

# What Economists Teach and What Economists Do

David Colander

*Abstract:* Fifty years ago what was taught in the principles of economics course reflected reasonably well what economists did in their research. That, however, is no longer the case; today what economists teach has a more nuanced relation to what they do. The reason is that the economics profession and the textbooks have evolved differently. The author addresses the implications of the changes that have occurred in the profession for the way economics is taught and the way economics is presented in the micro principles textbooks. First, he summarizes the changes he sees happening in the profession. Second, he discusses the stories that the principles textbooks tell in micro. Third, he discusses how those stories might change to reflect better what economists currently do.

**Key words:** complex systems, economic pedagogy, microeconomics, principles textbooks

**JEL code:** A22

Fifty years ago what was taught in the principles of economics course reflected reasonably well what economists did in their research. That, however, is no longer the case; today what economists teach has a more nuanced relation to what they do. The reason is that the economics profession and the textbooks have evolved differently.

In my writings on the economics profession (Colander 2000a; Colander, Holt, and Rosser 2004) and on economic education (Colander 2000b; 2004c), I have discussed these differing evolutions and have argued that the way modern economists use theory and the way that they relate theory to the empirical evidence have evolved so significantly that modern economics needs to be given a new name to distinguish it from neoclassical economics. Those changes have been little remarked upon because they have occurred incrementally, not in sudden jumps, and the large cumulative movement can be seen only when one looks at the profession from a more distant perspective than most economists take.<sup>1</sup>

In this article, I deal with the implications of the changes that have occurred in the profession for the way economics is taught and the way economics is presented in the micro principles textbooks. First, I summarize the changes I see happening in the profession. Second, I discuss the stories that the principles textbooks tell in micro. Third, I discuss how those stories might change to reflect better what economists currently do.<sup>2</sup>

---

*David Colander is the CAJ Distinguished Professor of Economics at Middlebury College (e-mail: Colander@Middlebury.edu).*

## WHAT ECONOMISTS DO

All fields of research evolve, and economics is no exception. With the developments in analytic methods and computing technology in the past 50 years, it would be surprising if it were otherwise. Fifty years ago, computers were, practically speaking, nonexistent, and empirical work in economics consisted of running simple regressions calculated with mechanical calculating machines. Analytically, calculus was then seen as advanced mathematics, and deductive reasoning with two-dimensional graphs was still considered advanced theory. Macro was in its infancy; and although there was hope that in the future macroeconomic models would be developed into viable models, work on the simplest of such models was considered cutting-edge research. Simple consumption function and demand for money equations were at the forefront of theoretical and empirical research.

Today's economics is fundamentally different from the economics of 50 years ago. The reason is simple: Technology has changed. Economists' training today is statistically sophisticated, and in many ways, the "metrics" has progressed faster than the "econo." Today, computers are integral to research, both in analytic methods and in empirical work; today, data and theory are constantly being related in ways that were never considered by economists 50 years ago. Analytically, serious consideration of dynamic issues, which 50 years ago was beyond the analytic purview of even the most sophisticated mathematical economist, has replaced comparative statics on the forefront of theoretical issues, and the idea that one could do graduate work in economics without extensive mathematical training has become almost unthinkable.<sup>3</sup> Two-dimensional graphs, the mainstay of theory through the 1950s, are today seen as simplifying pedagogical devices, not as engines of analysis.<sup>4</sup>

The increase in the analytic and statistical sophistication of the profession has been accompanied by a growing acceptance that the economy must be analyzed as a "complex system" rather than as a highly complex, "simple system."<sup>5</sup> Simple systems, no matter how complex, can, in principle, be analyzed analytically and controlled, at least in a stochastic sense. Complex systems cannot. Although we are still a long way from complete acceptance of this complexity vision of the economy, cutting-edge research is moving in that direction and is, in my view, the future of economics.

Simple and complex systems differ in their micro foundations. Simple systems can be studied from micro foundations alone, by which I mean that one can build up from an understanding of the fundamental elements of the system to an understanding of the whole system. Complex systems involve emergent properties and cannot, in their entirety, be understood from an analysis of the components of that system. There can still be micro foundations, but the micro foundations of complex systems are contextual and can only be understood in reference to the existing system and its history. Such complex systems are built up in path-dependent stages, making individual optimization within such systems history—and institution—specific. This means that institutional structure is central to understanding a complex system, and that any assumed rationality must involve some boundedness.<sup>6</sup>



Parts of the system may be understandable using simple deductive analysis, but other parts will not be.

The acceptance of the economy as a complex system changes the focus of economists' analysis. In a simple system, it makes sense to analyze idealized agents and to see economics *as the study of infinitely bright agents interacting in information-rich environments*. The acceptance that the economy is complex makes such an analysis less relevant for understanding the economy and changes the focus of analysis to *the study of reasonably bright individuals interacting in information-poor environments*. It also changes the way in which economists think of their role in policy. Specifically, it moves them away from an economics-of-control framework—a *framework within which infinitely bright economists with full knowledge of the system design policy*, to an economics-of-muddling-through framework—a *framework within which reasonably bright economists with limited knowledge of the system provide inputs into a larger policy process*.

The acceptance that the economy is complex also suggests quite different research strategies than are appropriate for the study of simple systems; it requires less reliance on deductive theory and more on pattern analysis and inductive analysis. It involves more emphasis on studying how real people behave rather than on studying how infinitely rational people behave. Thus, it involves a movement away from the holy economic trinity of rationality, greed, and equilibrium and toward a broader economic trinity of purposeful behavior, enlightened self-interest, and sustainability.<sup>7</sup>

We can see the acceptance of complexity in the economics profession in the changing nature of research being done, especially by younger professors. Today, research is characterized by a blossoming of behavioral economics studies, which consider how people actually behave. This work does not assume full rationality but instead attempts to study purposeful behavior. Similarly, the growing field of experimental economics provides a way of describing the behavior of agents in the economic model, rather than assuming "rational" behavior. Experiments are introducing alternative ways to specify the degree of rationality and greed to assume in models.

Another element in the change is the rise of evolutionary game theory, which embeds the maximization process in an evolutionary system to gain insight into how institutions and norms develop; it then defines rationality locally in terms of evolutionary stable institutions, rather than globally. Still another element of the change is the rise of New Institutional Economics, which is focused on integrating institutions into economic analysis. Finally, there is the rise of agent-based modeling, in which the researcher creates a virtual environment allowing various behaviors of agents to compete and then sees which behaviors actually survive.

The acceptance of the complexity of the economy can also be seen in the empirical work that economists do. Most of this work has little to do with formal testing of economic theories consistent with general equilibrium but instead involves informal testing of various ad hoc theories. This work focuses on pulling information and insight from data, not on issues such as proving that demand curves slope downward. Modern empirical work is more often than not a search for patterns in data—a type of highly sophisticated data mining—not a test of theories.



Consider the recent work of Bertrand and Mullainathan on discrimination (2004). By conducting a field experiment in which they changed the name of a job applicant, they provided strong evidence that discrimination exists in the labor market. In their research, little in the way of economic theory was used directly. Although they discussed the results in terms of asymmetric information, screening, and statistical models of discrimination, the results stood on their own. The work was simply a well-designed field experiment that added insight into our understanding of the operation of the economy and the degree and nature of discrimination that exists. Another example is the oft-cited work on abortion and crime by Donohue and Levitt (2001). Again, the work is primarily statistical in nature with only loose guidance from economic theory. These examples are not unique; most applied work in microeconomics today is highly empirical and has only the loosest connection to general equilibrium theory.

The search for patterns in data can also be seen in the new work on power law relationships, such as Zipf's Law (Gabaix 1999), which some dynamic systems exhibit. Once a system has been shown to exhibit a power law relationship, researchers can study the system replicator dynamics that might lead to such results and thereby gain insight into the system. In this work, researchers rely on computing power to find patterns in the data, rather than using statistical work to test theories. They then attempt to structure theories that are consistent with the data. Theories that are not consistent with those patterns must be modified or abandoned.

In summary, economics today is not the economics of our grandparent's generation, our parent's generation, or even the economics of the generation of economists currently in their mid-40s. It has evolved significantly; it is more technical in an applied mathematical sense, but often less technical in a pure mathematical sense than the economics associated with general equilibrium analysis.<sup>8</sup> It is loosely designed around models and modeling, but those models are less likely to be tied to general equilibrium foundations. It is more consciously empirical than the earlier work.

## WHAT ECONOMISTS TEACH

Ultimately, the teaching of economics boils down to the telling of stories. In the principles of economics textbooks, we tell stories that are meant both to give students a sense of what economic analysis is (often expressed as teaching students the economic way of thinking) and to provide students with insight into how the economy operates. For most undergraduates, the mathematics used in cutting-edge modern economics research is the equivalent of Greek, and thus, the textbook authors have been, understandably, slow to incorporate the changes. The economic approach in the micro textbooks in large part still reflects the research approach to economics that economists followed in the 1930s to 1960s. In fact, the current structure of the textbooks still reflects the structure that was developed in the 1950s with Paul Samuelson's textbook (Samuelson 1948).<sup>9</sup> With the mathematical and statistical gulf between the research that economists do and the training in mathematics that undergraduates have growing ever wider, it becomes harder and harder to relate what economists do to what they teach.



Were the majority of economics students planning to go on to become economists, the answer about what to do about this situation would be easy: increase the mathematical and statistical requirements for studying economics. But fewer than 1 percent of the students taking principles of economics courses will ever go on to become research economists; the overwhelming majority will go on to work in a variety of other careers in which the significant mathematical training necessary to read the current research of economists, although helpful, is unnecessary. The “increase the math requirements” solution will not meet their needs. This means that the stories economists tell must be embedded in highly simplified models, which have varying degrees of relationship to the more complex models that are actually being worked on by economists.

To say that the textbooks do not reflect the research being done does not mean that what economics instructors teach is irrelevant or wrong, nor does it mean that they should change what they teach. The deciding factor of what instructors teach in principles should not be what is most up-to-date but what adds the most value to students’ understanding of the economy. Given that decision factor, there are numerous pedagogical reasons why instructors might choose to teach something different from the latest research that economists do.

In my view, what economics instructors currently teach is extremely valuable to students, and they can continue to teach what they currently teach with only slight modifications and feel good about doing so. So my argument is not that instructors should fundamentally change what they teach; my argument is just that there is an understandable tension between the simplicity and definitiveness of what they teach and the complexity and ambiguity of what economists do in research. It is an open question how the textbooks should relate to students the actual process of what economists do and how researchers believe the economy operates.

In micro, the story economists tell in the textbooks is probably best described as the “efficiency story.” It is a two-part story—one part about how rational individuals approach problems and a second part about how markets channel rational individuals’ actions into results that are beneficial for the common good.

The story of the rational individual focuses on scarcity and constrained optimization; it directs students’ attention to the TANSTAAFL (There Ain’t No Such Thing As A Free Lunch) law, opportunity cost, and how individuals economize to deal with scarcity. The focus of this story is on rational choice; students are taught a variety of models—the profit-maximizing model of the firm, the utility maximizing model of the individual, and simple game theoretic models such as the prisoner’s dilemma—that either reinforce that efficiency theme or have meaning in relation to it. To arrive at definite results, the rationality used in these models is narrowly defined in relation to utility maximization, and the behavioral foundations of individuals’ actions generally receive little attention. The presentation is generally deductive rather than inductive, and there is little discussion of empirical evidence that might support or contradict the presentation in the book.<sup>10</sup> Issues that cloud the efficiency story, which are on the cutting edge of modern theory, such as endogenous tastes, path dependency, and endogenous institutional structure, are avoided.

On the aggregate level, the story is a bit more complicated; it integrates the decisions of individuals into aggregate results through the market place. These



integrative stories use perfect competition as a reference point and provide students with a discussion of how markets channel individual interests into results that reflect the common good. As was the case with the story of the individual, these aggregation stories rely on narrowly defined hyper-rationality requiring individuals to maximize well-defined intertemporal utility functions specified over all goods, meeting a number of axiomatic conditions, such as transitivity of preferences, and careful specification of what is meant by the common good. Specifically, the story told is one of how a perfectly competitive system is driven by the invisible hand of the market to a Pareto optimal result in which no one can be made better off without someone else being made worse off. This aggregate efficiency story relies heavily on the narrowly defined rationality assumption. If individuals are not rational, as rational is used in its formal sense, it is impossible to arrive at the aggregate efficiency conclusions of the second part of the efficiency story.

In terms of policy, the focus of the story told in the principles course is again centered on efficiency. It conveys to students a sense of how restrictions on voluntary actions limit the attainment of efficiency, how externalities and monopoly can create a gap between social and private costs, and how, through appropriate taxation policy, government can correct those market failures and work to equate marginal social costs with marginal private costs. It is a control story in which there is a knowable social optimum that government policy is designed to achieve.<sup>11</sup>

There is much to be said for teaching this efficiency story. It is excellent for shedding light on many issues of which students do not have a good understanding and for shedding light on some important economic policy problems. But it has a number of well-known limitations. For example, it leaves out issues of dynamic efficiency and does not convey to students how less-than-competitive markets are more conducive to technological change than are perfectly competitive markets. It also misses many of the broader issues of policy in which the policy problem is not market failure but instead failure of market outcomes.

Students learn the lessons of this efficiency story in varying degrees. As they take higher level courses the coursework expands upon the efficiency story, but the central theme remains the same—the study of a system in which rational individuals optimize subject to constraints. What changes in the upper level courses is that the structure of the system being controlled, and the nature of the control, becomes more complicated—moving from a simple constrained static maximization story to a stochastic dynamic optimal control story, depending on how high-brow the upper level course is. The textbook story, although more complicated, is the same. In this system rational individuals are optimizing, and economists are the rational controllers who structure the rules and policies to optimize the social welfare of the system.

### **Bringing the Micro Story Up to Date**

The current textbook micro story was developed in the 1930s and became the textbook story beginning with Paul Samuelson's textbook. At the time it was developed, it was a reasonable description of how cutting-edge economists thought about the economy and of what they did. As I stated earlier, computers as



we know them did not exist, and sophisticated empirical work was difficult and extremely costly to do. The profession was still digesting the analytics of the general equilibrium model, and Walrasian general equilibrium was still on the theoretical front lines.

Today, the textbook micro story that instructors tell is still useful, but it is no longer on the forefront of theory, nor does it reflect how policy problems are approached. I think it nonetheless can be justified as a useful fable that we teach to students to convey important lessons to them. These lessons carry over to a broader set of issues, and although the specific results of the model are not robust, there is a feeling that the broader stories being told—TANSTAAFL, optimizing at the margin, and the positive effect of competition—are.

However, as I argued earlier, the specific stories economist are telling in the models can no longer be supported as a description of how research economists at the cutting edge think about issues. Modern economists use an inductive empirical approach that is only loosely guided by the theory that incentives matter. They do not test theories; there is no disproof of the efficiency story that would cause them to give it up. In modern economics, incentives still matter, but the standard of perfect rationality, greed, and equilibrium is being replaced by a standard of purposeful behavior, enlightened self-interest, and sustainability.

Ultimately, I suspect, the textbooks will better reflect the changes that are occurring in economics. The profession replaces itself every 35 years or so, and as that happens, what is taught will change, because teachers generally teach what they have learned. It will be a long time happening because of the built-in user problem. There is too much human capital tied up in the current pedagogical approach for it to disappear quickly.

Given this institutional structure, I expect that the change in the principles textbooks will take place in two ways. The first is evolution of the current story as it is modified by the changes that are occurring. But there is no way that existing textbooks can ever fully capture the new approach because they are built on a foundation that was built in the 1950s. Thus the second path will be an entirely new type of textbook, built on induction, one that jettisons the supply and demand framework and much of the analytic foundations of the efficiency model. Given that the current approach to teaching is built into the current institutional structure, both in course offerings and in the structure of the textbook market, I suspect that this second path is a long time in the future and will probably occur only as print textbooks give way to online presentation of material and alternative methods of instruction. Thus, my focus in this article is on the less dramatic evolution of current textbooks. Specifically, I consider five ways in which I think the micro textbook could change to reflect better the new work.

*Models as Calisthenics, Not as Truth.* The first change that would better integrate modern work with the models presented in the textbooks is a change in the way the models are presented. Instead of presenting them as blueprints of reality, embodying truth, instructors can present them as logical exercises that can be helpful in understanding the economy. This allows than to tell students about the more complicated approach that modern economists take while still teaching

students the simpler models. Such an approach to models is consistent with a complexity vision because in that vision even the most sophisticated models that instructors have today are far below the sophistication needed to understand the economy.

Let me explain what I mean by this. If the economy is a complex system, models are not used as a blueprint but rather as a guide to stimulating thought about the economy and as a means of structuring analysis. In this “theory as a guide” approach, when there is a difference between practical experience and theory, pure theory is not the guiding factor—practical experience guided by theory is. Ultimately, induction, not deduction, underlies all reasoning about complex systems.

To justify my teaching models as calisthenics, I explain to students that their minds are like my body—a bit flabby—and that both could use a bit of exercise. The models they are learning are designed to provide precisely that, and although the models do not prepare students to understand economic reality, they do provide the training that eventually will help students understand the issues better.<sup>12</sup>

*A Decrease in the Emphasis Given to Efficiency.* The current micro story is designed around efficiency, as if that were a goal of society. Actually, efficiency only becomes a goal in a highly rarified model, and achieving efficiency is a reasonably desirable goal only if one accepts all the assumptions of the model that underlies it—costless redistribution of income or homothetic tastes, no interdependent utility functions, and full rationality of individuals. Modern economics recognizes that and treats efficiency as a useful shorthand for maximizing total output independent of distributional consequences. When those assumptions do not hold, economists’ role is not to design policies that achieve efficiency, but instead, to design as cheaply as possible the policies that achieve whatever goals society specifies. Economists are not specifying the goals, they are only specifying how best to achieve those goals. It was that recognition that led J. N. Keynes (1891) and Robbins (1953; 1981) to emphasize the importance of maintaining a separate branch of applied economics and of not drawing policy implications from theory.

One method of incorporating this broader approach into the textbooks is to introduce into the presentation failures of market outcomes in addition to market failures (Colander 2003). Failures of market outcomes occur when the market is doing everything it is supposed to do but society still does not like the result. These failures can occur because of psychological issues in which individuals’ actions do not reflect their true desires. Discussion of such psychological issues would allow the incorporation of insights from behavioral economics. Another reason these failures can occur can be because of distributional issues. Raising distributional issues emphasizes to students that consumer surplus reflects demands at the current distribution of income, not welfare of society as most students think of it. A final reason these failures can occur is because moral considerations override efficiency considerations, such as the examples pointed out by Sen (1970).

*A Change in How Equilibrium Is Presented.* A third change that can better relate the economics in the current textbooks to modern research is in the



presentation of equilibrium. Specifically, I would change three aspects of the way in which equilibrium is discussed in the textbook.

The first change is to present equilibrium as a state of the model, not as a state of the economy.<sup>13</sup> In this view of equilibrium, the existence of equilibrium does not mean that one believes that the economy is ever going to arrive at an equilibrium; it simply means that there are forces pushing the economy in that direction, and that, other things being equal, which they never are, the economy would move there.

A second change I would propose that would make the textbooks more consistent with the modern approach is to present a multiple equilibrium model. The standard models now used in principles textbooks are all unique equilibrium models. Complex systems generally have an infinity of, or a large number of, equilibria, which means that equilibrium selection mechanisms become very important; these equilibria selection mechanisms choose which of the many equilibria the economy will gravitate toward. Discussing such forces would involve a larger discussion of institutions than currently exists and a greater emphasis on public choice and rent seeking.

A third change in the discussion of equilibrium that would make the books more consistent with modern research would be to present alternative ways in which individual agent equilibria are connected to aggregate equilibria. Currently, aggregate equilibria are equated with all agents within the model also being in equilibrium. The complexity vision of the economy offers an alternative aggregate equilibrium in which no individual agents are in equilibrium, but in which the aggregate is in a type of equilibrium in the sense that it will not have a tendency to move from where it is. It is a statistical equilibrium consistent with what one sees in statistical mechanics, not a static equilibrium. Statistical equilibria are much better suited to explain equilibrium in the aggregate economy and offer a number of advantages in explaining observed phenomena to students. Consider profits, which in the current standard textbook exposition cannot exist above the opportunity cost of implicit factors of production. If the system is in statistical equilibrium in which fluctuations of system elements offset each other (Foley 1994), that need not be the case, because profits are guiding agents in their decisionmaking, and there is no reason why the profits being made in the economy could not exceed the losses; when that happens, it means that the economy is growing because, on average, people are making decisions that are panning out.

*Present Rationality as Reasonableness Rather than Rationality.* Another change instructors can make is to get the students thinking in terms of reasoning that involves higher levels of rationality, rather than the simple rationality that the textbooks currently focus on. One way I do this in class is with the following game, which is called the Beauty Contest game (Nagle 1995). In this game, I pass out small sheets of paper on which each student is asked to write a number between 0 and 100 that will turn out to be two-thirds of the average number chosen by the group. For example, if the average number chosen turned out to be 30, the winning guess would be 20.

After playing the game, I discuss with the class the nature of the decision process appropriate for this decision. The logical answer is to push toward zero,

but zero is not a correct answer; thus the game becomes one of behavioral strategy, as are many of the decisions people make in real life. What's interesting about this game is that usually the results are relatively easily predictable for the group playing, and in the initial round, the winning guess is generally somewhere around 20 to 25 when played by students unfamiliar with the game.

Right after playing and discussing this game, we play the average game, in which students are asked to pick a number between 0 and 100 that is the average of the number picked by all students. Here, the expected answer is 50, but the playing and discussing of the previous game inevitably leads some students to choose a lower number, and the winning number is generally closer to 35 or 40. Again, behavioral considerations are integrated into the discussion.

*More Focus on Increasing Returns, Path-Dependencies, and System Resilience.* A final change that would incorporate better new work in advanced theory into the textbooks is a greater focus on increasing returns and path dependencies. Currently, such issues are only presented as addenda because they do not fit the efficiency story. However, once multiple equilibria models have been introduced, increasing returns and path dependencies become important elements of the equilibrium selection mechanism. This raises the question of equilibrium resilience as a goal of a system, and an important policy question becomes whether agents in a system want a shift from one equilibrium to another to occur. In ecological economics, there are models in which there are sudden changes from one equilibrium to another, as the forces of change have built up beyond a certain level. Currently, there are no models in the principles textbooks that introduce the importance of resilience in systems; all the models suggest to the students that change always occurs incrementally. By including a model that has a sudden change—and a shift point—one can convey to students the essence of the policy implications of non-linear dynamic models.

New work being done in agent-based modeling, such as the work of Leigh Tesfatsion and Blake LeBaron (available online), allows one to give visual demonstrations of sudden shifts. Eventually, agent-based modeling will be central to the teaching of principles of economics. Currently, it is unfamiliar to most professors. One way in which I present the idea of multiple equilibria to students is with John Conway's game of life (available online) that conveys to them how easy it is for a small change to occur and encourages them to think in terms of dynamic processes rather than static models.

## CONCLUDING COMMENTS

My discussion of what economists do and what they teach may have made it seem that the textbooks are hopelessly out of date. Let me reiterate the point I made earlier: *that* is not my view; textbook authors do many things, and keeping up with the latest developments in what economists do is only one of them. The principles of economics course has, in my view, enormous strengths; the no-free-lunch lesson alone—one of the most important lessons that a student can learn—fully justifies the micro course. The macro principles course gives students a good



sense of the aggregate forces that drive the U.S. economy and of what inflation and unemployment are and a working knowledge of monetary and fiscal policy. Given the opportunity costs, both these courses are fully justified.

Because I believe that the current courses have enormous value, I am hesitant to change too much in the current presentation, even though I agree that what economists teach does not reflect what they do. Maintaining compatibility between what economists teach and what they do is not a requirement of good teaching in economics. Before economists make any changes in the principles course to reflect better what they do, they want to be sure that those changes do not dilute the strengths of the current presentation. I am not sure whether instructors are ready to do that, which is why I stick with the standard presentations in textbooks, even though in my research, I spend time thinking about problems created by modern research. Teaching, like the economy, is a complex system, and economists' fate in both is to muddle through as best they can.

### NOTES

1. This has also been the case with previous changes in economics, such as the movement from classical to neoclassical economics (Colander 2000c).
2. In this article, I consider only micro issues. The reasons are that (1) the macro story told in the textbooks is less coherent than the story told in micro, and (2) there is much more diversity of opinion about what story should be told in macro than there is in micro. I discuss macro issues in Colander (2004a).
3. Whether these changes are good or bad is debatable and not the subject of this article; my point is simply that this is the way it is.
4. In Colander (2004c), I discuss the IS/LM model as an example of the changing way in which graphs are used.
5. I am using "complex" and "simple" in a technical sense here. For a discussion of what is meant by "complex system," see Auyang (1999).
6. These ideas are developed in Anderson, Arrow, and Pines (1988) and Arthur, Durlauf, and Lane (1997).
7. Kreps (1997) discusses the movement.
8. To say that economics has evolved is not to say that it does not reflect its past, and in many ways, the changes being made are as small as possible. For example, behavioral economics is moving only slowly away from the deductive foundations and is seldom presented as being part of a broader complexity vision. Most of the published works make only small deviations from standard models. Similarly, most economists think of what they do in reference to what they were taught. It is at the margin, with new professors, that the changes are largest.
9. Samuelson's text was first written in 1948 (Samuelson 1948). It is currently in the 16th edition but is now written jointly with William Nordhaus.
10. Examples of issues that are not discussed include the experimentally determined results that sunk costs and fairness often do enter into people's behavior, and that the utility gained from consumption is often determined by one's consumption relative to what others receive, not by the absolute amount one receives.
11. The efficiency story has not always been the central story of economics. It developed in the 1930s and was structured in its current form in Lerner's *Economics of Control* (1944), which is why I call it the economics of control story. Lerner had a gift of seeing everything in simple terms and of designing teachable black and white models that others saw in shades of gray. For Lerner, theory was a blueprint upon which policy could be built. See Colander (2004b) for a discussion of this evolution.
12. Solow (1964, 7–8) has used similar reasoning in justifying the teaching of some high-level models that also do not reflect how economists think. He wrote: "In economics... I like a man to have mastered the fancy theory before I trust him with simple theory. The practical utility of economics comes not primarily from its high-powered frontier, but from fairly low-powered reasoning. But the moral is not that we can dispense with high-powered economics, if only because high-powered economics seems to be such an excellent school for the skillful use of low-powered economics."

13. Some advocates of a complexity approach have argued that accepting that the system is complex means that economists must give up equilibrium because the economy is continually changing. I do not agree. Once students see models as tools, not blueprints, equilibrium as a state of the model does not tell them anything about the state of the economy, and it can be very useful to use equilibrium models as reference points for thinking about possible basins of attractions, which are the multiple equilibria equivalent of equilibria.

## REFERENCES

- Anderson, P. W., K. J. Arrow, and D. Pines, eds. 1988. *The economy as an evolving complex system*. Redwood City, CA: Addison-Wesley.
- Arthur, W. B., S. N. Durlauf, and D. A. Lane, eds. 1997. *The economy as an evolving complex system II*. Redwood City, CA: Addison-Wesley.
- Auyang, S. 1999. *Foundations of complex-system theories in economics, evolutionary biology and statistical physics*. Cambridge: Cambridge University Press.
- Bertrand, M., and S. Mullainathan. 2004. Are Emily and Greg more employable than Latisha and Jamal? A field experiment on labor market discrimination. *American Economic Review* 94 (Sept): 991–1014.
- Colander, D. 2000a. New millennium economics: How did it get this way, and what way is it? *Journal of Economic Perspectives* 14 (Winter): 121–32.
- \_\_\_\_\_. 2000b. *The complexity vision and the teaching of economics*. Cheltenham, UK: Edward Elgar.
- \_\_\_\_\_. 2000c. The death of neoclassical economics. *Journal of the History of Economic Thought* 22 (June): 127–43.
- \_\_\_\_\_. 2003. Integrating sex and drugs into the principles course. *Journal of Economic Education* 34 (Winter): 82–92.
- \_\_\_\_\_. 2004a. A brief history of post Walrasian macroeconomics. Middlebury College Working Paper, Middlebury, VT.
- \_\_\_\_\_. 2004b. From the economics of control to the economics of muddling through. Middlebury College Working Paper, Middlebury, VT.
- \_\_\_\_\_. 2004c. The strange persistence of IS/LM model. *History of Political Economy* 36 (4): 305–22.
- Colander, D., R. Holt, and B. Rosser. 2004. *The changing face of economics*. Ann Arbor: University of Michigan Press.
- Conway, J. Game of Life. <http://encyclopedia.thefreedictionary.com/Conway's%20Game%20of%20Life>.
- Donohue, J. J., and S. D. Levitt. 2001. The impact of legalized abortion on crime. *Quarterly Journal of Economics* 116 (May): 379–420.
- Foley, D. 1994. A statistical equilibrium theory of markets. *Journal of Economic Theory* 62 (2): 321–45.
- Gabaix, X. 1999. Zipf's law for cities: An explanation. *Quarterly Journal of Economics* 114 (August): 738–67.
- Keynes, J. N. 1891. *The scope and method of political economy*. London: Macmillan.
- Kreps, D. 1997. Economics—The current position. *Daedalus*. 126 (Winter): 59–88.
- LeBaron, B. <http://people.brandeis.edu/~blebaron/acf/index.htm>.
- Lerner, A. 1944. *The economics of control*. London: Macmillan.
- Nagle, R. 1995. Unraveling in guessing games: An experimental study. *American Economic Review* 85 (5): 1313–26.
- Robbins, L. 1953. *The theory of economic policy in English classical political economy*. London: Macmillan.
- \_\_\_\_\_. 1981. Economics and political economy. *American Economic Review* 71 (May): 1–10.
- Samuelson, P. A. 1948. *Economics*. New York: McGraw-Hill.
- Sen, A. 1970. The impossibility of a Paretian liberal. *Journal of Political Economy* 78 (1): 152–57.
- Solow, R. 1964. *Capital theory and the rate of return*. Amsterdam: North Holland.
- Tesfatsion, L. <http://www.econ.iastate.edu/tesfatsi/ace.htm>.