Biology and Economics: Metaphors that Economists usually take from Biology

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Introduction. I. Economists and Biology: Some Origins. II. Direct links between Economics and Biology. III. Some Ideas from Economics and Biology. IV. Some Examples: From Biology to Economics and vice versa. Conclusions. References.

Abstract: Adam Smith, Alfred Marshall, Stanley Jevons, Karl Marx, Francois Quesnay and Joseph Schumpeter all have at least one thing in common: they used biological metaphors when speaking about economics. Nonetheless, today, this relation subsists and biology and economics are viewed as complementary sciences that have a lot to gain from joint research in fields like: evolutionary economics, economic growth, cognitive economics and environmental and ecological economics, among others. This paper, divided in four sections, will show this conclusion and explain that biology and economics are more sisters than strangers.

Key words: biology, economics, evolution, metaphors.

Resumen: Adam Smith, Alfred Marshall, Stanley Jevons, Karl Marx, Francois Quesnay y Joseph Schumpeter tienen todos algo en común: todos usaron metáforas relacionadas con la biología cuando hablan de economía. Sin embargo, hoy esta relación existe y biología y economía son vistas como ciencias complementarias de las cuales ambas tienen mucho que ganar en la realización de investigaciones conjuntas en campos como: economía evolucionaria, crecimiento económico, economía cognitiva, economía ambiental y economía de la ecología, entre otros. Para tal propósito, este artículo se ha divido en cuatro secciones que mostrarán esta conclusión y explicarán que la biología y la economía son mas hermanas que extrañas.

Palabras clave: Biología, economía, evolución, metáforas.

Clasificación Jel: B00, B41, N01, Q00, Q57.

Biology and Economics: Metaphors that Economists usually take from Biology

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Introduction

Classic and modern authors in economics use metaphors constantly. It is a way of argumentation that sometimes can even be an example simultaneously and, consequently, convince and make understand a reader an idea or theory. However, it seems as if economics has always taken a big amount of its metaphors from biology and perhaps even their methods. That is why some authors like Alfred Marshall point out that biology is natural economics (Ghiselin, 1978) or combine both sciences to say that they form a branch called general economics. This article intends to explore that relation and show that indeed biology and economics have more in common than normally thought and that significant gains can result from associations between scientists of both areas.

In order to show the importance of biology and economics as complementary sciences, some papers and classic and modern literature will be addressed. It will be shown that concepts like competition, equilibrium and markets have applicability in both fields of knowledge. And it will even be suggested that authors from schools on either side have been inspired in economic or biological facts in order to build their theories or form there ideas. Finally, it will be concluded that fields like evolutionary economics and economic growth, cognitive economics, consumer theory and specially ecological and environmental economics can have significant outcomes from joint research.

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For methodological purposes, this paper will be divided in four sections: economists and biology: some origins, direct links between economics and biology, some economic ideas and biology and some examples: from biology to economics and vice versa. In each one, the reader will find explicit relations drawn between economics and biology; nevertheless, in the first section a point of view related to some classic authors is established. However, the major emphasis of this relation is done in the second and third sections and later presenting in the fourth section some advantages of combining biology and economics.

I. Economists and Biology: Some Origins

One of the first to use biology or biological metaphors in economics was the Dutch Physician Bernard De Mandeville in 1714 in his *Fable of Bees,* where he argues that evil vices lead to public benefits. Even though he did not appoint a metaphor, his title of distinguished physicist makes it mandatory to mention him: Sir Isaac Newton, who wrote about inflation in his paper *Representations on the Subject of Money.*

Adam Smith, David Ricardo and Karl Marx also used biological metaphors to explain or form economic theory (Wyatt, 2004, 246). As Hirshleifer (1978, 238) mentions, the relation between economics and biology cannot be more straightforward, even Alfred Marshall said that economics is a branch of biology or as he points out, according to Ghiselin (1978), biology is natural economics.

In the same sense, physician Francois Quesnay also related economic relations with biological references. He pointed out, in his theory, that the natural state of the economy can be described as a situation were the circular flow of income between economic sectors and thus social classes sought to maximize the net product, and compared this idea with the circulation of human blood and homeostasis of the human body (Spencer, 2000).

William Stanley Jevons, associated periods of recession and growth with the regularity of sunspots, and maybe he was not wrong; Fulmer (1942) shows that yields of cotton, apple, winter wheat, peaches and peanuts depend on solar and sky radiations, among other factors. However, priorly Garcia-Mata and Shaffner (1934, 21 and 26) established a statistical correlation between solar sunspots or the Spoerer law cycle and business cycles, restating the biology economics link. Therefore, aggregate economic fluctuation could be related with environmental phenomena and then it is plausible to insist in the common connection between economics and biology.

Similarly to Jevons, Henry L. Moore (1914 and 1967) related business cycles with weather cycles and the position of planet Venus. Analogously, Johan Akerman connected them with the consequences of small weather driven season cycles. Following comparable theories, Huntington (1916) corroborates and analyzes the relation between economic cycles and climatic variations, concluding that the theoretical proposed idea is in fact empirically valid. Thus, not only in theory but in practice a relation between biology and economics is established by these early economists.

Another distinguished economist that has been related with biological metaphors is Joseph Schumpeter. However a debate about if he was or not an evolutionary economist has been recently revived. Even though several have argued that he was not, Hodgson (1997) shows that the critics were wrong and that he indeed can be catalogued as such, nonetheless Schumpeter mentions that metaphors between economics and biology should be established with carefulness. Nevertheless, analogies between economics and biology have long been used and will continue to be seen in the dismal science.

II. Direct links between Economics and Biology

Economics has an important link with biology, especially with sociobiology (Hirshleifer, 1977). The similarity is such, that in economics we analyze agents that are supposed to choose the alternatives or actions that optimize their economic decisions; similarly in biology it is said that entities choose the strategy that will allow their success or survival in relation with other species, phenomenon denominated adaptation (Hirshleifer, 1977, 2, 48 and 50). In consequence, some methods and analogies used in economics are applicable in biology and vice versa.

Ropke (2004, 296), also points out that economic phenomena can also be seen as a natural process therefore it can be analyzed as a biological process and change. Recently, Galor and Moav (2002) develop a theory of economic growth related to the evolution of mankind and with the appearance of the human specie, demonstrating that the border between economics and biology is getting thinner and thinner as time passes by.

In accordance with the previous idea, Hodgson (2002) argues that Darwinism is inherent to economic theory and not as some say: inappropriate to analyze economic phenomena. He adds that it has cooperation and competition, both present in economic and biologic systems, and this theory has several similarities, nonetheless we must view it as a complement since

we cannot deny that there are other principles and actions of pure economics that cannot be found in Darwinism. However, it is possible to conciliate both visions. Hodgson (1996), for instance, proposes an economic growth theory related with evolution and thus with biology.

Controversially, the idea of "survival of the fittest" has caused much debate and it is still in use to justify neoliberal and market freedom ideas (Dowdy and Seidl, 2004, 344). The notion of the selfishness gene as a way of saying that human selfishness comes from a microbiological suggestion and therefore consistent with natural biology theories of species survival, imply the equivalency in human and specie choices and thus a consistent and self-centered election present in all nature (Dowdy and Seidl, 2004, 346). However humans can be prosocial or altruistic, that is, take decisions that can benefit the group even though it does not benefit him, standing aside from the natural gene paradigm, but justifying the need to make joint research in economics and biology.

There is no doubt that the economic evolution found in the neoclassical economic theory is comparable to the ultra-Darwinian point of view in evolutionary biology (Gowdy, 1997, 380). The concept of progress implicit in Darwin is one of economics where the accumulation of adaptations is closely related to technological innovation (Ghiselin, 1995). But, naive theories of market efficiency should be left behind in order to make good policy recommendations. That is why we should look at evolutionary biology to understand more the coevolution of the society, environment and economy (Gowdy, 1997, 380); a complex system in a dynamical world.

But other links can be established between economics and biology. For example, game theory is not only successful in economics but in biology too, nonetheless it has currently more advantages and applicability in economics (Robson, 2001, 12). Division of labor is inherent to human processes and animals in a process denominated adaptive radiation (Ghiselin, 1978, 234), making more connections that tie both sciences in similar directions. Furthermore, maybe rationality is more present in the social context. Experiments in chimpanzees show that they develop more intelligence than required in their environment because of social interactions (Robson, 2001, 28), maybe this is also the case for human beings.

The relation between economics and biology is fruitful and there are common research topics yet to be exploited with more deepness (Samuelson, 1985). Nonetheless, several topics have already been analyzed jointly: signaling, markets, statistical reasoning, cooperation, punishment, reputation and social

norms; one of the promising fields of joint research is neuroeconomics, especially because its relation with consumer theory (Hammerstein and Hagen, 2005).

Then, there can be no doubt that new discoveries in biological basis of human behavior will have an important impact in explaining the way we understand people's actions and relations (Bainbridge, 2003, 643). Also, cognitive economics with the idea that the *homo economicus* takes decisions that depend on psycho-neurobiological factors, is foreseen as a future important field of research that is already being studied (Rizzello, 2003).

The relation between evolution and economics is also pointed out in several papers summarized by Modelski and Poznanski (1996). And, even though the complexity of interrelating evolution theory and economics, current tools and developments in the dismal science allow these ideas to be studied and therefore incorporate them making economics a more evolutionary science and thus stronger to analyze the complexity of society (Nelson, 1995).

III. Some Ideas from Economics and Biology

Economics has been increasing the use of mathematics tools in its interpretation of the world. That has given economists the possibility of looking to other sciences like biology and physics and trying to take advantage of their methods. For example, when using differential equations and encountering complex roots in a problem, it is normal to introduce such case with an example of Hooke's law, that is, that the force on a frictionless spring is proportional to the displacement of the spring from its equilibrium point (Simon and Blume, 1994, 636).

Nonetheless, when speaking about Malthus's law, that is, assuming a constant percent rate in population growth, it is compared with the growth of species and bacteria, for example. Or, when discussing about the possibility that a firm survives in a market or not, a parallel is drawn with the prey-predator model in order to argue that competition is like natural evolution: only the strongest survives and firms do not tend to cooperate but to take out of the market their competitors.

Another metaphor, but in this case related to physics and microeconomics, is given by Varian (2003) when he says that the laws of economics–microeconomics–act like the laws of physics on a pool player, friction and gravity are there even though the player is not aware of it. The same happens to the economic agent, when he goes to market he is not thinking–literally–that

he wants to maximize his utility subject to his budget constraint, but he is acting as if he did exactly that.

In development economics there is a theory called the periphery theory, were it is established that two developed centers, cities, regions or countries will have more economic relation–like commerce or capital flows among them–among them or be more attracted the bigger they are. This is taken directly from Newton's gravity theory, that is, two objects or planets in space will be more attracted to each other the higher the mass they posses.

IV. Some Examples: From Biology to Economics and vice versa

Some argue that biology and economics form a single branch of knowledge. Natural economy (biology) plus political economy (economics) form a branch of knowledge that could be called general economy (Ghiselin, 1978, 233). What seems to be supported by Adam Smith's invisible hand seems to have been an inspiration for Darwin (Robson, 2001, 11), and self interest and profit maximization became for Charles Darwin the effort for species to reproduce successfully (Robson, 2001, 11).

Biologists have also used analogies from economics (Ghiselin, 1978, 236), but the simile from the dismal science to natural science is also possible, for example, firms are relative to species and employees to organisms (Ghiselin, 1978, 237). In the paper written by Robson and Kaplan (2005, 18), costs and benefits, in an opportunity cost sense, are related to problems like mutation, aging and immunity, all biological concepts, implying similar relations to the ones previously mentioned.

Additional comparison can be made with concepts and situations like scarcity, competition, equilibrium and specialization; all concepts that have common grounds in biology and economics, but such similarities also appear in fields like mutation/innovation, optimizing/adapting and evolution/progress (Swanson, 1979, 853). Also, metaphors as relating organisms with firms, genotype and technology/institution and ecosystem and market (Khalil, 1998), can be laid.[2] Also, when studying entrepreneurship, Greenfield and Strickon (1981) use a population model with biology as its root metaphor, confirming the possibility of analyzing economic relations in biological frameworks.

2 A complete paper with bibliography related to Biology and Economics (Ghiselin, 2000).

Nevertheless, the relation between economics and biology and the metaphors are taken from one science to the other without showing a one way relation. Specifically biology, for example, uses economics and precisely division of labor and trade to explain how modern humans surpassed the obstacles that Neanderthals could not overcome (Horan *et al.,* 2005). However, not all biological points of view can be used in economics, and cautions should always be beard in mind when relating concepts and theories.

But specific fields in economics like environmental economics can have big gains from incorporating biology into their analysis. For instance, when thinking in conservation, economic and biological effects should be addressed; implying that ecologists and economist should work together (Doherty *et al.,* 1999), as biology and economics should look as complementary sciences. This is illustrated in the case when analyzing a fishery. There, biological and economic objectives should be taken in account as shown by Ami *et al.* (2005). Also, authors like Hannon (1997) develop a framework for ecology that is in accordance with economics and gives consistency to their combination: ecological economics, a field of biology and economics.

Economic and biology must be seen as a complement to each other, especially when addressing environmental or ecological issues. Such is the case of Gottfried's *et al.* (1997) paper where to analyze dynamically shrimp ponds and mangroves in Ecuador both a biological and economical perspective were adopted. As Castle (1999, 301) points out concepts from biology give a better notion of our understanding of institutional change what should be taken as a matter of importance in natural resource economics and in economics in general. And overall, payoffs can be obtained by taking in hand both biology and economics to analyze social phenomenon, after all, as Aristotle said: "humans are rational animals".

Conclusions

Classical authors like Adam Smith, David Ricardo, Francios Quesnay and Karl Marx have been inspired by biology and have used metaphors from this science in order to demonstrate their points of view. Nonetheless, current authors are also influenced and were influenced in the past century: Alfred Marshall, William Santley Jevons, among others.

Analyzing human beings implies understanding a specie that is a rational animal, therefore, some tools and theories applied to other species would explain certain behaviors in economics. But, since economics has developed a

framework based on equilibrium, competition and markets, these theories can also be applied with success to biology since, at the end, they share common grounds.

Finally, fields like evolutionary economics and economic growth, cognitive economics, consumer theory and specially ecological and environmental economics can have significant outcomes from joint research. Economics and biology are two complementary sciences and are away from being disjoint. They have much more thing in common than things that bring them apart.

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