredients” and it is conceptually more general. An important question arises, of course: how does the specific clipping “know” to behave in a dissipative manner, but the question can also be how does the specific clipping “know” to self-repair or self-reproduce. The answer might be the following: the dissipative system contains *internal* information which “requires” entropic self-maintenance. The information must be internal and not external because, in the latter case, we may have entropic maintenance generated by an external factor (we may also have reparation

or reproduction generated by an exterior factor). Although the postulation of the existence of this internal program (or information) is, somehow, metaphysical, the observable reality requires such postulation (it is true however, that that here, the required logical considerations seem to yield place to contingent considerations).

One can observe immediately the interdependence and consistency of the two sufficient predicates (which will, obviously, be necessary predicates too). Once a real system qualifies as SLV by the veracity of its sufficient predicates, it will generate, logically, three new, unnecessary predicates, as follows:

c. self-poietic capacity (self-generating, self-regenerating, self-organising, self-reproducing); we note this new, unnecessary predicate with A_{SLV} ; the logic formula generating this predicate is: $D_{SLV} \rightarrow A_{SLV}$;

d. non-linearity (it doesn't allow predictions⁽²²⁾, because predictions exclude novelty⁽²³⁾), but only the decrease of incertitude concerning the future⁽²⁴⁾; we note this new, unnecessary predicate with \bar{L}_{SLV} ; the logic formula generating this predicate is: $D_{SLV} \rightarrow \bar{L}_{SLV}$;

e. invariant of the total complexity⁽²⁵⁾ (invariant, permanent maintenance⁽²⁶⁾ of the logical sum between the internal complexity of SLV and its external complexity – the external complexity is also called ecological complexity and it expresses the degree of SLV metabolism with its environment); we note this new, unnecessary predicate with I_{SLV} ; the logic formula generating this predicate is: $(\Sigma_{SLV} \wedge D_{SLV}) \rightarrow I_{SLV}$.

The three new, necessary predicates are, obviously, consistent and we will accept that they are independent too.

Therefore, noting with SLV_S the multitude of the predicates sufficient for a SLV, with SLV_N^n the multitude of the new, necessary predicates and with SLV_N the multitude of the necessary predicates, we may write successively:

$$\begin{aligned} SLV_S &= \{\Sigma_{SLV}, D_{SLV}\}, \\ SLV_N^n &= \{A_{SLV}, \bar{L}_{SLV}, I_{SLV}\}, \\ SLV_N &= \{\Sigma_{SLV}, D_{SLV}, A_{SLV}, \bar{L}_{SLV}, I_{SLV}\} = \\ &= \{\Sigma_{SLV}, D_{SLV}\} \cup \{A_{SLV}, \bar{L}_{SLV}, I_{SLV}\} = \\ &= SLV_S \cup SLV_N^n, \\ SLV_S \cap SLV_N^n &= \phi, \\ SLV_S \cap SLV_N &= SLV_S, \\ SLV_N^n \cap SLV_N &= SLV_N^n. \end{aligned}$$

Therefore, by a logically vivid system (SLV) we understand that system which verifies the predicates from SLV_N multitude.

6. Network

The network concept must be anchored within the system concept. We will therefore enunciate the sufficient predicates of the network (or better said, of the system organised⁽²⁷⁾ as network):

a. the quality of *system*; we note this sufficient predicate with Σ_R ;

b. *indiscernibleness* of the elements composing the system (there are no “statutory” privileges or privileges of definition at the level of the elements composing the system⁽²⁸⁾); we note this sufficient predicate with I_R ;

c. universal *accessibility of the information* within the system, at the level of the system (any information input into the system or generated by the system, at the level of a system component, is immediately⁽²⁹⁾ available to any other

component of the particular system); we note this sufficient predicate with A_R .

One can observe immediately that the sufficient predicates of the network are independent and consistent among them.

The sufficient predicates, once verified, generate a new, necessary predicate:

d. feedback spontaneity of the system components⁽³⁰⁾ (the negative or positive feedback appears spontaneously and generalized in all system components); we note this new, necessary predicate with S_R ; the logical formula of derivation is: $(I_R \wedge A_R) \rightarrow S_R$.

Therefore, noting with R_S the multitude of predicates sufficient for a network, with R_N^n the multitude of new, necessary predicates and with R_N the multitude of unnecessary predicates, we may write successively:

$$\begin{aligned} R_S &= \{\Sigma_R, I_R, A_R\}, R_N^n = \{S_R\}, \\ R_N &= \{\Sigma_R, I_R, A_R, S_R\} = \\ &= \{\Sigma_R, I_R, A_R\} \cup \{S_R\} = R_S \cup R_N^n, \\ R_S \cap R_N^n &= \phi, R_S \cap R_N = R_S, \\ R_N^n \cap R_N &= R_N^n. \end{aligned}$$

Therefore, by network we understand that real system which verifies the predicates from R_N multitude.

7. Emergence

Emergence is, obviously, a process. But is it a natural process or an economic process? The question is deep and, therefore, the answer to it cannot be a short one; hence we will make some comments on it based on which we will try thereafter to identify, as usually, the sufficient and necessary predicates of this concept.

1. emergence rejects, by definition, any connotation related to a deliberate, planned,

conscious character of it. These specifications relay immediately to the answer that emergence is a natural process because these characteristics preclude the purpose (final cause). Indeed, the entire pre-human evolution on the planet is the effect of processes of emergence⁽³¹⁾, i.e. the spontaneous emersion of the novel quality⁽³²⁾;

2. however, emergence processes have been also observed in the reality which includes the man (and society), i.e. the reality guided by a purpose. How can this happen? The explanation follows: as shown at pct.1 of these comments, emergence is something non-computational, non-algorithmic⁽³³⁾. But this character refers to a top-down algorithm, which is an algorithm unable to allow its own evolution by its run. In the reality which includes man, the capacity of an algorithm to learn and to perfect (more generally, to modify), from its own experience generated by running, is an actual capacity. Therefore, the driving algorithms can be of bottom-up type. Which is the consequence of this fact? The consequence is that we may have at the same time purpose (verified by the design and implementation of a bottom-up algorithm) and novelty, which is emergence. Therefore, it is not impossible for the emergence processes to occur in mixed (economic and natural) processes too, and history shows not only that such emergence processes occur within the mentioned conditions, but that their speed and “density” is much higher, related to the cosmological scale, than of the purely natural processes;

3. therefore, the answer to our initial question, whether emergence is specific to the natural processes, or to the economic processes, might be the following:

emergence is specific to all the situations (processes, evolutionary arrangements) which allow novelty⁽³⁴⁾, that is, to all the situations which allow to go beyond the simple morphological combination of the existing elements, either by accident⁽³⁵⁾, or by algorithms which learn while running, or by an effect of synergy⁽³⁶⁾.

We will say therefore, that emergence is a process which verifies the following sufficient predicates:

a. it involves a *system*; we note this sufficient predicate with Σ_E ; the sufficient character of this predicate results from the fact that the identification of an emergence process requires a clipping of reality, to be distinguished from the environment of the clipping or from other such clippings; if there is no system, the process of emergence is non-observable;

b. it is *non-deliberative*⁽³⁷⁾, meaning that it is spontaneous (it is not the effect of a decision, singular or integrated within a particular program or strategy); we note this sufficient predicate with \overline{D}_E ;

c. it is *non-computational*⁽³⁸⁾ (or, which is not the same thing, it is non-algorithmable); we note this sufficient predicate with \overline{C}_E .

One can observe immediately that the sufficient predicates of the process of emergence are independent and consistent among them.

The sufficient predicates generate a new, necessary predicate:

d. it is *non-structural*, that is, it can not be inferred from the structure of the system in which the particular process takes place or might take place; non-structuralness is a

necessary predicate because if it would not be verified, than we might conclude that emergence is plannable⁽³⁹⁾, which would contradict, for instance, the sufficient predicate of non-deliberativeness; we note this new necessary predicate with \overline{S}_E ; the logical formula generating this predicate is: $(\overline{D}_E \wedge \overline{C}_E) \rightarrow \overline{S}_E$. The non-structural character of the process of emergence is particularly important because it allows a high “creativity” in the generation of novelty.

Therefore, noting with E_S the multitude of the predicates sufficient for the process of emergence, with E_N^n the multitude of the new necessary predicates and with E_N the multitude of the necessary predicates, we may write successively:

$$\begin{aligned} E_S &= \{\Sigma_E, \overline{D}_E, \overline{C}_E\}, E_N^n = \{\overline{S}_E\}, \\ E_N &= \{\Sigma_E, \overline{D}_E, \overline{C}_E, \overline{S}_E\} = \\ &= \{\Sigma_E, \overline{D}_E, \overline{C}_E\} \cup \{\overline{S}_E\} = E_S \cup E_N^n, \\ E_S \cap E_N^n &= \phi, E_S \cap E_N = E_S, \\ E_N^n \cap E_N &= E_N^n. \end{aligned}$$

Therefore, by emergence we understand that process which verifies the predicates from E_N multitude.

8. Six Theorems

Based on the predicates sufficient and necessary proposed for the logical definition of the concepts of *economic process, system, logically vivid system, network and emergence*, we may state several theorems useful in examining the reconfigurations required to substantiate a model of the economic process, implicitly of the economic prediction.

Following is a systematisation of the predicates obtained for the five concepts:

	Sufficient predicates	New, necessary predicates
System	<ul style="list-style-type: none"> ▪ Membrane ▪ Composing elements ▪ Connexions 	<ul style="list-style-type: none"> ▪ Metabolism ▪ Qualitative identity
Optimal economic process	<ul style="list-style-type: none"> ▪ Natural process ▪ Presence of the human factor 	<ul style="list-style-type: none"> ▪ System ▪ Optimal purpose
Sustainable economic process	<ul style="list-style-type: none"> ▪ Optimal economic process ▪ Moral code 	<ul style="list-style-type: none"> ▪ Sustainability
Logically vivid system	<ul style="list-style-type: none"> ▪ System ▪ Dissipativity 	<ul style="list-style-type: none"> ▪ Auto-poietic capacity ▪ Non-linearity ▪ Invariance of the total complexity
Network	<ul style="list-style-type: none"> ▪ System ▪ Indiscernibleness ▪ Universal accessibility 	<ul style="list-style-type: none"> ▪ Feedback spontaneity
Emergence	<ul style="list-style-type: none"> ▪ System ▪ Non-deliberativeness ▪ Non-computational 	<ul style="list-style-type: none"> ▪ Non-structuralness

▪ **Theorem 1.** *Any sustainable economic process is an optimal economic process as well* ($PES_N \subset PEO_S$)

- **demonstration:** the theorem is obviously true, since one of the necessary (even sufficient) conditions of the sustainable economic process is to be an optimal economic process. As we have thus verified the generation of the sufficient predicates⁽⁴⁰⁾ of an optimal economic process by the necessary predicates of the sustainable economic process, the theorem *is* demonstrated.

▪ **Reciprocal of theorem 1.** *Any PEO is a PES* ($PEO_N \subset PES_S$)

- demonstration: it can be noticed immediately that none of the necessary predicates of PEO generates, with logical necessity, at least one of the sufficient predicates of PES, which is the “moral code”; it results that the reciprocal of theorem 1 *is not* true, which means that there are optimal economic processes which are not sustainable economic processes.

▪ **Theorem 2.** *Any optimal economic process is a logically vivid system* ($PEO_N \subset SLV_S$)

- **demonstration:** first, both the optimal economic process and the logically

vivid system are systems, therefore they verify the logical implication: $\Sigma_{PEO} \rightarrow \Sigma_{SLV}$; second, dissipativeness is a necessary characteristic (in logic terms) of the presence of the human factor (therefore, of the purpose) within the economic process⁽⁴¹⁾, therefore it verifies the logical implication: $U_{PEO} \rightarrow D_{SLV}$. As we have thus verified the generation of the sufficient predicates of the logically vivid system by the necessary predicates of the optimal economic process, the theorem *is* demonstrated⁽⁴²⁾.

▪ **Reciprocal of theorem 2.** *Any SLV is a PEO* ($SLV_N \subset PEO_S$)

- **demonstration:** it can be noticed immediately that none of the necessary predicates of SLV generates, with logical necessity, at least one of the sufficient predicates of the optimal economic process, the “presence of the human factor”; it results that the reciprocal of theorem 2 *is not* true, which means that there are logically vivid systems which are not sustainable economic processes.

▪ **Theorem 3.** *Any sustainable economic process is a logically vivid system* ($PES_N \subset SLV_S$)

- **demonstration:** from the first and second theorems it results that any sustainable economic process is a logically vivid system.

▪ *Reciprocal of theorem 3. Any SLV is a PES* ($SLV_N \subset PES_S$)

- **demonstration:** from the reciprocals of theorems 1 and 2 it results that the reciprocal of theorem 3 **is not** true, which means that there are SLV which are not sustainable economic processes.

▪ **Theorem 4.** *Any network is a SLV* ($R_N \subset SLV_S$)

- **demonstration:** first, both the network and the SLV are systems, therefore they verify the logical implication: $\Sigma_R \rightarrow \Sigma_{SLV}$; second, feed-back spontaneity, together with the universal accessibility to any information (feed back included) provides for the dissipative capacity, verifying thus the logical implication $(S_R \wedge A_R) \rightarrow D_{SLV}$. As we have thus verified the generation of the sufficient predicates of SLV by the necessary predicates of the network, the theorem **is** demonstrated.

▪ *Reciprocal of theorem 4. Any SLV is a network* ($SLV_N \subset R_S$)

- **demonstration:** it can be noticed readily that none of the necessary predicates of SLV (and no logical combination of them) can generate, with logical necessity, the sufficient predicate of the network called “indiscernibleness”; it results therefore that the reciprocal of theorem 4 **is not** true, which means that there are SLV which are not networks⁽⁴³⁾.

▪ **Theorem 5.** *Any living biological system (SBV)⁽⁴⁴⁾ is a SLV* ($SBV \subset SLV$)

- **demonstration:** it can be observed that the necessary predicates of SLV make

no reference to the microscopic foundation of SLV (carbon, silicon, metal, etc.); therefore, any such microscopic foundation is acceptable; since SBV foundation is carbon (at least this is what we can notice presently in our corner of the Universe), it results immediately that any SBV is a class of SLV. As we have thus verified the generation of the sufficient predicates of SLV by the necessary predicates of SBV, the theorem **is** demonstrated.

▪ *Reciprocal of theorem 5. Any SLV is a SBV* ($SBV \subset SLV$)

- **demonstration:** since, as shown before, it seems that SBV is based on carbon, while SLV accepts any microscopic foundation, it results that the reciprocal of theorem 5 **is not** true, which means that there are SLV which are not SBV.

▪ **Theorem 6.** *Any network implies a process of emergence* ($R_N \subset E_S$)

- **demonstration:** first, both the network and the process of emergence are systems, therefore they verify the logical implication: $\Sigma_R \rightarrow \Sigma_E$; second, the sufficient predicate of network “indiscernibleness” generates, with logical necessity, the sufficient predicate of “non-deliberativeness” of the process of emergence (indeed, since there are no privileged components in the network, there are no hierarchies, therefore there are no deliberative decisions⁽⁴⁵⁾), which verifies the logical implication: $I_R \rightarrow \overline{D}_E$; third, the new necessary predicate „feed-back spontaneity” of the network generates with logical necessity the sufficient predicate of „non-computationality” of the process of emergence (indeed, spontaneity defies any algorithm, be it ex ante or ex post), which verifies thus the logical implication: $S_R \rightarrow \overline{C}_E$.

As we have thus verified the generation of the sufficient predicates of the process of emergence by the necessary predicates of the network, the theorem *is* demonstrated.

- *Reciprocal of theorem 6. Any process of emergence involves a network* ($E_N \subset R_S$)
 - **demonstration:** *first*, both the process of emergence and the network are systems, therefore they verify the logical implication: $\Sigma_E \rightarrow \Sigma_R$; *second*, the sufficient predicate of “non-deliberativeness” of the process of emergence generates, with logical necessity, the sufficient predicate of “universal accessibility” of the network (meaning that since there are no processes of information concentration or selection due to reasons of deliberativeness, then the information is available distinctly in the system), which verifies thus the logical implication: $\overline{D}_E \rightarrow A_R$; *third*, the new necessary predicate „non-structuralness” of the process of emergence, will generate with logical necessity, the sufficient predicate of “indiscernibleness” of the network, which verifies thus the logical implication $\overline{S}_E \rightarrow I_R$. As we have thus verified the generation of the sufficient predicates of the network by the necessary predicates of the process of emergence, the reciprocal of theorem 6 *is* true.

Therefore, theorem 4 could be reformulated as follows: *the network and the process of emergence are logically equivalent.*

We may note therefore, the following results, written formally, concerning the concepts discussed above:

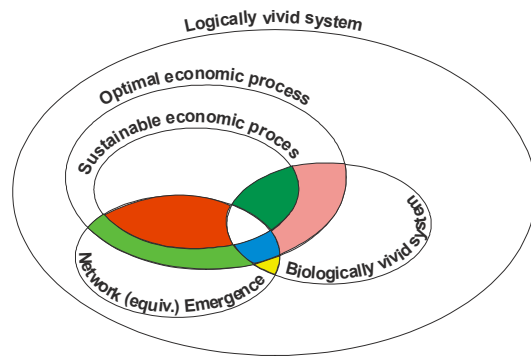
(a) $(\forall)PES_i, (\exists)PEO_j | PES_i \subset PEO_j$
 where “i” and “j” are two common counters ($i, j \in N^+$, where N^+ is the multitude of the natural numbers, without the null element);

- (b) $(\exists)PEO_i | (\forall)PES_j, PEO_i \not\subset PES_j$
- (c) $(\forall)PEO_i, (\exists)SLV_j | PEO_i \subset SLV_j$
- (d) $(\exists)SLV_i | (\forall)PEO_j, SLV_i \not\subset PEO_j$;
- (e) $(\forall)PES_i, (\exists)SLV_j | PES_i \subset SLV_j$
- (f) $(\exists)SLV_i | (\forall)PES_j, SLV_i \not\subset PES_j$
- (g) $(\forall)R_i, (\exists)SLV_j | R_i \subset SLV_j$;
- (h) $(\exists)SLV_i | (\forall)R_j, SLV_i \not\subset R_j$;
- (i) $(\forall)SBV_i, (\exists)SLV_j | SBV_i \subset SLV_j$;
- (j) $(\exists)SLV_i | (\forall)SBV_j, SLV_i \not\subset SBV_j$;
- (k) $(\forall)R_i, (\exists)E_j | R_i \subset E_j$;
- (l) $(\forall)E_i, (\exists)R_j | E_i \subset R_j$;

From the primary formal relations above, we may further extract the following logical consequences:

- a. of logical equivalence: from (k) and (l): $(\forall)i, j, R_i \leftrightarrow E_j$;
- b. of logical possibility: from (c) and (e): $(\Omega)i, j | (PES_i \subset R_j) \vee (R_j \subset PES_i)^{(46)}$.

A synoptic presentation of the correlations of logical inclusion (necessary, possible or desirable) between the four concepts may be represented as follows:



As it can be seen, the logic “wrapper” of the four analysed concepts is the logically vivid system. Therefore, in our opinion, the reconstruction of the logical foundations of the economic epistemology and praxiology should be set on this concept. In consequence, the modelling of the economic

process (either abstract or instrumental – of quantitative or heuristic model) should rely on the same concept. The concept of logically vivid system must be previously developed enough, may be even as a theory of the logically vivid system.

9. Theses-conclusions

At least the following theses-conclusions can be inferred from the above considerations:

1. the deadlock (partially acknowledged) of the economic science concerning the veridicity and practicability of economic process modelling originates in the naturalist paradigm of this process;

2. the reinsertion of man (of the epistemic and praxiological subject) within the object of economic knowledge (which means to give up the epistemological principle of objectivation) is the key to identify the ways in which the economic process can be modelled veridically;

3. the economic process (and therefore, any structure of it – organisations, institutions and in general, any economic phenomenology) must be seen as logically vivid systems;

4. only with the paradigm of the logically vivid systems is it possible to solve coherently and consistently difficult impediments of the economic process modelling such as: the variation of the initial conditions (see the Oedipus effect), the qualitative change (see the emergence of novelty), the non-linearity, while providing for the epistemological simplicity (indispensable to understanding, therefore indispensable to integrating the results of the economic process within the values composing the quality of life);

5. the structural-causal prediction is doomed, in principle, to fail (by failure of

the prediction we understand not mere unacceptable deviations of what was predicted from the actual measurements at the end of the time horizon, but an unacceptable deviation from the veridicity⁽⁴⁷⁾ of the economic process); as shown before, the prediction of the economic process must be, in principle, normative, actually requiring *retrodictions* for the time horizon “future-present”, and not predictions for the time horizon “past-present-future”;

6. the novelty (qualitative change) requires the network, which is logically equivalent to the processes of emergence;

7. the logically vivid system, the network and the emergence are the pillars which should support a possible review of the logical bases of the economic epistemology and praxiology;

8. such a review should also involve the reevaluation of the following issues of general economic methodology:

- the consideration of an economic space, and of an economic time (dependent as density and speed/acceleration, on the reference framework⁽⁴⁸⁾ - for instance, on the level and/or structure of development);

- reevaluation of the presence of the linear overlap in our economic models (including at the level of the economic predictions);

- reevaluation of the epistemological and even methodological/instrumental role of probabilities, which introduce an unnecessary or even harmful statistic ingredient, in our opinion, to the modelling of the economic process⁽⁴⁹⁾;

- evaluation of the possibility to achieve the epistemological simplicity in the general modelling⁽⁵⁰⁾ of the economic process by the methodological linearization of the ontological (immanent) non-linearity

(which also exists in the economic process, as demonstrated above);

9. we consider that the rejection of the Newtonian paradigm of the economic process modelling (particularly of the economic phenomenology reversibility), with the simultaneous recovery of the

dynamic character of the description of the economic evolution (possibly by the replacement of the classical probability with the principle of the linear overlapping of the states) is an urgent necessity both for the economists and for the philosophers or logicians.

10. The evolution of the driving paradigms

- man and any artefacts containing it generate dissipative systems
- the dissipative systems are non-equilibrium systems
 - they are systems functioning far from the state of equilibrium (see I. Prigogine)
- the dissipative systems are ambivalent systems
 - driving systems: generate the contingent change
 - self-reflexive systems: generate knowledge
- primary knowledge: generated by problem solving (see K. Popper)
 - it is exclusively contextual (local – spatially and temporally)
 - it is empirical (reactive) – it generates solutions to the problems
- secondary knowledge: generated by the cognition of the primary knowledge
 - it is a-contextual
 - it requires the elaboration of theories (knowledge systems which save thinking); it is pro-active – generates problems.

Paradigm of stability

- wide scale process reproducibility
- complete, natural or “naturalised” circular processes
 - homogenous speed of the entropy within the dissipative system and within the environment
- generates the phenomenology of localization
- it is a “dead” paradigm within the present civilization.

Paradigm of optimality

- intra-temporal criterional extremisation of the processes
- it generates processes “with rest”, unintegrable naturally
 - accelerated speed of the entropy within the environment, compared to the dissipative system (entropy “pumping” into the environment)
- it generates the phenomenology of globalization
- it involves simultaneously primary knowledge and secondary knowledge
- it is the current paradigm of our civilization.

Paradigm of sustainability

- inter-temporal criterional extremisation of the processes (sustainability criteria)
- complete, “naturalized”, circular processes
 - higher speed of the entropy within the environment, compared to the dissipative system, but lower that for the paradigm of optimality (lower “production” of entropy)
- it generates the phenomenology of fully integrated localization
- it involves simultaneously primary knowledge and empirical knowledge
- it is an “emerging” paradigm.

Paradigm of viability

- It recaptures the entire paradigm of sustainability
- It adds the moral code of civilization
 - higher speed of the entropy within the environment, compared to the dissipative system, but lower that for the paradigm of sustainability (additional reduction of the “production” of entropy)
- it generates the phenomenology of service provisioning (transformation of the artefacts in logically vivid systems)
- it involves, simultaneously, primary knowledge and secondary knowledge
- it is a desirable paradigm, upon finalization of the globalization process.

Notes

- (1) The process, in general, represents a variation of the state vector of a certain entity to which a state vector is possibly (intelligibly) to assign. We are not interested here in a specific qualification of this variation (whether it is reversible or irreversible, periodical or singular, natural or artefactual, etc.).
- (2) We can easily demonstrate that the economic science is in principle non-theoretical, but this distinction between theoretical science and empirical (non-theoretical) science, is not relevant to the objective of this paper.
- (3) Here, the meaning of the notion of modelling is very wide, referring to any explicative demarche, theoretical or logic (it is by no means reduced to a quantitative, possibly equational description).
- (4) In a genuine meaning, hypothesis testing presumes the possibility of repeating the test (including the experimental design) by several independent persons or structures (for instance organisational structures at any level). Because social (and implicitly, economic) testing is not possible in laboratory time, but only in real (historic) time, and because the invariance (identity) of the initial conditions can not be maintained, test reproducibility is compromised.
- (5) Meaning an exchange of matter, energy and information with the environment. As it is known, the metabolism is the logical sum of the anabolism and catabolism.
- (6) The economic process, in the abstract meaning of the word (better said, in the meaning referring to the “first” appearance of a praxiological action of the man in relation with the nature), is, of course, an emergent process. In its concrete and, particularly, modern meaning, the economic process is no longer an emerging process (in the same way in which, for instance, in the analytics of the production functions, the natural factor no longer exists as such, rather being incorporated in the capital factor). In other words, one may say that the results of the non-emergent processes necessarily are artefacts, while the results of the emergent processes can be artefacts.
- (7) In the most general meaning (which, however, is not of distinct interest for us in this paper), this exchange between man (society) as dissipative system and nature presumes an exchange of entropy: low entropy from the nature towards the dissipative system and high entropy from the dissipative system towards the nature.
- (8) A natural process is that real process in which three (Aristotelian) categories of causes function: the material cause, the formal cause and the efficient cause.
- (9) The compulsory character of the sufficient predicates resides in the fact that empirically (therefore in terms of an experience to be communicated between subjects) there are, in the observable universe, processes which verify the sufficient predicates.
- (10) Obviously, the optimal purpose involves the operation of the final Aristotelian cause (*causa finalis*). The other three causes, also to be found in the natural process, are: a) the material cause (*causa materialis*); b) the efficient cause (*causa efficiens*); c) the formal cause (*causa formalis*).
- It is, however, extremely arguable whether the natural process requires the formal cause. It might rather seem that this type of cause is related to the final cause but, considering for instance the genetic code (provided we exclude the divine intervention in designing it), it seems however, that the natural process is also characterised, though, by the formal cause. We will subsequently accept the idea that the economic process differs from the natural process just by the existence of this fourth cause, the final cause (purpose).
- (11) We might wonder whether nature optimises. We consider that the answer is negative: nature’s “rationality” is towards sustainability, not towards optimality (the historical “evidence” is the long time required by the natural evolution, related to the rather short time required by the social evolution). By evolution we understand, of course, an irreversible loss of identity.
- (12) The unsustainable character of the economic process appears with the emergence of optimality as generalised driving paradigm. Globalization, which is the effect of the driving paradigm of optimality, becomes (the process has already started) the cause for replacing the paradigm of optimality by the paradigm of sustainability (which will be replaced in turn by the paradigm of viability

- formed of the logic sum of optimality and moral code). In the economic theory, the expression of the paradigm of optimality is the methodological individualism.
- ⁽¹³⁾ Of course, the economic process can be replaced with a wider process (the widest process involving human action): the social process, the conclusions being, however, rigorously the same.
- ⁽¹⁴⁾ In a general meaning, by consciousness we will understand the reflexive capacity to observe the self and to differentiate it from the environment. In a narrower meaning, but more useful to our present discussion, by consciousness we will understand the capacity to understand the significance of one's own action or of the actions of the other entities in the environment. Understanding (comprehension) implies intuition, while explanation implies reason.
- ⁽¹⁵⁾ It is somehow curious how the new syntagm of the informatics society or of the knowledge society succeeded, for most of us, to break any ties with the natural process within the economic process specific to the new paradigm. As if it would be enough to draw bread on computer and to eat it. No matter how many links would science and technology introduce within the material exchange (or, many times, in the fully dematerialised exchange) between the people, ultimately it is about an exchange between man and nature (someone, sometime must simply bake that physical bread; do not mistake the fact that we can produce an increasing amount of artificial products for the fact that we still need the nature or the natural process – the production of artificial goods only takes us a few links farther from nature, but can not break us from it).
- ⁽¹⁶⁾ Also see the opinions expressed within CCFM on the evolution of the driving paradigms in human mankind (especially the presentations within the Seminary of Methodology and Logic of the Economic Knowledge „Nicholas Georgescu-Roegen”, 4th session)
- ⁽¹⁷⁾ We do not insist here on the complications raised by the emergence of artificial intelligence and even of the robots “candidate” to the status of logically living entities.
- ⁽¹⁸⁾ We note that the first “species” of economic process which appeared was that of the optimal process (the degree of optimality is irrelevant – achieved by primitive rituals or through sophisticated econometric models running on computers).
- ⁽¹⁹⁾ We would like to suggest a rather a-historical moral code, although we are conscious of the strong contextual print of the moral. Due to reasons of abstract reasoning, however, it is very useful, though, to accept the possibility of an a-contextual moral code.
- ⁽²⁰⁾ The rational knowledge of the economic universe is guided, as it is commonly known, by two fundamental principles: a) the principle of intelligibility (one can identify a logical explicative model – a paradigm – coherent, consistent and complete on the economic phenomenology which is the object of knowledge); b) the principle of objectivation (the cognitive subject is not part of the reality which is the object of knowledge; rather it is located outside the object of knowledge, which it doesn't influence by the approach of knowledge – in other words, the approach of knowledge is of von Neumann type). If there is no doubt on the legitimacy of the principle of intelligibility, things are more complicated concerning the principle of objectivation. Although the classical science achieved quite unimaginable progress exactly on the basis of this principle (from the ancient western science to the theory of relativity included) the new developments (particularly the psychology, biology, the quantum theory, the theories of cognition) can no longer ignore considering the knowing subject as part of the object of knowledge. We think it is about the time that the economic science (or theory) too, gives up the principle of objectivation (it is of course arguable whether giving up the principle of objectivation will undermine or not the principle of intelligibility as well. We hope to be able to maintain the latter principle because no acceptable replacement is foreseen. At least in the field of the economic science, the preservation of the principle of intelligibility, concomitantly with giving up the principle of objectivation, is expected to produce, as we understand things, a paradigmatic reconsideration of the entire economic phenomenology).
- ⁽²¹⁾ Also see our study, Dissipative systems and sustainability, published in Theoretical and Applied Economy, no. 3/2008 (the ideas from the study also have been presented and debated within the 4/2007 session of the Seminar). The study also proposes a demonstration of Prigogine's principle of the minimal production of entropy, as well

- as a logical model of the entropic interaction.
- (22) Predictions exclude novelty, being mere morphological combinations of the known elements. Hence, as we will subsequently show, logically speaking, in the economic process we have some kind of ... retrodictions (retrodictions obtained not by the simple reversal of the algebraic sign of time from the analytic of the reversible laws of process movement, but by target setting. We would have actual retrodictions only if we would replace mutually the initial conditions with the final conditions, which, as we will subsequently show, is impossible in the economic process).
- (23) As we will see further, novelty is associated to emergence, which is inconsistent with computability, namely, with the deliberative planning.
- (24) Although it is possible to argue against the independence of the three new necessary predicates (it seems that non-linearity might be regarded as a necessary consequence of the self-poietic capacity), we prefer to assume this possible logical non-rigorousness with the purpose to reveal the crucial importance of the predicate of SLV non-linearity, with fundamental consequences in the debate on the necessity of epistemological simplicity of the economic conjecture.
- (25) We notice here, that the invariant of the total complexity is not a necessary predicate of a general system. At the same time, there is no logical connection between the (relative) invariance of the set of identity parameters of a system and the invariance of its total complexity.
- (26) We may be fully entitled to speak of the character of continuity (so that we will ignore this possible attribute of the total complexity invariance), as long as the hypothesis of the quantum nature, at ontological level, of the macrocosmos is not yet accepted (although quantum nature at ontological level of the microcosmos is accepted and furthermore the principle of correspondence is introduced, which makes intelligible, at the level of the macroscopic epistemic subject, the directly non-intelligible world, at the microscopic level).
- (27) Here, the notion of "organised" doesn't necessary has an anthropomorphic connotation.
- (28) The inexistence of privileges regards concomitantly: a. location; b. role (function); c) potential. The hierarchical systems, unlike the network (or networked) systems do not verify this predicate.
- (29) Here, the term "immediately" has not a temporal significance (with no delay), rather a relational significance (with no intermediation).
Therefore, having in view the objective existence of a lag in the transmission of, or access to system information (particularly in the case of a large and/or complex system), the idea we want to highlight is the direct availability of any existing information (input into the environment or generated locally), for any indiscernible component of the system.
- (30) Having in view that the feedback is an information generated by the system itself, it results that once this information appears in the system it is, according to predicate AR, available immediately to all the components of the particular system.
- (31) In other words, emergence is something that appears by itself, without a planned expectation, or an algorithm for it.
- (32) Let us observe that emergence, that is, novelty, appears in spite of the formal cause, which is also present, as argued before, within the natural systems. We may even say that emergence is something produced outside the algorithm of evolution (algorithm stipulated in the formal cause), something that occurs in a non-computational manner (by computational we understand the manner of action of an universal Turing machine, or approximately, the manner of action of an ordinary computer of our time, programmed top-down).
- (33) Non-aritmomorphic, as Nicholas Georgescu-Roegen would say.
- (34) It results immediately that emergence can not be predicted.
- (35) Such as the mutations in the evolution of the biological systems, for instance.
- (36) As it is known, synergy is the situation in which the multitude of the properties of an assembly of components has the cardinal higher than the cardinal of the reunion of the multitudes of the properties of the assembly's components.
- (37) It is obvious that we may accept, within the economic process, variations of the state vectors of the process, which are not, however, results of deliberative acts.
- (38) It is obvious that the predicate of non-deliberativeness is independent of the predicate of non-computability, because a decision (which is a deliberative fact) may coexist with non-computability. On the other hand, it

is possible to demonstrate, ex post, that a process which verified the predicate of non-deliberativeness may be described by an algorithm. For instance, the automatic stabiliser of the policies of macroeconomic adjustment is non-deliberative but computational, because it was designed so as to follow an automated procedure (which is what we usually call an algorithm) when its efficient cause is met.

- (39) According to the postulate from the system theory, that the structure generates the function.
- (40) As it can readily be noticed, it verifies even more than that, i.e. all the necessary predicates of the optimal economic process.
- (41) It can be readily noticed that optimality doesn't necessarily generate dissipativeness (there also may be dissipative systems within a paradigm of sustainability; it seems that sustainability is nature's "patent" – while optimality is man's "patent"; man will return to nature's "patent" after the process of globalization ends).
- (42) Here is, therefore, a logical motivation to consider the economic organisation a SLV and, therefore, to reconsider our microeconomic models from this perspective.
- (43) A contingent example could be the hierarchical socio-economic systems.
- (44) Evidently, the class of living systems in "prelogic" terms, can be expanded indefinitely, to include not only what we know from the observable Universe (for instance, the biological life based on carbon) but also the potential ones from the non-observable Universe, or from alternative imaginable Universes.
- (45) Besides the case when we accept the existence of a sui generis deliberativeness of the assembly of indiscernible

(something similar to the way in which some analysts speak of the social conscience). Such a conjecture is, in our opinion, an unacceptable speculation.

- (46) We noted with (Ω) the functor of the logical possibility. We may even say that it would be desirable that part of PE is of R type, just so as the existence of the network at the level of the economic process (or at the level of a large part of the economic process) may generate, permanently and continuously, novelty
- (47) We should observe that the veridicity (or veracity) of modelling losses significance when we discard the structural economic prediction (causal at the level of the efficient cause) and when we replace it with the normative "prediction" (causal at the level of the final cause). Within this context, instead of model veridicity we may put model verosimilarity or even better, model desirability.
- (48) We consider this desiderate to be urgent including in what concerns the reevaluation of the philosophy of European construction (construction which is, obviously, preponderantly normative, as intellectual project). We will observe, for instance, the existence of important elements of network organisation (including at the state level), or the existence of processes of emergence (see the operationalisation of the principle of subsidiarity) at the level of the European institutional construction.
- (49) We will observe that the normative "prediction" doesn't even need probabilities, since they model an incertitude related to the efficient causality, not to the final causality, characteristic to the normative modelling.
- (50) With the risk of looking pedant, we repeat that by the economic process modelling we understand the most general and abstract possible explanative description (theory, paradigm, conjecture) of this process.