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ECONOMICS AND BIOLOGY – IN SEARCH OF COMMON GROUND

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ABSTRACT

The article touches on the issues of relations between economics and biology from economic point of view. Its aim is to try to integrate the chosen achievements of both sciences. The author, inspired by statement of Alfred Marshall, supports his position that economics is a branch of biology. Reflections on this topic enhance interdisciplinarity of such fields of study and improve our understanding of the reality. By way of analyzing literature and by using deductive and reductive reasoning relations between economics and biology are pointed out as well as implications. Also, the reasons and indications of the integration are shown as well as existing problems in such approaches.

Key words: methodology, economic theory, biological theory

INTRODUCTION

Alfred Marshall [1920] once said that "economics has no near kinship with any physical science. It is a branch of biology broadly interpreted". In spite of his words a trend in economics to integrate achievements of various sciences can be observed only recently. Interdisciplinarity makes everything more complex without a doubt but there is no turning back while it is a means of understanding reality better. Especially, a closer relation of economics and biology may advance efforts for the economic theory to accept a more realistic nature of economic agents.

Although biological theories are not to be compared with physical theories in terms of better predictability of various phenomena, the divergence between them is explained by specific conditions and nonlinear systems of observed adaptation processes. At the same time biology resembles economics in terms of creating efficient models explaining behaviour of biological systems [Krakauer et al. 2011]. Both disciplines aim at discovering laws which govern the behaviour of living creatures. Both of them feature also evolutionary logic in reasoning in the sense that agents are subject to evolutionary pressure to maximize their utility (in case of biology it is further genes replication). Micheal Ghiselin [1978] emphasizes the benefits possible to achieve when generalisations from a certain level could be used between these sciences. He notices that a field of knowledge which covers economic processes (e.g. competition) should be acknowledged irrespective of whether it is associated with humans or not. This is why he proposes to acknowledge the collection of knowledge called natural economy (biology) which is harmonised with political economy (economics), making together general economy. He is conscious though of the differences between these collections.

This article represents the point of view of an economist. The author's position is that it is essential to come back to the roots and place emphasis on science interdisciplinarity. What makes it even more urgent is that it refers to economic theory which analyses and predicts behaviour of various agents. Taking

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advantage of achievements of biology in economic theory contributes to better understanding of reality and more precise analysis of economic agents' behaviour. This paper is an attempt to broaden the existing paradigm of (neo)classical economics. The author tries to achieve it by way of deductive and reductive reasoning through the analysis of economic literature and biological theory literature.

ECONOMICS AND BIOLOGY – THE HISTORY OF EARLY RELATIONS

The very first common relations are mentioned already in ancient times when there was no division in science.

The father of economics, Adam Smith, was using the phrase oeconomy of nature especially in his *The Theory of Moral Sentiments* [1759]. What he meant was praising positive effects which were unintended but derived from an intelligent agent. This phrase was, however, taken from Carl Linnaeus in 1751. Smith was his student along with Charles Darwin. Apart from that, he based division of labour that is the foundation of economic activity on biological instinct of humans which stimulates them to exchange and trade. In the 18th century also Bernard de Mandeville [1714] was referring to biology in *The Fable of the Bees* in which he was comparing society to a hive as well as François Quesnay, fascinated by discovery of blood circulation and homeostasis of human body.

Thomas Malthus [1798] with his book *An Essay on the Principle of Population* was an important source of inspiration for Charles Darwin and Alfred Russel Wallace. Malthus' idea of struggle for existence was adapted in Darwin's theory of natural selection. The creator of the phrase the dismal science was convinced that population multiplies geometrically and food arithmetically so everybody will face natural selection in fight for survival. Gertrude Himmelfarb [1959] finds however that this idea could have been utilized by taking biological analogies attributed to Benjamin Franklin.

John Gowdy's view [1997] is that it is Herber Spencer who is the most prominent promoter of biological analogies in social science. He developed both the theory of evolution and evolutionary approach in them. It is him, not Darwin, who used the term evolution. He influenced thoughts of Thorstein Veblen and Alfred Marshall but not only theirs. He is also indirectly present in works of the founders of the Austrian School. According to Spencer, evolution is closely related to progress which is not accidental at all. It is just an inherent part of nature [Spencer 1851]. The creator of the collocation "the survival of the fittest" is indirectly responsible for the similar rule in economics which comes down to profit maximizing by entrepreneurs. It is however a notably theoretical approach in both fields of study. Herbert Simon showed in economics that the indication of rationality is making optimal choices which are not the best ones but which are good enough only. Spencer's thought about social progression through competition is still present in economic theory though.

Thorstein Veblen is thought to be one of the fathers of evolutionary economics, although he wrote an article in which he negated economics as an evolutionary science [Veblen 1898]. In his view, economic systems are subject to permanent and complete evolution but also institutions within them are subject to selection [Veblen 1919].

The aforementioned Marshall was often refererring to biology but he was not making use of it often at the same time [Thomas 1991]. He was conscious that biological concepts are very complex [Marshall 1920] and perhaps this is why he was somewhat humble by saying that a Mecca for economists is in economic biology rather than in dynamics [Marshall 1961]. He was very particular about economics taking care of human beings in a state of flux. Statistical hypotheses play only an ancillary role to what is the main point of interest of economics, that is living force and movement [Marshall 1920]. After his death interest in interdisciplinary topics including biology in social sciences dwindled [Degler 1991].

This issue witnessed a strong revival in the 1950s with the groundbreaking work of Armen Alchian [1950], although it was also Milton Friedman [1953] who paid attention to biology. A period of a certain fashion in using evolutionary analogies was very short thanks to criticism of Edith Penrose [1952]. Another wave of interest was accompanied by inception of sociobiology [Becker 1976, Hirschleifer 1977] and was

advanced since the publication of the book by Richard Nelson and Sidney Winter [1982].

A discussion in the literature about relations between economics and biology could be difficult to follow due to too many threads. A methodological indistinctness of axiological nature appeared on the horizon and it could be helped by searching for the common denominator. It seems justifiable to evaluate what biological concepts may be used in economics to help solve specific economic problems.

REASONS AND INDICATIONS FOR INTEGRATION

The author of this paper thinks there are issues which may link achievements of both sciences. They are: preferences; metaphors and analogies; evolution and evolutionism; cooperation; new science disciplines within economics.

Preferences

The problem of preferences is strictly associated with the utility theory and the assumption about rationality of *homo economicus* which was already challenged [Simon 1957]. Questions may arise here regarding the purpose of the utility function and its adaptation as well as the nature of preferences. The economists have not been carrying out research into origin and content of preferences. They have been treated as given (*De gustibus non est disputandum*).

The achievements of biology may considerably enrich the theory of economics. Biological factors are the basis of our preferences, also of these which are associated with time and risk taking. They may also supplement the economic concept of rationality. The biologists make use of this concept as well but they emphasize issues of tendency, instincts, the selfish gene, conditioning or habituation more. At the very basic level, the creation of needs may be associated with homeostasis, which relies on behaving in such a way so that the individuals try to maintain the key variables in certain limits allowing for survival and optimal functioning. It is a very simplified approach however.

The economists do not take altruism, especially towards relatives, into consideration. It is understood by them as an action beneficial for others but as a relative cost for the individual who encourages it. This topic was covered by Theodore Bergstrom [1995, 1996] who wrote about economic interactions within families with reference to biology. The newest experimental results regarding altruism and its variations were discovered by Martin Zwick and Jeffrey Fletcher [2014] although its genetical conditioning had been noticed earlier.

Jack Hirschleifer [1982] agrees that tastes are genetically controlled because they have to be permanent in the face of possible free riding activity. Our selfless or irrational aims allow us to compete better in groups in the course of evolution. Robert Frank's [1987] opinion is similar and he treats selfless preferences as genetically programmed. He makes use of Darwinian selection mechanism in his analysis and tries to explain difficult for the (neo)classical theory of economics phenomena by linking them with the utility function. Nikolaus Robalino and Arthur Robson [2013] add also that economic preferences have been conditioned by both genetic and cultural evolution.

It is worth to complement the existence of preferences to a topic of neurobiology which is associated with the brain structure. The limbic system responsible for the reward system is evolutionarily older than the frontal lobes responsible for decision taking. Equally interesting is the idea of the selfish gene [Dawkins 1976] which explains selfishness of all the living creatures. From a deterministic and teleological point of view life evolution is driven by genes (replicators) and its aim is reproductive success. In order to protect their replications genes are to create certain behaviour mechanisms which affect preferences of the living creatures.

Metaphors and analogies

Biological metaphors and analogies are used in economics but linking them purely and simply with evolution would mean oversimplification of this matter. Similarly, the approach of economists to analogous thinking may be oversimplified as well. Bruce Hannon [1997] emphasizes its meaning noting that analogies refer to creative researchers.

Elias Khalil [1998] gives five examples of metaphors and their roles in economic theory. The first metaphor of the selfish gene shows that non-human

agents allocate scarce resources and do not act selfishly according to rational optimization. It is consistent with the neoclassical theory of choice-making. The second metaphor of ecological influx explains the prowess of various (human and non-human) agents to produce surplus and it also differs from rational optimization. The third one of genotype shows how technology or institution schemes inform the development and behaviour of any organisation. The fourth metaphor of the organism explains the order of firms and states. Finally, the ecosystem metaphor explicates the order of markets which is different from the order of organisations.

Utilization of biologic metaphors by economists should be characterized by great caution. They can not be applied everywhere but they may give new insight and better understanding of phenomena. The existing metaphors and analogies can be divided into three categories [Gowdy 1997]: the ones to justify capitalism and especially markets; the ones enriching the neoclassical model with e.g. diffusion of technological innovations and decision making under uncertainty; the ones using the achievements of evolutionary biology in order to analyse nonoptimal economic results.

Evolution and evolutionism

According to Richard Nelson [1995], the state of both sciences, their tools and level of development, allow today to research and utilize the theory of evolution in the theory of economics making the analysis of societies better. It is especially useful in institutional economics in the context of Douglass North's book [1990] describing the existence of cumbersome institutions in economic history. The utilitarian nature of this topic can be observed for example in cases of such institutions as money and a firm. A novel approach to Darwin's concepts was developed by his predecessors Thorstein Veblen and Joseph Schumpeter who took a different approach at the same time.

From a methodological point of view the proponents of the evolutionary attitude reject theorising in neoclassical economics paradigm in favour of methodology of biology. George Modelski and Kazimierz Poznanski [1996] notice that such change from mechanics to biology means transition from statics (this is the nature of the neoclassical theory) to dynamics. Then the analysis moves from time free reality towards reality in which time matters. This, in turn, involves irreversibility and opens the way for history. Biology is not focused on determining but on probability and chance as well as on diversity and change. It may offer economics supplementing its theory with concepts of accidentality, irreversible change and uncertainty.

Change in economics takes place by innovations. At the micro level individuals use more and more effective technologies or they are in retreat. The cumulative effect of such changes makes new quality. In comparison to biology, the way of change is identical in other fields (market forces). Evolution is progressive and it favours agents who maximize their profits. This is the process of optimization in economics and it was mentioned also by Milton Friedman [1953] when he wrote about natural selection.

Cooperation

Competition is associated with cooperation. It is present in biology between various species but also within them. Individuals or groups of individuals (firms, industrial branches, states) who are in a certain habitat (market) compete with each other for the same resources. Economists analyse cooperation of individuals and competition between them using achievements of behavioural and experimental economics. The acclaimed game theory should be mentioned here. Peter Corning [1997] finds that this theory can support both realistic and holistic view of economic evolution. He indicates the disadvantages of game theory (the prisoner's dillema) which is to favour specific behaviour. Players can not do certain things and this implies lack of realism with people and with all the biological world because free riders and cheating can not be punished and communication is not allowed.

The explanation of rules and the mechanics of human cooperation is a big challenge to social and natural science. One of such mechanics is a strategy of strong reciprocity which is based on two pillars. The first one is based on psychological propensity to cooperate with reference to social preferences (especially altruism). The second one implies that integrity and moral feelings are biologically costly and it poses a paradox for natural selection which favours non-altruists. This

is why evolutionary mechanisms are so fundamental here because they can sustain behaviour which is not beneficial to an individual [Rosas 2011].

New science disciplines within economics

Economics now looks like a great tree with many branches but it is branches what make a tree and not *vice versa*. The process of new branches formation, that is science disciplines, has been taking place for some time now and it takes us even closer to a more realistic picture of human nature. They are supposed to be complementary to each other. Emery Castle [1999] noticed that biological concepts allow to understand institutional change better. It should occur in the theory of economics and in natural resources management.

Evolutionary economics is one of such branches. It underlines human capabilities to accumulate competitive knowledge resources and to influence institutional surroundings which affect social actions [Martens B. 2011]. It also brings out collective and environmental factors that influence individuals and tries to raise the problem of genetic conditioning which influences economic behaviour.

Behavioural economics came into existence due to discovery of a departure from homo economicus rationality. Its representatives study how cognitive limitations of humans, their attitude towards risk, social factors, influence the process of decision making. They utilize the achievements of biology including those regarding the structure of brain and its functioning. Human mental skills which have developed through natural selection are somewhat limited and this fact is taken into consideration in behavioural economics. Heuristics, cognitive limitations in information processing and decision making are among them. Ulrich Witt [2011] says that, with very few exceptions such as Daniel Kahneman and George Loewenstein, the omitted aspects of this branch are motivational dimensions of behaviour that is where comes motivation from and how it changes over time.

Ecological economics studies the issues at the intersection of economic systems and biophysical world. From a biological point of view which is neglected by economists present economic activity has an adverse effect on the environment and it is impossible to sustain it in the long run. Some say that economics and ecology are two separate systems that are not to be compared with each other [Vedeld 1994] but there are also opinions that ecological issues may broaden the theory of economics providing a new perspective on economy and nature [Binswanger 1993, Ring 1997]. Certain theoretical achievements regarding problems of the natural environment in the face of limited resources may improve interaction and influence of humans on the flora and fauna [McCoy 2003].

Bioeconomics which came into being in the 1970s is to integrate economics and biology in order to enrich both disciplines by way of expanding their theoretical and empirical basis. Economists may take advantage of economic policy implications for the benefit of the people [Landa and Ghiselin 1999]. Issues covered by this discipline include information processing by the brain, rationality and preferences of humans.

ISSUES CONCERNING THE INTEGRITY APPROACH

In author's opinion, few issues arose while integrating economics with biology: the problem of the agent; reductionism; building models; taxonomy.

The problem of the agent

With intergration of economics and biology a question arises about the subject of research being treated in a similar way. Micro- and macroeconomics study individuals or aggregates such as consumers, households, firms, organisations, states. Nevertheless, biologists are interested in other subjects such as bacteria, cells, organisms, herds, colonies.

Comparing firms and organisms with each other creates three kinds of problems. The first one is associated with purposefulness in contrast to optimisation. The second one concerns the status of attributes or behaviour. The third one regards organisations' coherence. This division is suggested by Elias Khalil [1997] and it can be also considered from the point of view of naturalists and their opponents.

Reductionism

A reductionist method as a paradigm of scientific methodology means treating phenomena and complex processes in a simplyfying way or it means explaining

complex phenomena through description or explanation of their fragments. Reductionism is very common in the theory of economics and in other science and it can be especially helpful in searching for common ground for economics and biology. Economists tried to develop macroeconomics in the 1970s on a solid microeconomic basis but they started to turn to the game theory and psychology in the face of difficulties they came across. It turned out that mathematical analysis of behaviour did not come up to expectations. It was Alan Kirman [1992] among others who thought that analysis of individuals should be abandoned.

Complete reductionism is wrong because higher complex systems are not just a sum of lower systems and they are also characterised by new qualities impossible to explain by looking at their fragments only. Science can not do without it to a certain degree however. Each measurement, experiment and theory are its manifestation. A challenge here is to find the golden mean. Tony Lawson [1985] finds that no particular level of analysis should be favoured because all fragments and systems are inextricably bound up with each other.

Building models

A notion that people are not the only species in the dynamic ecosystem of this planet is a new perspective for economists. This fact should be incorporated in their models and it is all the more reason that people's life is dependant on other species.

Modelling simplifies reality and certain models are applied in theories and may be used for convenience of analysis and not because they are close to reality. This problem relates to both economics and biology and it may even be highlighted in an attempt to integrate them. Till Grüne-Yanoff [2011] thinks that economists have been using biological concepts uncritically in their models (e.g. selection and replication) but there are reasonable possibilities to interpret them in order to explain social situations. Collin Rice and Joshua Smart [2011] draw conclusions on importing models from various disciplines. Moreover, they identify and analyse specific strategies as well as utilise premises and theories from other disciplines. Achievements of other sciences may be useful. They may allow for right conclusions if used reflectively and carefully [Martens J. 2011].

Taxonomy

It is the science derived from biological sciences employed originally to name, describe and classify organisms. It is now used also in other disciplines, e.g. in economics to make stock portfolio.

The aforementioned Alfred Marshall [1920] may be ac-kowledged as one of the very first economic taxonomists but his opinions were very general. Michael Ghiselin [1978] with his proposal to divide economics into political, natural and general made a step forward with his precision treating biology as an economic discipline.

CONCLUSIONS

There is a growing tendency in science to cross particular disciplines. It is not the easiest process in the case of economics and biology but a slow incorporation of their achievements allows for more realism in theory. Empirical economic analysis is usually in accordance with the paradigm of neoclassical theory but some studies of e.g. indifference curves and isoquants do not yield results in conformity with reality. In the face of the above the Marshall's words of economics as a branch of biology seem understandable. Kenneth Arrow [1995] was not the only one who figured that the idea of what comprises the economic theory would have to change and that the biological paradigm was more appropriate for economics than equilibrium models analogous to mechanics.

It is assumed in the analysis of the decision making process that humans are rational beings. It turns out that some tools and theories used for other species may also explain some behaviour in economics. Economics and biology can be complementary to each other because they have more in common than they have differences. We can not be too optimistic, however, in joining them together. Great care subject to discussion is advisable here.

The author of this paper had to solve the perennial dilemma and decided to choose a relatively broad range of issues. The opportunity cost in this case is the depth of analysis. It is also obvious that some issues are omitted because this paper can not exhaust the topic. There are still no exhaustive answers to many questions. These may be got after further research.

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EKONOMIA I BIOLOGIA – W POSZUKIWANIU WSPÓLNEGO MIANOWNIKA

STRESZCZENIE

Artykuł porusza problematykę związków ekonomii i biologii z punktu widzenia ekonomisty. Jego celem jest próba integracji wybranego dorobku obu nauk. Inspirując się słowami Alfreda Marshalla, autor wspiera jego twierdzenie, że ekonomia jest dziedziną biologii. Rozważania tej tematyki wpływają na rozwój interdyscyplinarności dziedzin naukowych i przyczyniają się do lepszego zrozumienia rzeczywistości. Przy wykorzystaniu analizy źródeł oraz rozumowania dedukcyjnego i redukcyjnego wykazano związki między ekonomią i biologią oraz przedstawiono implikacje z tego wynikające. Ponadto scharakteryzowano przyczyny i przejawy integracji oraz istniejące problemy w integracji podejść.

Słowa kluczowe: metodologia, teoria ekonomii, teoria biologii