

## Behavioral economics: implications for economic theory and policy<sup>☆</sup>

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### Abstract

The concerns of behavioral economics are considered in the context of the decentralized, private ownership market economy. Modes of adaptive economizing behavior are outlined and their implications for augmenting the classical paradigm outlined. The role of viability mechanisms that indirectly and adaptively coordinate producers and consumers out of equilibrium is emphasized. The destabilizing nature of the creative intelligence and adaptive economizing transforms the world. The example of internal combustion, its effect on agriculture and transportation and the corollary use of resources provides a timely example.

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*JEL classification:* E10; B41; D90; O11

*Keywords:* Adaptive economizing; Viability mechanisms; Creative destruction

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Rational man's stone of Sisyphus is to think the possible, form his values, to plan. His respite comes with the act. He observes himself, collects his rewards and punishments, and renews himself for the next intellectual struggle, the next leap of faith.<sup>1</sup>

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<sup>☆</sup> This paper was presented as a featured lecture, Society for the Advancement of Behavioral Economics, Lake Tahoe, Nevada, July 28–31, 2003.

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<sup>1</sup> "Rational Choice and Economic Behavior", *Theory and Decision*, volume 1, p. 249, 1971.

## 1. Introduction

When I first began writing and speaking about adaptive economizing and economic dynamics almost fifty years ago, I thought I had pretty much discovered the last word on the subject. In the meantime, as I elaborated on various aspects of the overall perspective, I discovered that other scholars had already been or were currently in the process of articulating their own versions of similar ideas. This occasion, however, is, I believe, the first time I have been given the opportunity—as the last speaker—to actually have the last word on the subject. I want to thank Mark Pingle and those who helped him put together this interesting conference for giving me that honor. Behavioral economics consists in (i) identifying general characteristics, rules, or principles of economic behavior based on direct observation and inquiry; (ii) constructing models based on these characteristics; (iii) determining the extent to which behavioral models approximate observed behavior; (iv) the use of models to generate scenarios of future behavior that may be influenced by policy instruments or exogenous influences. In contrast to the position represented by Milton Friedman's 'as if' proposition, to the behavioral economist the realism of a model's assumptions or axioms is as relevant as that of its implications.

Obviously, however, the very act of identifying general characteristics involves abstraction and decomplexifying the details of everyday experience in all its manifold variety. One does not escape the methodological problems inherent in this process by taking the behavioral point of view. In this talk I want to touch on some of the problems that have arisen in my own attempts to advance the behavioral approach. These involve (i) the abstraction process; (ii) the behavioral content of the classical/neoclassical and contemporary macro concepts of a market economy; (iii) augmenting that content with concepts of adaptive economizing; (iv) exploring implications of the behavioral approach for understanding economic change in the world economy.

## 2. Abstracting and decomplexifying

The fundamental problem of any theoretical science is to identify, isolate or synthesize salient features of experience that make it possible to reduce the complex movements of phenomena into systems of cause and effect. This task is one of abstracting and decomplexifying experience so we can think about reality. We can, however, think about just so much, so we decomplexify to suit our needs, to satisfy our aesthetic sense, to facilitate our plans of action.

Regardless of our motivation, it is only in terms of such systems that the dynamics of experience can be understood, communicated unambiguously, and subjected to the demands of logic. In no other realm of inquiry is the difficulty inherent in this task greater than in economics. Individuals interact among themselves and within hierarchies of organizations that interact among themselves, all of which interact with the biological and physical world. The theoretical economist is faced with systems within systems within systems. Moreover, our fundamental atoms have imagination: the ability to create images of things that do not exist and stories of events that have not happened. They have the potential to design and carry out actions that embody those created images in new artifacts that transform those

created stories into realized histories of happenings. So far as we can tell, physical atoms do not consciously cook up new ways of combining with each other to form molecular structures that then evolve new laws of interaction. The physicists have it easy. The animal kingdom has evolved species whose individual physiologies are as complex as ours. Some of their social organizations are elaborate. Some have even evolved the rudiments of culture. Still, the biologists' tasks are trivial compared to our own. It is little wonder that our science has progressed so little relative to theirs.

We do have a single but overwhelming advantage; we are the atoms of our science. By conscious introspection we have direct access to a part of our inner workings. We know what our rationality is; we know we cause things to exist and events to happen. We experience and understand to some degree the limitations that bound our thoughts and circumscribe our actions. In spite of this advantage our abstractions and decomplexifications can lead us to adopt economic theory utterly inconsistent with what we know, inconsistent indeed with what any thoughtful person knows about our basic natures. I take the central task of adaptive or behavioral economics to be that of finding ways to abstract and decomplexify economic experience while retaining the salient properties of human nature and social interaction, as we know them to be.

### 3. Decentralized production and exchange

The salient properties of real private ownership economies that had emerged out of the feudal, manorial world by the time Adam Smith set his intellectual gaze on them were

- (i) that the production of individual commodities involved sequences of tasks that led to a division of labor and a distinction between labor and its coordination by management;
- (ii) that managers and the owners of wealth guided investment and production in an effort to make profits;
- (iii) that consumers guide their supplies of services and purchases of goods to satisfy their needs and wants;
- (iv) that competition among producers and consumers tend to increase prices of goods in excess demand and decrease prices of goods in excess supply.

Accordingly, the core abstraction of the economic theory of democratic capitalism became that of a society made up of a set of independent, privately owned and managed producing firms, and a set of independent households who supply labor and management to firms and demand the goods produced by firms. This private ownership economy is theoretically specified usually without reference to a system of polity or any other social structure.

No guiding principle of overall rationality is explicit in these abstractions. Consumers and producers are individual, each by itself doing the best it can contingent on its own situation, knowledge, and preference. In terms of behavioral economics the rationality of each neoclassical firm or household is bounded. The idea of a competitive equilibrium emerges as a potential implication of these primitives. It consists of prices at which all supplies and demands are balanced even though no individual producer or consumer knows—or needs to know—the technology and preferences of any other. From the theoretical point of view

the concept explains with crystal clarity how prices can facilitate the working of an economy that is far too complex to be managed without their aid. From the behavioral view competitive equilibrium is a potential that may or may not be realized. If it is realized, it will do so even though individual producers and consumers have incomplete knowledge of the system as a whole.

The abstraction of an economy of decentralized production, consumption, and exchange among individually owned firms and independent households—if not a mirror image of a modern, market-oriented society—is surely a good working representation. The existing private ownership economies, however, have not yet brought about a competitive equilibrium during their several centuries of existence, surely a period long enough to qualify as a ‘long run’. Why haven’t they done so? To answer this question, I believe we should augment our theoretical primitives by taking into account some of the principles of behavioral economics. I would like to suggest how this task should proceed. Before doing so, I want to comment on an important macroeconomic mis-representation of the private ownership, market economy paradigm.

#### **4. The economy as an unboundedly rational agent**

Among a prominent school of macroeconomists, the term general equilibrium theory is used while the underlying primitives of that theory are all but abandoned. I am speaking of the real business cycle (RBC) or dynamic programming school of macroeconomic theory. That approach is built on the idea of a large number of independent identical, infinitely lived Robinson Crusoe consumer–producers who plan optimally with respect to a complete ordering of all possible consumption trajectories of a single good forever. Each being the same, any one ‘representative producer–consumer–agent’ is representative of all. Given a constant homogeneous production function and a constant rate of productivity improvement, the aggregate behavior of all is represented by any one. Each one knows everything one needs to know about the entire economy, its technology and preferences forever. No need to bother with the role of money and a price system as a decentralizing medium, or with demand and supply, or with their difference. No need either to mention the coordinating function of prices in a decentralized economy of differentiated producers and consumers. Instead, one speaks of the coordinating function of implicit rates of return on investment over time, implicit rates of return that enable one to decentralize the representative agent into Robinson the producer and Robinson the consumer.

In this theory the infinite horizon utility function of the representative agent is representative of the economy as a whole. The agent knows his preferences for the entire future, the technology of the whole economy forever, and the probabilities of stochastic events that can occur in the future. The discussion of intertemporal exchange rates implicitly draws on the Lange/Lerner socialist dictator or helmsman who computes and announces the intertemporal ratios to the several Robinsons in their manifestations as firms and households. The assumption of identical agents who are producer/consumers is what makes all this go through. When everyone is identical, each is a dictator. Indeed, an economy of one such dictator is equivalent to an economy of many identical dictators. There is no need for anyone of them to announce intertemporal prices to anyone else.

As a device for illuminating the potential decentralizing role of prices, for introducing some aspects of capital theory in a coherent way, and for defining the purely formal idea of an equilibrium over time, the theory has pedagogical value. Moreover, as a device for characterizing the greater than exponential measured GDP growth of the market economies, it exhibits noteworthy fits to the data.<sup>2</sup> But, as a general theory of a market economy, can one get farther from the behavioral realities of the private ownership economy? Can one get further from the vision of Adam Smith or its mathematical embodiment in Walras or Arrow and Debreu?

## 5. The economy as a collection of adaptive economizers

The problem here is not between rationality, irrationality, or non-rationality. Rather, the problem is to characterize rationality at the level it operates and in the way it operates. As an outcome presumably of the physiology of a single human brain, it is not a property of nations or indeed of any social group right down to a family or a pair of lovers. Any set of plans or sequence of acts undertaken collectively by a group of individuals may reflect common values and an agreed strategy for affecting them. In this way the group reflects the rationality of all the individuals involved. More generally, agreed upon plans and actions are the outcome of a confrontation of differing values, technical conditions and constraints. A common commitment to action emerges through an interactive process of argument, debate, persuasion, and negotiation; or failing this, through a power struggle for a dominating individual or cadre of individuals. In any case, rationality is at work but in a far more complex, interactive, and adaptive manner than is characterized by a rational individual choice among alternative goods.

So how should individual rationality be characterized? First, one must retain the fundamental neoclassical primitives of (i) a set of perceived alternatives, (ii) a subset of those alternatives that are thought to be feasible, and (iii) a preference ordering among the alternatives. Given these primitives, an existence theory of a best choice can be formalized in the usual way. That is as far as equilibrium theory needs to go for most of its purposes, but not so for the rational individual. That individual must actually choose among the alternatives in some way, perhaps by comparing individual cases, perhaps by some more systematic mental analysis, or perhaps by intuitively choosing without conscious understanding how. In this context it is amusing to quote a supremely gifted economist who observed that

... I had to make a decision in a hurry. No doubt I acted as if I were maximizing an infinite discounted sum of one-period utilities, but you couldn't prove it by me. To me it felt as if I were saying to myself, 'What the hell' (see Solow, 1995).

Thus, actual economizing often proceeds in ways that seem on the surface to be irrational at worst and arational at best.

The modes of actual behavior for making constrained choices include (i) habering or doing what you have been doing or what you "have always done before"; (ii) doing what you are told to do by an advisor or authority; (iii) imitating what someone else is doing; (iv) engaging

<sup>2</sup> See Cooley and Prescott (1995).

in trial and error search; (v) unmotivated searching driven by curiosity, a sense of adventure, or thoughtless impulse but without a conscious comparison of prospective economic outcomes; (vi) acting according to hunch, in some mysterious way arriving at seemingly good decisions without conscious reasoning (see Day, 1984; Pingle and Day, 1996).

A moment's reflection convinces us that all of these have a role to play in the arduous process of 'being rational'. They all economize on information, data processing, and calculation. Habering is just a latinized expression for "if it works, keep doing it", not entirely bad advice when the outcomes of alternative actions are problematic. Doing what you are told to do may be an excellent strategy when you are ignorant and have much to learn before you could exercise your own discretion. Unmotivated search compels the exploration of the unknown where unimagined knowledge and rewards may lie. Acting according to hunch sometimes works when no rational basis for action can be derived. If the potential outcomes are not too obviously threatening, trial and error is effective and a virtually universal mode of behavior which, because knowledge is limited, encompasses using even the most sophisticated conceivable optimizing model and procedure. Indeed, the algorithms used to solve constrained optimizing problems in practice all involve sequences of simpler steps involving approximation and locally best directions of search (see Day, 2004; Chapter 3).

Thinking things through is advisable when the stakes are high, when the potential outcomes of alternative actions can be imagined with some confidence, and when time permits. Even so, the alternatives explicitly accounted for must be small relative to the number that could be considered. They will usually be based on approximations or guesses. The preference ordering among them will often be provisional. Moreover, one will often center any consideration of action around what has been done and act cautiously by limiting the degree of change during any one period to some lesser or greater degree. After acting, the entire situation will be reassessed and the choice problem reconstructed and the plan of action reconstituted.

Early in my career I developed a class of recursive programming models that incorporate the latter way of representing decision-making. Empirical versions were tested in various agricultural and industrial settings. Rolling planning and—at its most sophisticated manifestation—Baysian Decision models fall within this class. In my model probabilities are not used. Rather, caution is represented by 'zones of flexible response' that constrain choice around a neighborhood of current experience. These neighborhoods expand recursively in the direction of successful action and shrink in the direction of failure. Empirical results were encouraging.<sup>3</sup>

What are the implications of thinking of the economy as a collection of adaptive economizers? That is the question explored in the remainder of these remarks.

## **6. Viability mechanisms**

For the time being, let us stick with the classical–neoclassical–modern decentralized, market economy paradigm. The first and foremost implication of adaptive economizing is

<sup>3</sup> A nontechnical description of these studies will be found in Day (2004). *The Divergent Dynamics of Economic Growth*, Cambridge University Press, 2004. An early theoretical exposition is in my essay, "Rational Choice and Economic Behavior", *Theory and Decision*, volume 1, 1971.

that an explicit process must be added to account for the generation of prices. Equilibrium prices are determined once equilibrium production and consumption decisions are given and vice-versa. In reality they are determined by agents—some by producing firms, some by mediating individuals or marketing firms. They may sometimes be arrived at by means of barter and auctions. In most cases, however, they are determined by price markup rules and adjustments in response to inventory or order backlog changes. Inventory and order backlog changes result from excess supply or demand. They make such excesses feasible, that is, they make it possible for individuals to demand more than is supplied and to supply more than is sold. In this way, inventory-order-backlog-adjustment mechanisms maintain viability when current demands and supplies are imperfectly coordinated: viability rests not on equilibrium but on explicit mediating mechanisms provided by internal procedures and by specialist brokers, stores, and other marketing middlemen.

In a competitive general equilibrium such functions are not needed and are therefore absent in its theory. In reality they may contribute as much value added as production, typical markups running a hundred percent or more of labor and material costs. Why should marketing cost so much? Obviously, because coordinating production and consumption is a time consuming task with many intermediate steps. Without viability mechanisms a modern economy could not work at all, let alone work in perfect coordination.

The people who operate price and quantity viability mechanism are themselves adaptive economizers. They base their decisions on imperfect estimates of future sales and profits and behavioral rules that have worked in the past or that are derived from grossly simplified models of revenues and costs. Their decisions are re-adjusted adaptively in response to new information and past errors.

It is a fact that economies based on such mechanisms never arrive at states of perfect market clearing. Instead they fluctuate in a more or less irregular manner. Occasionally they exhibit substantial imbalances, sometimes of sufficient magnitude to threaten the viability not only of a few individual households and firms, but of the system as a whole. Although instability is not a necessary logical implication of adaptive economizing behavior, its universal appearance in real world market economies is enough to add it to the list of salient characteristics that must be explained.

## **7. Creative and destructive morphogenesis**

The instability that emerges from viability mechanisms is exacerbated by the creative faculty of mind that so complicates every attempt to reduce human thought to strict cause and effect relationships. The imagination is clearly a cause which initiates a process that literally creates something new, something that never happened or existed previously. The cause and effect of that process, however, is hidden from conscious thought. Nonetheless, its role both in creating inviabilities and in overcoming their effects can be understood.

The viability mechanisms were innovated along with the political institutions of city states and trading empires several thousand years ago. Ownership of property and inventories of commodities came into being along with trade among individuals and between states. Money, banking, and corporate forms of ownership evolved along with the political institutions of civic order. The emerging of ancient civilizations was made possible by

preceding innovations involving the domestication of plants and animals, of metallurgy, irrigation, and of implements that facilitated agriculture and manufacture.

A growing agricultural surplus in turn made possible and facilitated urban agglomeration, political organization, business management, and intellectual development. In modern, as well as ancient times, the co-evolution of economy and polity emerges in a drama of creative and destructive morphogenesis as new ways of living replaced old ones. In his later years Schumpeter, the great theorist of an evolving economy based on invention, innovation, and adoption, saw the process ending in a socialist or fascist state in which the underlying entrepreneurship of capitalism would die out. Most contemporary Schumpeterians do not follow him that far, and see in bursts of small firm oriented innovation the possibility of a continuing dynamic.

The recognition of these alternative scenarios is instructive. Invention, innovation, and entrepreneurship flourish in some societies and not in others. Where they flourish, ideas are not suppressed and can be tested. Successful new production processes and products are adopted. The composition of technology, work, recreation, education, and social values change. Fortunes rise and fall as new activities flourish and old ones are abandoned. Many people willingly change. Some are unwillingly forced to adapt, or are reduced to impoverished bystanders. People migrate from rural to urban areas, from one part of the country to another and from some parts of the world to another. Few of the changes that reverberate through time and space are anticipated by the inventors who are the catalysts of these vast transformations. Nonetheless, adaptive economizers, creating new ideas and artifacts, seizing current opportunities as they are created, responding to their unanticipated consequences as best they can, transform the world.

The economic rewards and punishments that accompany the periods of greatest change are inevitably divergent. Though many people may well rejoice in the new opportunities, others may look with regret on what eventually involves a destruction of old values and ways of life. It is little wonder that conflict should arise as some industries, some regions of a country, some occupational groups flourish while others decline. When divergent fortunes contrast enough, political turmoil usually follows. This in turn motivates institutional innovation that modifies existing rules of ownership, resource allocation, and civic order, a process aptly described as ‘the co-evolution of economy and state’ (see Day, 1998). General equilibrium and game theories are not adequate to comprehend it. They shed little light because they ignore essential behavioral properties of choice and social interaction. The developments I have been emphasizing are played out on too large a canvas to be portrayed adequately by those limited tools. A full understanding of contemporary events requires historical knowledge and a dynamic point of view.

## **8. Internal combustion and a world on the edge of conflagration**

My thesis research long ago was devoted to a study of production, investment, and technological change in agriculture. Support for the work was motivated by what was at the time a major political issue, the so called agricultural surplus problem that grew out of depression era agricultural subsidy programs and which was creating a vast system of bins and warehouses, visible along the roads and highways throughout the middle west and



south and costing tax payers millions of dollars in storage costs for seemingly unwanted goods. A major issue in the presidential campaign of 1960, it became an early centerpiece of John F. Kennedy's administration when he elevated the director of the already existing Food for Peace program to Cabinet rank. In his inaugural address he ordered its use as a major weapon in the worldwide campaign against communism.

My job was to build a model that could be used as a prototype of a national system for predicting the impact of technological change and government policies on the production of agriculture commodities. I constructed it after traveling widely in the prototype area selected for the study and after interviewing several dozen producers varying in size from 16 acre sharecropping farms to the vast 50,000-acre Delta Pine and Land Corporation. On the basis of a detailed activity analysis it incorporated several technological alternatives, various types of land, and quite a number of other inputs. The result was a recursive-programming model of representative adaptive economizers.

As the work progressed, what came to interest me most was the implications for labor utilization implied by the model dynamics. What the simulation portrayed was a year by year reduction in labor requirements, first in land preparation, then in planting and cultivation, and finally in harvesting. The result was a substitution of day labor for sharecropping and the eventual decline of day labor itself. In reality millions of sharecroppers and small farmers moved to villages scattered throughout the region and thence into cities in both the south and north. Race riots broke out as formerly rural people crowded into declining neighborhoods and growing slums in cities all across the country—Birmingham, Cincinnati, Chicago, Los Angeles.

All these people—the adopters of labor reducing new technology, the small farmers who had to wait until a secondhand market emerged in farm machinery, the sharecroppers and day laborers who left the rural life for urban centers—all based their decisions on past experience, current data, and existing opportunities. Some established prosperous new occupations, others—many of them content with things as they had been—lost their livelihood and were forced to explore new and unknown situations with little information about the possibilities and few resources to deal with them. These adaptive economizers reacting to the past—some with more or less elaborate plans for the future, others only little more than hopes—transformed the American landscape (see Day, 1963, 1967).

The inventions that were responsible for all this began in 150 B.C. when Greek metal workers originated the use of the piston for blowing air.<sup>4</sup> Dozens of other discoveries, most in the 19th Century, led eventually to the perfection of the internal combustion engine. Automobiles and trucks began to replace buggies and wagons in cities. Tractors replaced horses and mules on farms. By mid 20th Century the horse was virtually eliminated as a draft animal. The economies of mass production permitted all but the poorest people to operate their own vehicles.

A corollary of these trends was an increase in the use of petroleum as fuel, which together with its use as a feedstock for plastics and fertilizer production, led to an explosive increase in the consumption of petroleum. The accompanying growth in the general economy led to an accelerating depletion of domestic stocks of oil, iron, copper, and other ores and, during the last two decades, accelerating dependence on imports from abroad, in this way arriving

<sup>4</sup> Encyclopedia Britannica, "Internal Combustion" (1964).

on the edge of a worldwide conflict of cultures that reflects the incredible imbalances of economic growth, resource exploitation, and cultural change.

It is a strange artifact of empirical macroeconomics that all of this is subsumed in aggregate indexes which, transformed appropriately into “labor efficiency units”, can be represented approximately by a balanced growth path that can be derived from an infinite horizon optimization of a single utility function conveniently (but otherwise arbitrarily) chosen to facilitate the mathematics. Far from an optimal solution of any government bureau or representative individual person, however, the outcome of an economy of adaptive economizers is better understood in Tocquville (1833) terms,

... time does not stop its course for nations any more than for men; they are all advancing towards a goal with which they are unacquainted.

Not everyone should try to deal with the vast issues I have raised here. Some people should continue to concentrate on understanding better how people really behave in well-defined choice situations. Others should continue to advance our understanding of how people interact in well-specified institutional settings. Still others, building on what has been learned so far, must find ways to incorporate the findings of behavioral economics in models that can provide coherent, rigorous, yet relevant characterizations of economic process at a macro scale.

If we are not to be overwhelmed in the future by developments already discernible in the present, we must develop an economics that can explain the central features of our past. If we succeed in that, we would then know how to prepare better for the future consequences of current actions. The methods of behavioral economics, based on direct observation and inquiry, will play a key role.

## References

- Cooley, T.F., Prescott, E.C., 1995. Economic growth and business cycles. In: Cooley (Ed.), *Frontiers of Business Cycle Research*. Princeton University Press, Princeton, Chapter 1.
- Day, R.H., 1963. *Recursive Programming and Production Response*. North-Holland Publishing Company, Amsterdam.
- Day, R.H., 1967. Technological change and the demise of the sharecropper. *American Economic Review* 57, 427–449.
- Day, R.H., 1984. Disequilibrium economic dynamics: a post-Schumpeterian contribution. *Journal of Economic Behavior and Organization* 5, 57–76.
- Day, R.H., 1998. An evolutionary theory of democratic capitalism. In: Eliasson, G., Karlson, N. (Eds.), *The Limits of Government: On Policy Competence and Economic Growth*. Papers from the Sixth Conference of the International Joseph A., Schumpeter Society in Stockholm, City University Press, Stockholm.
- Day, R.H., 2004. *The Divergent Dynamics of Economic Growth*. Cambridge University Press.
- Pingle, M., Day, R.H., 1996. Modes of economizing behavior: experimental evidence. *Journal of Economic Behavior and Organization* 29, 191–209.
- Solow, R., 1995. My evolution as an economist. In: Breit, W., Spencer, R.W. (Eds.), *Lives of the Laureates*, third ed. The MIT Press, Cambridge, MA.
- Tocquville, A., 1833. *Democracy in America* (Special edition, 2000), Paladium Press, Birmingham, AL.