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# A Current Perspective on the Relationship between Economics and Physics

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**Abstract:** If we recognize that the foundations of modern economics were laid by Adam Smith's famous work "Wealth of Nations", we see that economics has interacted with other disciplines for almost two and a half centuries. Among these disciplines, the place of physics is undoubtedly several steps ahead of others. In the course of this interaction, economic theory was also influenced by paradigm shifts in physics and developed in a continuous evolution. By the end of the twentieth century, the concept of econophysics appeared, as statistical physics was mainly used by various scientists to understand economic phenomena. This article discusses the relationship between econophysics and the field of economics, especially financial economics. Why econophysics is seen as a different discipline is explained based on the working methods and assumptions of both scientists.

**Keywords:** Econophysics, Economy, Financial economy, Physics.

**INTRODUCTION:**Economics has undergone many changes and developments in the two and a half centuries since it laid its modern foundation with Adam Smith's famous work The Wealth of Nations (1776). During these paradigm shifts, debates and compromises, the relations of economics, a social science, with other sciences also changed, and in some periods it had more active relations with other social sciences, and at the same time, there were such times. his interaction with the physical sciences was high. The interaction of economics and physical science is probably one of the most decisive factors in the process of economics becoming or developing into a science.

Throughout their development from the classical to the neoclassical, economists were inspired by the conceptual and mathematical developments of the physical sciences and their remarkable success in describing and predicting natural phenomena. Adam Smith was undoubtedly influenced by the work of Newton, the founder of classical physics. The elegance that Newton's laws of motion brought to physics was something that scientists in other disciplines of the time emulated for their own fields. Taking into account that physics imitates the position of physics in the physical sciences in the process of scientificization of economics, it switches to using mathematics for this purpose, Classical economics with Newtonian physics and Euclidean geometry, Neoclassical economics with thermodynamics and differential calculus, Einsteinian physics. and Riemannian geometry and Keynesian economics, quantum physics and topology. The approach of general equilibrium economics is also important for understanding today's interactions.

The direction of this interaction was mainly from physics to economics. One of the reasons for this is that it has some of the most advanced computational methods in the sciences outside of the theoretical approaches of physics. However, there are also important names who studied physics and contributed to economics. Alphonse Quetelet (1796-1874), Léon Walras (1834-1910), Vilfredo Pareto (1848-1923), and Robert Gibrat (1904-1980) all contributed to economics by studying physics or engineering.

There are many differences between the methods of studying natural sciences and social sciences, examining phenomena and testing their hypotheses. Despite the problems of science amenable to experimentation and replication, the social sciences are primarily concerned with people and human-made social structures, which are inherently variable. This article examines the past and present state of interaction between social sciences, natural sciences, physics and economics, and presents the relatively new concept of econophysics and the debates surrounding this concept.

**Economics and physics**

If the 18th century is accepted as the century in which the foundations of economics were created, it can be said that the interaction of these two sciences began in this century. In Adam Smith's laws of supply and demand, one can see traces of Newton's laws of motion, especially the third law that every action produces a reaction. Early economists tried to see the economic system as a mechanical system and to justify their analysis in the same way as physicists or engineers. Arguably, the only difference is that in science, experiments form the basis of theories, while in economics, observations serve the same function. At the end of the 19th century, inspired by some ideas of physicists Francis Edgeworth and Alfred Marshall, the economy came to equilibrium, just as Clerk Maxwell and Ludwig Boltzmann proposed for gases.

This interaction also manifested itself at the beginning of the 20th century. Mathematician Louis Bachelier developed a mathematical theory of diffusion during his attempts to model the movement of stocks and bonds on the Paris Stock Exchange, and soon after, Albert Einstein proposed the theory of Brownian motion based on the same diffusion equation. Einstein's theory, whose contribution to quantum physics cannot be denied, is one of the main theories applied to the movement of stock prices, especially in financial economics.

**Criticisms and implications of the new physics**

It seems that throughout the historical process, economists have generally imitated the scientific power of physics in the natural sciences, but have not wanted to follow the changes that physics has undergone in the 20th century. It can be said that since the beginning of the 20th century, there have been paradigm changes in both physics and other natural sciences. The work of Einstein and others, the theory of relativity, and the birth of quantum physics brought many innovations. Established theories in natural sciences such as physics and later chemistry and biology were challenged. The economy was less affected by this change compared to previous experiences. Theoretically coherent and elegant mathematical models were insufficient to explain the facts because of the limited assumptions on which they were based. While the natural sciences have focused on disequilibrium, economists have continued to analyze equilibrium in which a perfectly informed, rational, and impartial homo economicus occurs, and dynamic behavior is exogenous. One important example of these is the general equilibrium paradigm.

The general equilibrium paradigm of Leon Walras, one of the representatives of the neoclassical movement, parallels 19th century physics in almost every respect. Walras has been widely criticized in his work, claiming that he either misrepresented the mechanics of his theory or misunderstood the mathematics. Mirovsky's findings that neoclassical economics takes developments and fundamental elements from physics and introduces them into economics and therefore has blind spots is one of the important criticisms leveled against neoclassical economics, along with quantum mechanics. Although Mirovsky's theses were criticized and some mathematical errors were found in his findings, Mirovsky achieved a serious intellectual formation in economics. At this point, it would be safe to say that as physics changes dimensions with quantum mechanics, ideas, desires or thoughts cannot affect what happens.

The concepts of uncertainty and complexity are gaining importance. The approaches of physicists and economists to the analysis of these concepts differ sharply. Today's economic approach ignores uncertainty and attempts to fill this gap with concepts of risk and expected return. The quantum revolution in physics ended the deterministic approach brought about by Newton's classical understanding. An example of this is Heisenberg, who in 1927 suggested that the position and velocity of a particle cannot be determined simultaneously. While physics embraces uncertainty, especially at the micro level, the search for certainty in economics has continued.

**A new approach in economics**

The field of econophysics is a field that arose as an attempt to explain some issues in economics, particularly in finance, mainly with the help of statistical physics. Although some schools have emerged in this field since its inception, the most influential among them is undoubtedly the Boston School. Of course, this concept is due to the fact that the physicist Eugene Stanley, who presented this concept at a conference in Calcutta in 1995, is in the physics department of this university. Although it is still a new field of science, statistical physics, especially its efforts to explain financial phenomena, is attracting more and more attention of physicists every day. So what motivates physicists to study the social sciences? Physics is concrete and specific and derives its predictive power from certain universal truths; However, the question arises whether such truths exist in the social sciences. Given the complex world of humanity, is there any information that could explain this? A pioneering paper on this topic was written by Majorana. This article establishes the relationship between statistics in the physical and social sciences and focuses on the similarities. At first, it was noted that two very different disciplines have important similarities. One of the most important similarities is that both disciplines look at things from different perspectives.

Rohner responds to criticisms of why physics should have a say in the social sciences by arguing that physics contributes to the social sciences by providing an experimental methodology. Physicists, especially statistical physicists, are undeniably experienced in working with data. Given the availability of large-scale data in economics, especially in finance, the existence of various distributional properties and power laws governing these data and their possible consequences can be included among the main areas of interest in econophysics. The impact of increasing computers and computing power on the development of data-driven methods is also significant.

Nowadays, since computers have the ability to process large amounts of data and simulate stochastic processes, there is no need to strive for simplicity, no matter how complex it is. Economic systems are complex systems that interact with each other and contain large amounts of numerical data (most of which have never been verified). The study of the statistical properties of these data has attracted the attention of scientists for a long time. The variance of the distribution of financial time series was first revealed by the mathematician Mandelbrot. It has been observed that stock market index returns do not follow a normal distribution (Gaussian) but exhibit fat tail behavior. However, stylized effects such as volatility clustering and leverage effects have also been observed in various studies. Due to the inability of economic theory to explain empirically observed non-Gaussian distributions, the approach of econophysics came to the fore. Distributional properties of financial time series are still one of the main topics of econophysics. According to Richards, one of the greatest contributions of econophysics to the literature was to show that financial time series have fractal properties.

**Breakdown points**

In the last 15 years, the relationship between econophysics and economics has not strengthened, on the contrary, the gap between them has widened. A lack of methodological consensus may account for the widening of this gap. In mainstream economics, economic phenomena are modeled by working with a priori models. The basis of this approach is that the importance of data is not taken into account. Econophysics, on the other hand, starts with data and moves away from a basic model approach. In this context, they often ignore the assumptions of mainstream economists. In reality, these assumptions are not met, especially in complex fields such as finance, leading to poor explanatory power of the models. Economic assumptions are aimed at simplifying real situations. But physicists have no such goal. They try to understand real situations through images. Schinkkus argues that economics, which has been criticized for being sterilized and simplified by various axioms, is not even a science in this sense. He also argues that econophysics, which rejects mainstream economics with some of its views, is not a new approach, but a new science.

**Summary:**Since the 18th century, economics has developed in collaboration with many other sciences and has taken its current form. Among the sciences with which it cooperates, the place of physics is clearly different from others. Economics based on 18th century physics and laws of motion changed with the rise of quantum physics in the 20th century. Along with physicists, economists also contributed to this change. In particular, criticisms of neoclassical economics contributed greatly to the development of economics. With this development came different views in economics. The most important of them is financial economics, which uses quantum physics without deviating from the basic principles of economics, and econophysics, which uses similar methods, but puts forward the idea that all foundations should be created with knowledge obtained through experiments. This article discusses the approaches of economics and econophysics to economic phenomena and how they differ from each other. Apparently, the main difference is that economists are based on a data-driven approach, while economists try to draw conclusions based on certain assumptions. For this reason, views that econophysics is a different science began to appear in the literature.

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