

**Essays on Genetic Evolution and Economics**

A thesis presented

by

**Terence Charles Burnham**

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# Essays on Genetic Evolution and Economics

A thesis presented

by

Terence Charles Burnham

to

The Committee of Business Economics

in partial fulfillment of the requirements  
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## ABSTRACT

Ever since Charles Darwin published *The Origin of Species* in 1859, genetic evolutionary theory has increasingly served as the foundation for fields that deal with organisms that arose by natural selection. This thesis argues that economic theory should integrate with Darwinian theory through the creation of a “genetic evolutionary economics”. The promise of genetic evolutionary economics is a better understanding of human nature and, consequently, a more accurate and comprehensive economic science.

Economic theory rests on a set of assumptions about human nature. These economic axioms concern human genes, but there is no explicit connection between genetic evolution and economic theory. As a result, human behavior and economic predictions of that behavior diverge in a variety of important settings. Why, for example, do most people save too little for the future when economics assumes that they will save enough? Chapter 2 discusses the difficulties inherent in the standard economic approach. Natural selection theory, the chapter argues, is the best tool for refining the axioms of economics.

Genetic evolutionary economics allows the derivation of parameters that are intractable with standard economic techniques. There is, for instance, an ancient debate within economics about the role of self-interest in human affairs. Chapter 3 builds a genetic evolutionary model relevant to this issue, and concludes that a Darwinian lens removes many of the apparent paradoxes.

Genetic evolutionary economics is a scientific endeavor. As such, it produces specific, testable hypotheses concerning behavior in economically relevant situations. Chapter 4 reports on a theoretical and experimental investigation of gift giving. A genetic evolutionary model organizes the existing data on gift giving and makes novel, testable predictions. Laboratory experiments, performed to test the theory, confirm the evolutionary model's predictions.

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## Chapter 1: Charles Darwin can help Adam Smith

Human beings arose through a process of evolution by natural selection and this fact is important to economics. Most economists agree with the first statement. This thesis argues for the second -- that insights from the field of genetic evolution can significantly improve economics; specifically, by refining its core set of assumptions about human nature.

The foundation of economic theory has some well-known difficulties that are not likely to be solved from within the standard framework. The high stature and broad influence of economics are based, in large part, upon a rigorous mathematization following the method advocated by Rene Descartes in *Discourse on Method* (1637) and *Meditations* (1642). Neo-classical economics, offering a unified theoretical model derived from a core set of assumptions about human behavior, has a cohesiveness that is unique among the social sciences. However, because every result in a Cartesian system rests upon the starting assumptions, Descartes required them to be absolutely incontrovertible. Economics has honestly documented the ways in which the economic version of human nature fails to satisfy Descartes' strict criterion, but has not provided a solution.

Edward O. Wilson argues in *On Human Nature* (1978) that economics can be improved by Darwinian theory. All social sciences rely upon implicit models of genetic human nature that, Wilson believes, are circumscribed without an explicit grounding in biological theory. He states: "Without it [Darwinian theory] the humanities and social sciences are the limited descriptors of surface phenomena, like astronomy without

physics, biology without chemistry, and mathematics without algebra. With it, human nature can be laid open as an object of fully empirical research, biology can be put to the service of liberal education, and our self-conception can be enormously and truthfully enriched.” (p 2)

### Natural selection operates on behavior

In order for Wilson’s proposed natural and social science integration to be useful, human behavior must be significantly constrained by genes. Evolutionary theory predicts that, subject to physiological and informational constraints, organisms will act to maximize their reproductive success. When the appropriate measure of reproductive success is used, W.D. Hamilton’s (1964) *inclusive fitness*, non-human organisms’ behavior is consistent with this prediction. In particular, many animals exhibit remarkably sophisticated strategies that appear to be skillfully designed for gene propagation.

Evolutionary theory states that human behavior is subject to natural selection in exactly the same manner as physical traits and non-human behavior. However, the application of behavioral biology to humans presents two challenging but surmountable issues. The first is that until fairly recently humans lived in a different ecological environment. Just as generals are always prepared to fight the previous war, evolution results in design features suited for past environments. The human genome reflects millions of years of foraging, a few thousand years of agriculture, and two hundred years of industrial society.

To the extent that our world has changed more rapidly than our genes, we should expect a degree of mismatch between the two. Useful design features in one setting can be helpful, neutral, or even disastrous in a different environment. Current thinking is fairly sophisticated regarding physical traits. For example, almost no one is puzzled by the fact that the appendix, which arose to help humans survive, now causes problems. However, similar behavioral relationships, such as failures to analyze certain economic situations correctly, are still regarded as paradoxes. The solution to the theoretical difficulties presented by environmental mismatch is a case-by-case analysis of the evolutionary setting, the evolved mechanisms, and their implications in a modern setting.

The second theoretical challenge is the evolved human ability to override certain drives, a talent that appears to be unmatched by other species. This makes the observation and analysis of instinctual human behavior more subtle. It does not imply that modern human behavior is free of genetic history.

There is compelling evidence that human behavior is significantly channeled by our genes. Because of these genetic constraints, human behavioral biology has the potential to resolve several fundamental economic quandaries that are caused by the lack of a precise description of human nature. In the absence of clear data, economic theory can describe the implications of various versions of human nature, but cannot select among them. Biology brings additional discriminatory power by examining the evolutionary consequences of behavior. In addition to this role of refining existing economic axioms, behavioral biology allows the study of human parameters that are currently outside the scope of economics, such as risk attitudes and discount rates.

## Now is the time for genetic evolutionary economics

The geneticist Theodosius Dobzhansky said “nothing in biology makes sense except in the light of evolution.” (Dobzhansky, 1973) This thesis expresses the view that nothing in human behavior, including economic behavior, makes sense except in the light of evolution. The history of evolutionary thinking can be stylized as an increasing set of domains where Darwinian thinking is considered appropriate.

When *The Origin of Species* (Darwin, 1859) was published, many people were appalled at the thought of a continuity of physical traits between humans and non-humans. In a famous debate, Thomas Henry Huxley (“Darwin’s bulldog”) was accused, to the humor of the crowd, of claiming a chimpanzee ancestor. Today, everyone who accepts Darwin’s view of evolution admits a chimp-like ancestor, and, furthermore, feels no shame at the common origin of human and chimp features, such as opposable thumbs. Similarly, the view that non-human behavior is subject to selective pressure is no longer controversial.

E.O. Wilson’s publication of *Sociobiology* (1975) started the modern debate on the genetic roots of human behavior. While this battle is by no means over, the academic literature is filled with articles that assume human behavior is productively studied through an evolutionary lens (see, for example, the journals *Ethology and Sociobiology*, and *Human Nature*). The last several years have seen an explosion of best-selling books on the subject of genetic evolution and human behavior, including Robert Wright’s *The Moral Animal: Evolutionary psychology and everyday life* (Wright, 1994), Stephen Pinker’s *The Language Instinct* (Pinker, 1994), Oliver Sacks’ *An anthropologist on*

*Mars: Seven paradoxical tales* (Sacks, 1995), and Richard Dawkins' *River out of Eden: a Darwinian view of life* (Dawkins, 1995).

Mainstream economic thought has not incorporated a genetic evolutionary perspective. Soon after the publication of *Sociobiology*, economists including Gary Becker (1976), Paul Samuelson (1983), and Jack Hirshleifer (1977, 1978) wrote sociobiological papers. The full economics literature is reviewed at length in chapter two, but the compact summary is that the intellectual descendants of Adam Smith work without the benefit of Charles Darwin's insight.

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## Chapter 2: Genetic Evolutionary Economics

### Introduction

Chapter one makes broad claims about the appropriate role for Darwinian theory in the social sciences. This chapter makes the detailed case for the development of a field labeled “genetic evolutionary economics”.

All economists are sociobiologists even though most have never heard of the field. Economics is based on a version of human nature that includes optimization, time discounting, and particular attitudes towards uncertainty. The assertion that these fundamental properties apply to all humans in all settings is a statement about human genes.

What is the appropriate approach to study this genetic human nature? The question is relevant because there is a significant gap between economic theory and human behavior. This chapter argues that genetic evolutionary theory is likely to be a useful tool in refining the genetic version of human nature embedded within economics.

Understanding the world through a Darwinian lens requires careful analysis. The natural selection paradigm has fostered fundamental advances in a wide variety of fields. Progress in those fields, however, required concerted effort by many people over multiple decades. The creation of genetic evolutionary economics is likely to require similar levels of sustained effort. This chapter sketches the road ahead by anticipating the likely difficulties for genetic evolutionary economics and the solution to those problems.

### Motivation for genetic evolutionary economics

## **Introduction**

The economic model of individual behavior rests upon a set of axioms. While the rest of economic theory is derived, the axioms<sup>1</sup> are assumptions about human nature. It should not be surprising that “small” changes in these foundational assumptions lead to “large” changes in results. Consider that in mathematics changing one axiom about parallel lines creates the field of non-Euclidean geometry. Similarly, altering even slightly the neo-classical assumptions about the origins and pursuit of utility has well-known and dramatic effects on several important results of economics.

This section explores three economic results that depend on specific assumptions about human nature. These areas were selected because there is empirical evidence contradicting the relevant assumptions. Neither the theory nor the evidence presented here is new. They are repeated to make a simple point. The axioms contained within the economic model of individual behavior are extremely important to a wide variety of issues, and there is enough uncertainty about the validity of these axioms to merit further examination.

## **The neo-classical economic model of individual behavior**

A very short description of the neo-classical model of individual behavior is presented here. Every microeconomic textbook contains a more complete description. (See, for example, Mas-Colell et al., 1995, chaps 1-6.) In simplest terms, the model

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<sup>1</sup> Definition: A self-evident or universally recognized truth, an evident principle or one that is accepted as true without proof as the basis for argument; a postulate. Source: The American Heritage Dictionary

assumes that individuals survey their opportunities and, constrained by various factors including an imperfect knowledge of the world, choose the path that they expect to make them the happiest. This model is discussed below in slightly more detail by examining the human goals, and the method for attaining the goals.

### ***Goals***

The assumed human goal is, in a broad sense, consumption. Individuals are assumed to have *preferences* that translate “commodity bundles” consumed over time into a measure of happiness. Beyond certain consistency requirements, the model places very few restrictions on the specifics of an individual’s preferences. Humans are allowed to like or dislike anything -- cyanide, torture, hard work, heroin, football games, etc. The model does require that all items affecting happiness be representable as commodities; a variety of non-standard items such as children, infidelity, and self-esteem are “commoditized”.

### ***Goal fulfillment***

A “rational” person selects the behavior, from the feasible behaviors, that yields the most happiness. Humans, at least rational ones, maximize happiness or, as economists say, utility.

Two additions are required. First, there are multiple, interrelated periods. For example, the decision to work hard today may allow relaxation tomorrow. Individuals are assumed to convert units of happiness between different periods of time using a discount rate. Happiness is assumed to be worth more today than tomorrow -- which, in turn, is worth more than happiness the day after tomorrow.

Second, many important decisions involve uncertainty. Consider, for example, that a person must decide how much of income to save without knowing how long they will live. Uncertainty is dealt with by assuming that people take a weighted average of the possible outcomes.

The result is that people are still assumed to choose a path that yields the most utility. The two additions mentioned above alter the standard prediction only to take risk and time into account. In summary, the standard economic model allows individual goals to vary with few limits, but constrains everyone to maximizing expected, discounted happiness.

### **Example 1: The invisible hand and the rule of law**

The central problem in the theory of interpersonal comparisons of welfare seems to be an embarrassment of riches -- there are many reasonable ways of making such comparisons and they need not coincide. - Amartya Sen (1982, p 279)

#### ***Specific version***

How does a person value the lives of other people? One extreme version is that individuals are ruthlessly self-interested and act for their individual gain. Such a completely self-interested person might behave nicely because of societal repercussions, but at the core cares about others only as a means to a selfish end. In economic parlance, a self-interested individual derives utility only from his or her own consumption.

#### ***Evidence contradicting the narrow version***

The purely self-interested model does not appear consistent with a wide range of behavior (see chapters 3 and 4 of this thesis for more discussion on this point). On the positive side we see a variety of altruistic activities ranging from charitable donations to

heroic rescues of strangers. We also have examples of behavior such as vandalism, where the individual is apparently deriving enjoyment from a purely destructive act.

The notion of self-interest may be compatible with the observations above because of the societal repercussions. The altruist may donate to curry favor, and similarly the vandal's stature within his or her group may rise as a result of wanton destruction. So the falsification of a purely self-interested model is more difficult than may be initially imagined.

There are, however, several types of data that pass this more rigorous test. For example, the soldier who jumps onto a live hand-grenade knowing he faces certain death is pursuing self-interest only in a tautological sense. Another source of data comes from the field of experimental economics, where, analogous to biomedical experiments, individuals are put into precisely controlled settings so that their behavior can be studied. One experimental design has an individual (the "dictator") unilaterally deciding how much money to give to an anonymous second party. The result (Forsythe et al., 1994) is that many dictators give substantial percentages to people they never see, and will never interact with again.

### ***More general version***

As the Amartya Sen quotation above suggests, economic theory has no difficulty in accommodating an interpersonal component to preferences. The self-interested version is expressed mathematically as  $U(\text{own consumption})$  which means that happiness is derived solely from one's own consumption. This expression can be trivially modified to

U(own consumption, others' consumption) which allows an individual to derive satisfaction or discomfort from the lives of other people.

### ***Why it matters***

Some of the fundamental results of economics rely upon a narrow version of interpersonal utility. One of the dominant themes of modern economics, and a libertarian philosophy more generally, is that individuals, pursuing their own self-interest, will come to socially optimal outcomes. This is expressed most famously in Adam Smith's line that: "It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest."<sup>2</sup>

More formally this self-interest is one of several assumptions necessary for the "First Fundamental Welfare Theorem" which states that, under certain conditions, a free market will lead to a particular sort of optimal outcome. This "Pareto" optimality is defined as a situation where no person can be made better off without hurting someone else. The formal proof of the welfare theorem is technical, but the basic logic is clear. If there are possibilities for actions that help some people without hurting others, and the individuals know about these actions, then they will take these actions without the help of the government or any other outside party. The result is that there are no actions left undone which make some people happier and do not hurt others. This is exactly the definition of Pareto optimality.

So selfish acts add up to optimal social outcomes -- unless the assumptions are violated. One violation occurs if private acts have effects on other individuals. This fact

is well known in economic theory, as shown in the following quote: “But the effect on market equilibrium is significant: In general, when external effects are present, competitive equilibria are not Pareto optimal.” (Mas-Colell et al., 1995, ch 11, p 350) So in cases where people are altruistic, envious or spiteful, individuals must be constrained to yield optimal societal outcomes. A less quoted part of Adam Smith’s work is the need for self-interest to operate “within a framework of law.”

### **Example 2: Optimal rain forest destruction**

#### ***Specific version***

Economics assumes that an individual’s happiness increases as wealth increases. From one perspective, this assumption seems correct. A rich person can always become a poor person by giving away assets. Thus, it would seem obvious that, *ceteris paribus*, happiness will increase with wealth. Furthermore, changes in wealth certainly seem to effect happiness in this manner. Specifically, positive shocks to wealth (winning lotteries, obtaining salary raises, etc.) cause happiness while negative events cause unhappiness.

#### ***Why it matters***

The concept that wealth is an important determinant of happiness underlies many public policies. John Maynard-Keynes’ (1972) essay, “the economic opportunities of our

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<sup>2</sup> *The Wealth of Nations*, vol. 1, bk. 1, ch. 2 (1776).

grandchildren,” foresaw a world where material luxury enabled societal bliss. Many U.S. social programs target financial goals as proxies for recipients’ happiness.

Environmental policy is importantly affected by a notion of material wealth driving happiness. For discussion’s sake, assume that there is a trade-off between per capita GDP and environmental degradation. In other words, more rainforests and less atmospheric carbon dioxide can be attained only by reducing output. Under this assumption there is a wealth-environment trade-off. When this is combined with the assumption that wealth causes happiness, the result is a happiness-environment trade-off. An economist then calculates the optimal rate of rainforest destruction by balancing marginal lost happiness derived from foregone consumption with the costs of environmental degradation. The result is that the environment should be degraded at some rate that is greater than zero.

However, if the assumption that wealth causes happiness is incorrect, then preservation of the environment may decrease output without changing social welfare. There may be a free lunch, not in the quantity of food on the table, but rather in its appreciation.

### ***Evidence contradicting the narrow version***

There is evidence that the assumed relationship between wealth and happiness does not exist. Two psychologists, David G. Myers and Ed Diener, have produced a series of relevant articles (Diener et al., 1993; Diener, 1995; Myers and Diener, 1995), including a review of the World Database of Happiness (Veenhoven, 1995), a massive collection of over 500 studies covering more than forty countries.



The authors' conclusion is that only a small part of an individual's subjective well-being (SWB) is caused by any external, objective measure. In other words, income, race, and age have little predictive power for self-reported welfare. Specifically with respect to U.S. income they state: "... a mere +.12 correlation between income and happiness; increases or decreases in income had no long-term influence on SWB." (Myers and Diener, 1995, p 13.) Cross-cultural analysis (Diener, 1995) finds that per capita GDP only weakly correlates with self-reported welfare, and there are important exceptions.

Similarly, there is no trend over time that tracks happiness with wealth. The authors report that 32 percent of U.S. residents polled in 1993 said they were "very happy" -- as opposed to 35 percent in 1957, when in real terms U.S. per-capita income was only roughly half as high. Perhaps the most extreme study (Brickman et al., 1978) reports on lottery winners and people who were paralyzed in car accidents. The individuals had big changes in happiness at the time of the lotteries and accidents, but most people returned to pre-event levels within one year. More generally, Myers and Diener report that "... only life events within the last 3 months influenced SWB." (Myers and Diener, 1995, p 13)

The studies discussed are all based on self-reported measures. To avoid the problems inherent in surveys, some more objective behavioral data would be helpful. One important measure, average lifespan, has increased dramatically along with wealth. Another insight might be found by looking at suicides. While no measure is perfect, suicide rates might reveal something about happiness.