SOCIOPHYSICS AND QUANTUM ECONOMICS

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Abstract. *The contemporary economic reality could be more adequate for new sociophysics and quantum economics' models and methods. These new multi – disciplinary sciences are able to perform economical analysis, better than contemporary econometrics or economic statistics, in general. Other aspects of this article are related to the significance of time concept in the contemporary economics through physics way of thinking and to the integration of the multi-disciplines thought into the statistical evaluation of the economic results. This could be also a consequence of the experience generated by the global crisis in the economic world. The authors believe that new multi – disciplinary sciences can solve the problem of a better coverage of economic realities, through more adequate and comprehensive methods and models. In addition to this main purpose, the paper could be a good explanation for a better understanding of the crisis and recessions.*

Keywords: *sociophysics, quantum economics, macrorealism, particle, multi – disciplinary sciences.*

1. INTRODUCTION

The models are either a modality of representing a simplifying empirical objects from reality or parts of reality, phenomena, and physical processes (either models of phenomena or models of data), or an alternative in which the human way of thinking's processes can be amplified (for the scientist's thought, the construction and the manipulation of models are vehicles for learning and understanding), and, probably most of all, a substitute for direct measurement, experimentation and simulation of reality). Simulations are used only for the dynamic models, i.e. models that involve time (the simulation's aim means understanding, solving and projecting the equations of motion of such a model).

Researchers are acknowledging the importance of models with increasing attention and are probing the assorted roles that models play in scientific practice. Interpretation "in simulacra" of a special reality through the model means to simplify reflections of this reality, but despite their inherent and relative falsity, model remains extremely useful (in fact, there is no complete and entire true model, able to describe the reality).

2. NEW MULTIDISCIPLINARY SCIENCES, MODELS AND METHODS DERIVED FROM PHYSICS

The physics models used in (macro) economics generate the multidisciplinary models and do not analyze only economic or social processes and phenomena, but rather their continuity in evolution or involution. At the pragmatic and challenging crossroads of (macro) economics (i.e. econometric research) and sociology (sociological research), or, more recently, even of politology with physics (that is, the thought based on physical, quantum statistic, or the theory of relativity), completely new sciences have been generated over the last three decades, e.g. sociophysics and quantum economics, etc., which vie, through their seeming originality and simplicity, with the impact of other new modern research methods that emerge and take firmer shape, such as the science of complexity, the science of the neural net systems, of the genetic algorithms, of fractals, of chaos theory, of fuzzy and neutrosophic logic. Their historical evolution is an occasion for us to acknowledge the pace of the development of the border disciplines. The physics' model can contribute, through its sociophysics, quantum-economic, science of complexity, science of the neural net systems, genetic algorithms, fractals, chaos theory, fuzzy and neutrosophic logic, etc. forms, in an unexpected manner, to a better understanding of the economic problems, of the processes or decisions of an economic-social type.

Contemporary humanistic sciences are nowadays more and more distinctive, from psychology to the cognitive sciences, from sociology to economics, from the political sciences to anthropology, etc. The special humanistic sciences were previously known by the name of moral sciences, and, at the same time, were marked by the tradition of generating analogies with the ideas in the natural world and in the natural sciences. There exists a great diversity of the schools of thought of an economic type: that of the Austrian economists, that of the institutionalists, the Marxist one, that of the social economists, of the behaviouralist economists, of the theorists of chaos, of the Keynesians and post-Keynesians, of the neo-Ricardians, of the Chicago school theorists, of the constitutional political economists, of the supporters of the theory of public choice (the theory of rational choice already represents the focus of the economic discipline, in the balance of the neo-classical microeconomic, and the macroeconomic one).

Physics was born as a fundamental science, in demonstrative or reductive a manner of thinking, only to assume a manner of thinking of a universal type, with Newton. What is a fundamental science? Can unity exist without fundamentality? The form the unity takes, or should take, especially in physics, is a controversial question, which has led to plurality within the broad community of the whole discipline of physics. Physics has developed a genuine universe of the activities, between the theoretical and the experimental approaches and trends. That process has led to a lack of unity in the terms of any classical discipline, as well as a greater complexity of the sets of interactions within the usual term of *physics*, as it gradually became a great science, alongside of other disciplines, such as engineering, economics and management. A distinctive feature of the econometric model has to do with the fact that, whereas it shares with the physical model the application of mathematics and statistics, inductively or deductively, descriptively or explanatorily – with respect to the population, and the probabilistic interpretations – it seems that it still lacks the strict and accurate, correct approach to the universal laws in as “recognizable” a manner as in the physical model.

The economic model is a scientific model oriented towards the possibility of choosing, of managing risks, and making decisions with respect to some genuine, often serious problems, but it also involves a number of general aspects that are of special interest in understanding the phenomena or processes. Thus, after two decades of existence, it can be found that:

- the economic model only refers to certain aspects of the reality, where the man is concerned with limited resources, it is true more often than not in an optimal manner;
- the economic model always encourages the enforcement of the quantitative and formal methods, it confers intellectual legitimacy, associated with virtues of accuracy and precision, somehow relative, and of objectivity, sometimes only apparent;
- the subjects of the economic aggregates are made of the same simple material, as elements, atoms of the activities, units that are also physical entities: husbandries, households, corporations and financial or non-financial agencies, the labour market and other markets, but the economic laws, as formulated or invalidated through the econometric models, do not have the same type of viability as the models and laws of physics;
- the economic systems modelled in the econometric manner reveal they are on the increase, day after day, in natural or human environments, just like the other types of physical, biological and social systems.

All the above aspects show serious grounds for competition in knowing and quantifying, in modelling and forecasting the real world, simultaneously economic, physical, sociological, etc. The physical model can make a real contribution, through its sociophysics, quantum economics, etc. Forms, and in an unexpected manner, to understanding the economic problems, the processes or the decisions of an economic and social nature:

- through its methodology, which can be described as dual: of an analytical and experimental type at once;
- through its solutions of decomposing, coherently and very close to the reality, a system into its constitutive pieces, and its manner of final understanding, known through the formula “the whole is larger than the sum of its parts” (the *Gestalt* phenomenon);
- through its measuring scale, or it quantitative, relevant standpoint, where it describes the qualities of an economic system or its constituent and determinative phenomena, without however omitting the simplicity of the physical universe, assimilable to any other universe;
- through its specific vision and its manner of making references, always in terms of parts of the universe that must be studied within the great structural hierarchy of reality: from a micro-scale to a macro-perspective, which it deals with through its two main extreme disciplines (nuclear physics at the sub-level of the atomic particles, and astrophysics, at the aggregate level of the cosmic and universal type), connecting a great variety of disciplines, from chemistry, molecular biology, organic biology, psychology, up to economics, political sciences and sociology, ecology, geology and climatology and, to end with, astrophysics);
- through its contribution to establishing the equations that simplify, and the methods that describe phenomena with much more accuracy and precision, as compared with any other models, such as production, markets, migration, traffic or transportation, the financial world, etc.

The physics’ laws, mathematically express the conservation of a quantity, as well as the conservation of symmetries or the homogeneousness of space and time (the object space–time).

The physicists’ interest in the fields of the financial and economic systems has comparatively old roots, and a brief history of the appearance of sociophysics can be illuminating in that respect. Sociophysics has become also an attractive research domain in the last two or three decades, despite the controversies between sociologists and sociophysicists; it is all due to its extraordinary potential to allow the understanding of a simple principle in keeping with which social phenomena will always be victorious, unlike the scientific theories that explain them. By using statistical physics on a large scale, by modelling the relevant social phenomena, such as those of the making up of the cultural, economic or political opinions, the dynamics and dissemination of the opinions, the origin and evolution of language, competition, conflict, the behaviour of the masses, the spreading of the rumours, social contagion, the net systems of the Internet and the World Wide Web, scientific cooperation and research, the appearance and evolution of the terrorist networks, etc., sociophysics tries to supply new solutions in modelling such phenomena as the inter connexion between the dynamics of a number of social or demographic indicators (life expectancy, birthrates, fertility, etc.), and the distribution of wealth and well-being, religion, the ecosystems, friendship, the social and traffic networks, etc.

The origins of sociophysics can be detected as belonging to the ’70s and ’80s. One of the most frequently cited authors is Serge Galam, who published his papers in *Journal of Mathematical Sociology* and in *European Journal of Social Psychology*. The apparently conflictive nature of the new discipline, called sociophysics, in relation with the scientific communities of the classical physicists, is best described in his book *Sociophysics: A Personal Testimony (2004).* Physicist Elliott Montroll was the co-author of the first book that anticipated the evolution of this new science called sociophysics, alongside W.W. Badger, in 1974; the title of the book was *Introduction to Quantitative Aspects of Social Phenomena.* Sociophysics was defined, by association with econophysics, as the specific phenomenon of using the models of physics in sociology, as the first objective of the new science was to deal, in its models, with the human individual as statistical physics and the quantum physics or mechanics treat particles. Physics concentrates up to this day on the scientific and technological aspects of human society, and accepts ideas of Alfred Lotka, concerning the human populations as the owners of genuine solutions of transforming their own energies into specific dynamics (demographic migrations, cultural, educational, religious, behavioural changes). The sociophysical models can change the possibilities of the human population to know themselves, and physics itself dynamizes the investigation effort through its traditional analysis models based on quantum thinking, through the method of statistical physics, together with fuzzy logic, through the science of complexity, or through the methods specific to sociology; it thus enriches the methodological supply of sociophysics, the initial name of which was intended to be *psychophysics*. Starting with the 21st century, sociophysics is really a new science, and not only a mere multidisciplinary or trans-disciplinary slogan. Among the most important pioneers of the new science, we could mention, in addition to Serge Galam (*Sociophysics: A Personal Testimony*), Dietrich Stauffer (*Sociophysics Simulations I: Language Competition),* Paris Arnopoulos (*Sociophysics: Chaos and Cosmos in Nature and Culture*), etc.

The contemporary debate about the limits of the economic realism and the future of economics must defence the importance of the new alliance with quantum physics. Quantum physics can approximately be considered as a generalization of Newtonian physics and mechanics. The probability of finding a particle is given by a function having conformity with the principles of wave mechanics. Thus, the particle is dissipated in space, and it is only the probability of finding it in a certain location can be calculated, until it is noticed in a practical way. The thinking of quantum physics leads to the conclusion that using the probabilistic scenario with alternative state variants (very much as the particle–wave, in the quantum model), stands the best chances of coming near the description of the macroscopic, macroeconomic, macro-financial world of the companies. First, it becomes necessary to define the specificity of quantum physics' way of thinking.

Quantum physics remains a powerful science for studying subatomic particles. Very small particles at very high velocities behave differently from billiard balls and solar system planets and there are some non-intuitive effects of trying to observe and pinpoint features of individual particles. Quantum physics emerge from classical statistical physics or classical statistics. A typical quantum system describes an isolated subsystem of a classical statistical ensemble with infinitely many classical states. The state of this subsystem can be characterized by only a few probabilistic variables. Their expectation values define a density matrix if they obey a "purity constraint". Then all the usual laws of quantum follow, including Heisenberg's uncertainty relation, entanglement and a violation of inequalities. No concepts beyond classical statistics are needed for quantum physics - the differences are only apparent and result from the particularities of those classical statistical systems which admit a quantum mechanical description. The rule for quantum probabilities follows from the probability concept for a classical statistical ensemble. In particular, the non-commuting properties of quantum operators are associated to the use of conditional probabilities within the classical system, and a unitary time evolution reflects the isolation of the subsystem. But first of all, despite the scientific character of quantum physics, this incredible way of thinking offers and takes a spiritual perspective in which there are no separate parts, in which everything is fluid and always changing, from particle or atom to wave or energy, from material to spiritual, from realism to idealism, etc.

It is through our thoughts that we transform this ever-changing energy into observable reality. Therefore, we can create our reality with our thoughts. With quantum physics, science is leaving behind the notion that human beings are powerless victims and moving toward an understanding that we are fully empowered creators of our lives and of our world. Quantum physics shows that what's happening on the inside determines what's happening on the outside. It says that our world is shaped by our thoughts. Quantum physics' way of thinking is the nearest thought to the universe, and even beyond universe. The original connection between quantum physics and thought was made by David Bohm in 1951. The human brain is no Turing Machine. Roger Penrose tries to prove that our consciousness is non-algorithmic, and that we seem - to our conscious selves - able to make decisions in a flash. He finds that this could be explained only by quantum physical thought processes that proceed in sub-graviton parallelism until they reach graviton level, when they collapse and produce a conscious thought. Both Roger Penrose and Amit Goswami note that where quantum physics seems mystical, it is because it is not complete, stable, or a finished theory. Since quantum theory cannot explain the collapse of wave functions adequately we should not try to use to explain more complex phenomena either. We need better tools. Obviously, the brain is composed of particles obeying quantum laws (a notable case is that the retina accepts photons, which are small enough to behave strangely in terms of classical physics). Quantum physics is strange. So is consciousness. Maybe there is something in common between the two. The indeterminism in quantum physics is commonly modelled in a wave function - which is a combination function of possible outcomes, and determining the outcome is commonly termed "collapse of a wave function". Penrose says that consciousness as a side effect of running an algorithm is not possible. Amit Goswami completes this idea, and reconciling macro realism with micro idealism is possible in quantum physics' way of thinking because of six main reasons: a) the quantum state of a system is determined by the Schrodinger equation, but the solution of Schrodinger equation, the wave function is not directly related to anything that can be seen by someone; b) quantum objects are governed by the Heisenberg uncertainty principle: it is impossible to measure simultaneously and with certainty pairs of conjugate variables such as position and momentum; c) the paradox of wave-particle duality consist of quantum objects, needing for a solution which involves interpretation and philosophy; d) the discontinuity and quantum leaps are truly fundamental features of quantum systems behaviour; e) the physics' reality could be or not a coherent superposition; f) under certain conditions (for example, when energy levels of atoms are separated by very small spaces), quantum mechanical predictions could be reduced to those of classical mechanics. Macro realism arises whenever economics appear, but difficulties are more and more significant because of the quantum nature of reality. Very much as the measuring process gets us acquainted with quantum thinking, the concepts of statistical collective and ensemble, being tantamount to a number of sequences of probabilities and mean values of the variables of quantum physics, allow the mental associations among molecules or particles, and economic agents, or subjects. The world of physics thinking can impose to economical thought the probabilistic character of its forecasts, even in the case of a pure statistical collective, gradually eliminating the exclusively deterministic models of prognosis specific to classical economics. Probabilistic density will thus generate models for previsions s based on the probabilistic thinking structured in distinct scenarios. The merit of the quantum physics is that of acknowledging its limits in foreseeing future events, centred on the principle of uncertainty, and becoming familiar to future economics, as well. Economical thinking will also take over, in future, the simultaneity of the states of particle or wave, from quantum statistics, in an alternative approach to the various specific units defined through binary states. Finally, the quantum economics is the scientific compromise between the economic vision and quantum physics' thought. Quantum economics means also the coalition and the equilibrium between the two sciences. This coalition has three steps: a) the coalition must have "positive measure" (the coalition "matters", in the general sense); b) the both sciences (economics and quantum physics) prefer the new allocations of the common sense of thinking; c) the total endowment of the coalition must be sufficient for them to conduct to a better understanding of the economic world (more atomized and thus continuum). In his relative recently finished book, entitled "*Physical Modeling of Economic Systems. Classical and Quantum Economics"* (published in 2005), Anatoly V Kondratenko underlines that if compare quantum economics with other most known economic theories (neoclassical economic theory, institutional economics, evolutionary economics) it can be said, that quantum economics does not contradict them. Generally speaking, for the beginning, quantum economics has been considered a method for *ab initio* or *non-empirical calculations of demand and supply functions* and their dynamics or evolution in time due to all interactions in economic systems. Moreover quantum economics combines or/and unifies most important of mainstream theories and gives fruitful theoretical and computational tools for further development of them. As a matter of fact, quantum economics can be regarded as the first step in developing the 'grand unified economics' in a multidisciplinary theory, using multidisciplinary methods and models, etc. Really, on the one hand, quantum economics makes it possible to simultaneously consider influence exerted by the interaction of the economic agents (a major subject in neoclassical economic theory) and interaction of the government, society and other institutions with economic agents (subject of investigation by means of institutional economics) on the economy agents' behaviour, and on the other hand, to offer equations of motion of the economics phenomena that describe evolution of the economy in time (paradigm of evolutionary economics).

3. A FINAL REMARK

To conclude the presentation of the new model of sociophysics and quantum economics, the application of sociology and quantum theory in economics implies the fact that new systemical vision of sociology is alwazs a good option and the sum total of the information concerning a certain particle or an economic entity must be contained in the wave function or in the energy function of the economic activity which is associated to it, as the formalism of the wave functions is considered adequate, because their predictions are in keeping with the experiments and economic evolutions. The basic laws of quantum physics and mechanics describe the physics of the sub atom world, but the macroscopic world is itself a final case of that science of the greatest generality as we can see from economic point of view. In the thinking of quantum physics and mechanics, an entity of a sub atom particle, such as the electron, could behave not only as a particle, but also as a wave. This is the major change for economics' thought. Even economics' entity is not a particle, sometimes it is activity and results during the same time, like in quantum physics. That odd quantum effect is supposed to disappear, in accordance with the thinking of quantum physics, when the entities become bigger.

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