# Is Economics a Science? Social or Biophysical?




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## 17.1 Introduction: Much Early Economics was Biophysical

We start with a review of the basic ideas of some important economists as given in ▶ Chap. 2. Economies exist independently of how we perceive or choose to study them. For more or less accidental reasons, we have chosen over the past 140 years to consider and study economics as a *social science*. The present social science focus, however, was not particularly the case with earlier economists, before, say, 1880, who were more likely to ask "where does wealth come from?" than are most mainstream economists today. In general, these earlier economists started their economic analysis with the natural biophysical world, probably simply because they had common sense but also because they deemed inadequate the perspective of earlier mercantilists who had emphasized sources of wealth as "treasure" (e.g., precious metals) derived from mining or trade or plunder. In the first formal school of economics, the French *Physiocrats* (e.g., Quesnay 1758; see Christensen [1, 2]) focused on land as the basis for generating wealth.

The biophysical perspective continued with Thomas Malthus' famous *Essays on Population* (there were six of them), which assumed that human populations would grow exponentially—because it seemed unlikely that anyone would control the "passion between the sexes"—unless somehow "checked" by factors that either reduced the birth rate or increased the death rate. Since Malthus had little faith in the "moral restraint" of the working classes and believed that birth control was "vice," he recommended a rather Draconian social policy to increase the death rates among the poor. In Malthus' view, the agricultural production needed to feed this exponentially increasing human population could grow only linearly, i.e., less rapidly than the number of humans. He also opposed the importation of cheaper continental grains to England, as a limited food supply assured increasing rents for his patrons, the landed aristocracy, and squeezed the profits of the rival capitalists. It was this view—that the human prospect was limited by inadequate food supplies and that class conflict was inevitable—that led the Victorian philosopher Thomas Carlisle to give economics the label of "the dismal science." This was because, in the mind of Malthus and other classical political economists, the limited amount of fertile land (a fixed factor of production) ensured that wages would tend towards a meagerly subsistence level. Adam Smith and other *classical* economists focused on both land and especially labor as means of transforming the resources generated by the natural world into materials that we perceive as having wealth. Later, David Ricardo made important observations about the general need to use land of increasingly poor quality as populations (and hence total agricultural production) expanded. Even Marx, while focused firmly on labor, was keenly interested in the long-term adverse effects of large-scale agriculture on soil quality and wrote a great deal about the degradation of the soil in his chapters on ground rent in the third volume of *Capital.* He firmly believed that capitalism exploits the land in the same way it does labor. Marx was an avid follower of the breakthroughs in agricultural chemistry and was especially impressed by the work of Justus von Liebig, who considered English "High Agriculture" to be a generalized system of robbery. Unlike traditional agriculture where crop wastes were returned to the soil, early industrialized agriculture shipped the food to urban areas where the food waste became pollution instead of fertilizer. The important thing is that all the important early economists were all explicitly biophysically based, at least as much as they focused on the social or human aspects of the economies they were trying to understand.

But in the 1870s, these at least partly biophysically based perspectives in economics were displaced by the *marginalist revolution* of William Stanley Jevons, Karl Menger, and Leon Walras. Their perspective was based on abstractions such as "subjective utility" that ignored, essentially for the first time in economics, measurable physical inputs and outputs of material or energy. This novel approach to economics was called *neoclassical,* and the ideas of the marginal revolutionists still dominate today. In the words of the early marginalist Frederic Bastiat: "exchange is political economy." Hence production, a biophysical perspective requiring a knowledge of the natural sciences, became a less important, even nonexistent issue to economists compared to market-based human preferences, and the commonsense biophysical basis for economic analysis was snuffed out intellectually, although of course not in real economies. By the early twentieth century, land (representing all of nature) was simply omitted, along with energy (which had never been considered), from neoclassical production functions. Generations of economists subsequently have

been trained from a perspective that is divorced from biophysical reality except, occasionally, as it affects prices, within a worldview that is often extremely mathematical, theoretical, and even doctrinaire. On the other hand, one might say that neoclassical economics does a good job of reflecting the human characteristic of a desire for more of whatever and the reality that much of what happens within economics does indeed occur within what we may call markets. But the overall movement was away from economics being based on material reality and hence amenable to the tools of natural sciences, to one focused on the human or social perspective; in other words, the intellectual basis of economics changed from one that is quite comfortable with the natural sciences to one that is viewed and studied only as a social science.

Although conceptual economics divorced itself from biophysical reality, this was not the case, at least in theory, in one respect, which is with respect to the development of the underlying mathematical theory. At the turn of the last century, economists chose physics (and, more explicitly, the analytic mathematical format of classical mechanics) as a model for capturing the essence of their discipline. This is reflected in the familiar graphs and equations of commodity value and cost vs. quantity, with price determined as the intersection of downward trending demand curves (derived from utility curves) and upward trending cost of supply curves. Although physics served as the model and its intellectual popularity as the motivation, the resulting economic model was physically unrealistic because it represented a dynamic, irreversible process with a static and reversible set of equations as the conservation principles that constrained the equations of physics, were incompatible with capital accumulation and, indeed, growth or even production in the economists' model [3]. Thus in an irony that has escaped most if not all economists, the attempt of economists to add rigor and respectability to their endeavor by emulating physics in fact violated the second law of thermodynamics, something that would disqualify it immediately within physics.

### 17.1.1 Economics as a Social *Science?*

So far we have focused on whether we should use the word "social" (vs. "natural") in our consideration of the words "social science" as used as a descriptor of economics. Now we want to focus on the use of the word "science" in that descriptor. Banker DeLisle Worrall has said recently (and we agree) [3]:

"There are no laws in economics. A law in the physical sciences, as Beinhocker reminds us is a *universal regularity with no known exceptions*. There is nothing in economics which meets that standard. What we have are theories: explanations for why regularities exist and explanations of how they work. We need to desist from writing papers that "prove" theories; they always turn out to be mathematical exercises of no practical relevance, yielding no insight about how the economy really works. In our empirical work we must accept the reality that the limitations of model specification, measurement error, choice of proxy variable, etc. are so formidable that we can never "prove" anything in economics by appealing to the numbers."

So if we are to take this position, and we do, we have to ask why, then, is economics called a social science, or indeed any kind of a science, if it has no ability to generate laws that we can count on? Why do so many important Wall Street financial institutions turn over their analyses to highly mathematical (but barely financially literate) "quants" when they universally led their institutions and their investors off the cliff? [4].

This reintroduces the most basic message in our book. Should economics be principally about the social sciences, about human wants and desires and the ability of markets to fulfill these optimally, as most economics textbooks would say, or should it be about the biological and physical (i.e., biophysical) conditions that are behind the generation and even distribution of wealth. We believe that of course it should be some mixture, but we also believe that by focusing almost entirely on the social science aspects of economics while essentially ignoring, and even discounting, the biophysical aspects, conventional economics has failed in many ways to understand the processes that are in fact the essence of economics. Consequently mainstream, exchange-based economics is completely inadequate to deal with the new realities imposed upon the world by peak oil and the many issues associated with the end of what has been essentially a "resource free for all on a relatively uncrowded planet." But the planet now is very, very crowded, and depletion is increasingly important for many, probably most, of our resources. Economic theories and concepts can make only a

small impact on mitigating these basic problems. Hence we need a whole new approach to economics, one that not only recognizes but is based on the resources themselves, not the prices they command. We call this new approach biophysical economics, and this book is its first synthesis.

Economics as presently perceived may be the most widely, consistently, and incoherently taught course in American higher education, and the same is likely to be true in most other countries. By *widely* we mean that there may be more young people taking an introductory economics course than nearly any other single course in college except perhaps biology, or college algebra, or college composition. By *consistently* we mean that in preparation for writing this book, we reviewed about two dozen basic economics books and found that they are mind-numbingly similar, and all build up a system of economics consistent with the basic neoclassical framework. This consists of a caricature of real economies as that of simply firms and households interacting through markets, with a focus on humans, their wants and needs, and their independence in deciding what is good for them through their individual decisions in markets. In other words there is a consistent body of theory, known as neoclassical economics, that is, accepted or promulgated by essentially all economists, at least as represented in their fundamental textbooks. We assume that the readers of this book have at least passing familiarity with this conventional economics.

By *incoherently* we mean that many of the assumptions that conventional economists must make to generate their world of theoretical economics, the associated equations, and their applications defy logic to one trained in the natural sciences or perhaps even common sense. There are three ways in which conventional neoclassic economics fails these tests: behavioral, biophysical, and moral. Although these concepts have been presented previously, we review each below.

### 17.1.2 Behavioral

The canonical assumptions of *Homo economicus* (non-satiation, self-regarding behavior, strictly rational decision-making) are assumed to predict accurately how people make economic decisions. Thus the basic neoclassical model assumes that people are "rational," meaning selfish or at least self-regarding, so that they make market decisions based on their own self-interest. In fact, as summarized in ▶ Chap. 3, there has been a great increase in the degree to which basic human economic behavior has been tested using the scientific method and in very clever experiments in behavioral economics. The results have tended to show that the *Homo economicus* view is false or at least very poorly predictive. For example, Henrich et al. [5] after examining the results of behavioral experiments in 15 small-scale societies ranging from hunter-gatherers in Tanzania and Paraguay to nomadic herders in Mongolia conclude: "[T]he canonical model [i.e. *Homo economicus*] is not supported in any society studied."

### 17.1.3 Biophysical

Hall et al. [6] summarized the main ways that the basic neoclassical model failed even the most minimal standards for veracity in natural science: the basic model violated the laws of thermodynamics, had incorrect boundaries, and did not generate its premises by generating and testing hypotheses but rather as logical givens. Most basic models are *not* consistent with the laws of thermodynamics, nor do most economists even think about such laws [7]. This alone would be enough to disqualify any model in the natural sciences, but it has not seemed to bother economists. Gowdy et al. [8] provide many more ways that basic science is violated with the basic neoclassical model. The ability to predict is a crucial criterion for any economic model that is to be used to influence policy and hence the lives of many people.

One can certainly find some hypothesis generation and testing in learned economics journal. For example, Hall [9] examined some 127 articles in the leading economics journal *American Economic Review* and found that for this subset of papers, about 10 percent did test explicit hypotheses, which is good. Only 3 percent, however, could be construed as testing fundamental economic theories. These papers found more often than not that the basic economic theories tested in specific applications were more likely *not* to be supported than the converse. So we might say based on this study that economics is a good science because ideas were being subject to the scientific method or perhaps bad because such results have no impact on the center of gravity of

conventional economics, as is clearly stated by leading economists themselves (e.g., Krugman 2008 [4]).

A core belief of many economists is that good models make good predictions and that this is more important than whether or not the model is consistent with known mechanisms [10]. But in fact we find that the core models used by economists (economic man and perfect competition) consistently fail the "good prediction" test. For example, essentially all economists failed to predict the market crash of 2008.

### 17.1.4 Moral

Most of our students, possibly more idealistic than the average, are also very much put off, for both scientific and moral reasons, by the essential selfishness that is accepted by and even celebrated in the basic economic theory found in introductory economics textbooks. This perspective was made to us even more strongly by our colleague, Donald Adolphson a very popular and thoughtful professor of economics and finance at Brigham Young University in Utah. He said to us:

> "The students at BYU are virtually all practicing Mormons (Mormon is a Christian denomination also known as "The Church of Latter Day Saints", which is very strong especially in Utah and adjacent states). They are trained at home to think of their relation to God and then family first, community second and then the world community. Most travel to a foreign country as a late teenager as part of their preparation for life. When they take Introductory Economics, they are told in their textbooks that the basic neoclassical … starts with the assumption that humans are "rational", rational meaning entirely selfish, or at least self-serving, and principally materialistic. This just strikes them as wrong, and they reject their basic economics textbooks."

Well it strikes us as wrong too. It also strikes most of our own students in upstate New York as wrong morally and with respect to their own motivation. In particular it seems wrong to the majority of our students because they have a high sense of idealism toward nature and toward other people, neither of which they wish to see sacrificed for mere self-serving and often superfluous economic goods and services. This is especially the case when they view the world around them as full of hyper affluence bought at enormous expense to the environment and the enormous discrepancies between rich and poor. They want something else, and they have found it, to some large degree, in the biophysical ways we teach our own economics courses. But there has not been a rallying point, a central synthesis of the broadness of literature needed to understand real economies or a source of synthesized information needed to really understand economics and the basic economic relations of humans to our world. We try to do that in this book.

We cannot accept economics as presently practiced as any kind of science because it does not follow the rules of science as we summarized them in ▶ Chap. 15. This is true both for the behavioral aspects of humans (i.e., how they in fact interact with others vs. how the basic neoclassical model assumes that they do) and for the degree to which the model is inconsistent with the laws of nature as summarized in ▶ Chaps. 3 and 15.

### 17.1.5 Other Economists Agree with Us

Most knowledgeable economists, when pressed, will acknowledge at least some of this, yet economics as a discipline rumbles onward year after year with little real change in the way that our young people are inculcated into this august company. This point of view is not simply ours but was apparent to most of our students (especially those with a focus on, or at least reasonable experience with natural science). While our students can indeed learn the principles of economics in their first course in that subject and can pass and even do well on the tests, they generally do not, or barely, believe the concepts that they are taught there. Because many of the principles seem unrealistic to them, they are often deeply bored. They sometimes use very harsh words to describe their disbelief on what they are being taught. Well, we agree with them and believe that collectively we have been teaching something like one million young people a year in the United States alone something that might reasonably be considered, at worst, complete fabrications or at best a very simplistic and incomplete perspective on the

reality and richness of thought that can be brought to bear on economic issues and problems.

As some support for that point of view, we note that, as of 2006, six of the last eight most recent recipients of the Nobel Prize in economics were people whose works challenged, in various very fundamental ways, the basic existing neoclassical paradigm.

We find that there are many, many other scientists and economists who basically believe the same things as we do: that neoclassical economics is intellectually corrupt at its core. Economics has largely isolated itself from harder sciences, trapping itself as entirely a social science by relying on the laws of physics as they were known in the nineteenth century. This perspective is sometimes called "hermetic," in that economics is completely self-enclosed within its own narrow world.

As stated in Gowdy [8]:

> "The distinguished historian of economic thought, Mark Blaug, has remarked that economics has increasingly become an intellectual game played for its own sake (Blaug 1998, pp. 11, 34). A survey of graduate students in economics in the 1980s by David Colander and Argo Kamer (1990) found an astonishing lack of interest in learning about current economic issues or about the literature of economics. Colander and Kamer surmise that, sadly in their view, this may be rational behavior on the part of graduate students in economics. The quickest way to success as an academic economist is to concentrate on mathematics, rather than learning about how actual economies work. Alan Blinder, a former member of President Clinton's Council of Economic Advisors, has characterized training in economics as "increasingly aloof and self-referential"."

Other modern critics include McMurtry [11], Cox [12], Talab [13], Johansson [14], Sutter and Pesky [15], Hall et al. [16], Mirowski [17], and especially Easterly [18] and Piketty [19]. Many of these publications stress the physical harm that a belief in the abstractions of neoclassical economics causes to people, especially poorer people in the developing world.

It is arguable whether at present, the economic field is undergoing a fundamental shift to establish a more scientific foundation. Possibly, just as biology emerged as a true science in the twentieth century, so too will economics in the 21st. But in the meantime, it seems that economists are mostly circling their wagons, defending their assumptions against all attacks from the outside, or more normally simply ignoring them, retreating into their carefully constructed fantasy world of assumptions and impenetrable equations.

### 17.1.6 Is Economics a Science?

So our answer to the question posed by the title of this chapter is that, no, economics at this time is not a science. Its basic models violate too many scientific principles including the first principles that are necessary for any real model: laws of thermodynamics, the law of the conservation of matter, the ways that people actually do behave according to empirical studies, and so on. In addition even when economics appears to be "borrowing" equations from physics, it is doing so incorrectly, even in violation of the physics it is trying to emulate. Instead of following these principles, principles that all natural science follows or risks rejection or humiliation from peers, neoclassical economics has generated its own world, a world that reflects the real world in only the most basic and contrived ways. While in theory there is a model of physics behind, the equilibrium model is just a copying of the equation form without any understanding of the actual physics—in fact it violates the second law of thermodynamics [6, 17]. Additionally the assumptions of "rational actors" required to make this model work are inconsistent with how humans in fact interact with each other. The generation of theory based on a market concept of perfect information and equal power of interacting buyers and sellers that has not existed since agrarian England, if indeed they ever existed, combined with failure to make and test hypotheses, makes an acceptance of the basic neoclassical model an article of faith, not rationality. Curiously the ascendance and the power of the ideas of the advocates of market theory and self-interest have spilled over to our public and political life. This has destroyed many economies in the less developed world [16, 18], while completely changing the political perspective of many Americans from community, civic responsibility, and fairness in distribution of wealth and care for others to one of unbridled greed and self-focus, while turning, to some degree, universities from learning commu-

nities where highly trained and caring professors held students up to their own high standards to commodities where students buy their education and expect high grades with little work. This has also given a green light to those who have enormous financial power to buy and to manipulate our political system, while convincing many that "big government," their only defense against big money corporations, is something to be avoided. The net effect has been an assault on our public institutions, the only entity with enough power to stand up to ever larger and more powerful corporations and their ultra-wealthy directors [20]. It is a very large impact of a theory on reality which is scientifically indefensible at its heart. We conclude that a new, biophysically based economics is critically needed [21].

### Questions

1. Why is economics usually considered a social rather than a biophysical science? What is your view?
2. Do you agree, from your own experience, that humans are essentially selfish or at least self-regarding? Or does it depend upon the circumstances?
3. With respect to the previous question, is this pattern of basic selfishness found in all cultures around the world?
4. What are the characteristics of an endeavor that qualify it as a science? Do you think conventional economics qualifies as a science? Why or why not, or where and where not?
5. In the world of conventional economics, what does rational mean? What does it mean to you?
6. Conventional economics is usually classified as a social science. In your opinion does economics qualify as a science? Why or why not?

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