Hypnotized by Models

BY GENE CALLAHAN AND ROBERT P. MURPHY

We live in an age where abstract models of the real world are held in high regard. Wall Street firms hire mathematicians and physicists to create sophisticated mathematical representations of various assets and markets. Meteorologists employ computer simulations in an attempt to anticipate the path of storms and predict next week's weather. Marketing firms try to model how consumers will respond to a proposed ad campaign. Military strategists conduct virtual battles and wars. Bridges are built, planes are flown, giant buildings are raised, and crops are planted with the aid of abstract systems of equations.

The current respect for abstract modeling is not unfounded. Ever since the scientific revolution that took place during the sixteenth and seventeenth centuries, mathematical models of the physical world have continually increased humans' ability to manipulate their environment. On the other hand, repeated attempts to port the mathematical techniques that have proved so successful in the physical sciences directly to the social sciences have produced few positive results to date. But those who view the current methods of the physical sciences as the *only* valid way to achieve objective knowledge have claimed that this record of failure is due entirely to the relative youth of the social vis-à-vis the physical sciences and the greater complexity of their subject matter. Given enough time, they contend, mathematical models will depict the behavior of individuals and the evolution of social phenomena just as well as they handle inanimate matter and energy today.

For the time being we will set aside the question of whether those who contend that true social science *must* be based on mathematical modeling have a rational or empirical case for their stance. Instead, we will first point out that, for anyone engaged in the fascinating project of creating and perfecting abstract models, it is easy to forget that however useful and sophisticated his models might be, they are still only skeletal images of some subset of a complete human experience. Watching a simulation of a hurricane on a computer screen is a far cry from actually being in the midst of one. The chaos that ensues once a real battle is underway is never captured in a model of the conflict. A mathematical description of the atmospheric refraction of light at sunset does not convey the power of the setting sun as a metaphor for old age and death, the wistful nature of a winter sunset on a lonely moor, or the romantic mood created by watching the sun sink into the sea as one stands with a lover on a desert isle's beach.

However useful models might be, they are still only images of some subset of a complete human experience. Watching a simulation of a hurricane on a computer screen is a far cry from being in the midst of one.

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Correctly interpreting the relationship between a model and the raw experience from which it was abstracted is a matter of skilled judgment. A model cannot interpret itself; it asserts that *if* certain aspects of a particular situation closely conform to specifications contained in the model, *then* we can expect certain other circumstances to arise, either with full certainty or with some measure of probability. The question of how well a model captures the essence of some event in the real world cannot be answered mechanically.

All this implies an important pragmatic point about the application and misapplication of models: Skill at developing and manipulating the abstractions comprising a model does not necessarily correlate to skill at interpreting how that model relates to reality. Someone who is extraordinary at modeling various investment opportunities may be a disaster if he actually trades the securities he has modeled, which is why investment banks employ experienced traders to put their models into practice. A person who can develop top-notch simulations of the potential battle scenarios might be awful at responding to the constant surprises presented by a real battle, which is why armies have experienced officers in charge of their troops during an actual conflict.

Among economists, it is the Austrians who have been most keenly aware of the difference between being good at creating models and being good at interpreting their application to real events. They have noted that mainstream economists frequently develop highly simplified models of some economic process and then proceed to criticize the real economy because it does not perform like their model.

Perfect Competition

The model of perfect competition (PC), a mainstay of introductory economics courses, is a notable example of that tendency. The "competition" it depicts is deemed "perfect" because it leaves no unexploited gains from trade; for given technology, resources, and consumer preferences, there's no way to make any one person better off without harming someone else. However, in order for selfish decision-makers to be led by the "invisible hand" to this collectively efficient outcome, the model of perfect competition requires that neither the buyers nor the sellers of a good can affect its price. Instead, the model treats them as "price takers," passive entities who merely accept a price that emerges from mathematical equations. If the supply or demand for the good changes, its new price is automatically and instantly produced by the model. Should the demand for a good drop, all people selling it will suddenly discover, to their surprise, that they are now offering it for less! Somehow the price displayed on the sign on their shelf and in their newspaper ads will be changed by the supply and demand curves. Perfect competition is perfectly impossible, since it pictures a "market" in which human action, the driving force of all markets, is entirely absent.

But even if we set that aside, there is still a serious problem with the internal consistency of perfect competition. (This was first noted by mainstream economist G. B. Richardson.[1]) The model assumes that all market participants have identical knowledge of all economic conditions. Therefore, in response to a higher-than-normal return in the market for some particular good, all of them will be motivated to become suppliers of the good. However, their mass entry would result in a large increase in the supply of the good and a below-normal return. Since they all can anticipate the potential flood of new entrants, they will all be equally discouraged from supplying the good. But that leaves the return to the current suppliers above normal, spurring everyone to jump into the market, which would reduce the return to below normal, prompting everyone to stay on the sidelines . . . well, you can see where this is going. There are several potential assumptions that might be added in an attempt to rescue the model, but none of them is remotely realistic.

Despite all we have said, we don't suggest consigning the notion of perfect competition to the theoretical scrap heap. Even though it is highly unrealistic, it accurately depicts a particular, limiting case, which is implicit in the general analysis of supply and demand. Contemplating it may promote genuine economic insights. But we should keep in mind that it *is* an artificial construct, highlighting one aspect of the market process, at the high cost of pretending that there could *be* a market without the efforts of human

actors to adjust prices so that they better reflect prevailing conditions and preferences.

Yet what has the mainstream done with perfect competition? Rather than use the internally inconsistent model as a flawed but occasionally useful thought experiment, the typical economist uses its unrealistic (and indeed nonsensical) assumptions as a *benchmark* against which to judge the actual market economy. In particular, whenever firms in the real world engage in behavior that would be counterproductive in a PC model—and this includes such ostensibly consumer-friendly behavior as slashing prices and introducing new features to distinguish a product from its rivals—then this merely proves that the firms in question have "market power" and hence are not using resources efficiently. As F. A. Hayek said, "[I]f we ask which of the activities that are commonly designated by the verb 'to compete' would still be possible if [the conditions of perfect competition] were all satisfied . . . I believe that the answer is exactly none."[2]

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In addition to the model of perfect competition, we recently ran across a similar example in a textbook on international economics. Discussing the relationship of a nation's exchange rates to its balance of payments, the author says, "[U]nder a flexible exchange rate system, a balance-of-payments disequilibrium is *immediately* corrected by an *automatic* change in the exchange rates. . . ."[3] (Note that the author simply means the market will eliminate "gluts" and "shortages" of various *currencies* as surely as of commodities like milk and eggs.)

Now if a disequilibrium is "immediately corrected," in what sense did it ever exist? Wouldn't a market have to be out of equilibrium for at least *some* time, however brief, before we could say that there was any disequilibrium? The author's problem is that in the model he is using, exchange rates are always in equilibrium. He recognizes that real-world rates *must* be out of equilibrium at times—otherwise, why would any rational investor ever enter the foreign-exchange market?—but his model only deals with states of equilibrium. Therefore, he is forced to posit disequilibria that vanish simultaneously with their appearance.

And how would exchange rates change automatically? Is there a god of foreign exchange, attuned to the equations in textbooks on international economics, acting to enforce those formulas? In reality, isn't it when traders in the foreign-exchange market believe that an existing exchange rate is, in some sense, "wrong" that they make trades resulting in an alteration of the rate? In markets as liquid as the dollar-yen or dollar-euro, we might expect that such adjustments will occur very rapidly, so that reality will not be too different from a model in which they are instantaneous. Still, that does not make them automatic.

Models Can Be Useful

We could offer many more examples, but the two described above should be sufficient to illustrate our point. Again, we are not contending that all such models be banned from economics. Even those economists who disdain "unrealistic" models almost certainly give illustrative examples to their undergraduate classes in which, say, prices are rounded to the nearest whole dollar (even though this rarely happens in the real world). And what economist hasn't resorted to analyzing capital accumulation by picturing Robinson Crusoe, or analyzing international trade by considering a world with only two countries, each of which produces only one good?

However, to pass judgment on existing markets based on how closely they approximate an abstraction dreamed up by some theorist is to egregiously confuse the map and the territory. Even the most devout model builders will admit that their simplifying assumptions are acceptable *only if they do not lead one to an erroneous conclusion*. As David Romer—macroeconomist and author of textbooks that are *full* of models—puts it:

> [T]he purpose of a model is not to be realistic. After all, we already possess a model that is completely realistic—the world itself. The problem with that "model" is that it is too complicated to

> understand. A model's purpose is to provide insights about particular features of the world. If a simplifying assumption causes a model to give incorrect answers *to the questions it is being used to address*, then that lack of realism may be a defect. . . . If the simplification does not cause the model to provide incorrect answers to the questions it is being used to address, however, then the lack of realism is a virtue: by isolating the effect of interest more clearly, the simplification makes it easier to understand.[4]

At first, Romer's stance seems perfectly sensible. But in practice, his method contains an implicit bias toward government intervention. What has happened time and again is this: A macroeconomist devises a model in which the free market "fails," which is to say, the equilibrium outcome in the model is not "Pareto efficient." This is simply a fancy way of saying that the macroeconomist can formally show us that there is an alternative state of affairs (in his model!) in which every person in the economy (in the model!) could be made better off. The macroeconomist then takes this result and recommends that the government enact a certain policy to "correct" the market failure.

Now how is the free-market economist supposed to combat this? Of course, he can point out that the model used to justify the government intervention is unrealistic—but such an observation will be met with amusement by the likes of Romer. The free-market economist can come up with a *different* model, in which the recommended policy will lead to disaster. But then what? The typical macroeconomist has *his* model that recommends intervention, while the free-marketer has *his* model that advises laissez faire. How to decide? By Romer's stated criterion, we need to know which model's abstractions are harmless and which give us a false conclusion. Unfortunately, *that is precisely what the models themselves cannot tell us*. In practice, politicians tend to go with the activists, because at least then the public thinks "something is being done." And if it turns out to be a disaster, well, the macroeconomists just return to the drawing board and try to figure out a slightly *different* way to tinker with the economy. And, as history has shown time and again, the laissez-faire economists are at every step labeled "dogmatic," do-nothing cynics who are unwilling to experiment.

The modern fascination with models has influenced economics no less than other fields. Used properly, abstract models can often shed light on complex phenomena. Unfortunately, this practice has caused far more harm than good when it comes to the social sciences. Part of the problem is the qualitatively different subject matter: the physicist and chemist study inanimate matter, while the economist studies acting, self-aware beings with subjective desires and intentions. Another issue is simple duplicity: the politician eager for votes can always find *some* model to justify politically popular policies.

But perhaps the biggest flaw with current modeling techniques is their crudeness. The heroic simplifications necessary to make economic models "tractable" would be truly astonishing to those who assume the brain trusts at MIT and Chicago hold their financial future in good hands. For example, the baseline macro models taught at top-rank Ph.D. programs still feature economies with one good (which serves as both capital and consumption) and one consumer who lives forever and has perfect foresight. And yes, it is because of analysis based on such models that "expert" economists will recommend certain fiscal or monetary policies. Scary, isn't it?

1. See Gerald P. O'Driscoll and Mario Rizzo, *The Economics of Time and Ignorance* (London and New York: Routledge, 1996 [1985]), pp. 90–91.

2. F.A. Hayek, *Individualism and Economic Order* (Chicago: University of Chicago Press, 1948), p. 96.

3. Dominick Salvatore, *International Economics* (Hoboken, N.J.: John Wiley & Sons, 2004), p. 512, emphasis added.

4. David Romer, *Advanced Macroeconomics* (New York: McGraw-Hill, 1996), pp. 11–12.