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Beware of Economists Bearing Greek Symbols

by Emanuel Derman

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"In physics, it takes three laws to explain 99% of the data; in finance, it takes more than 99 laws to explain about 3%." So quipped MIT finance professor Andrew Lo at a dinner I once attended. Economists, he added, consequently suffer from physics envy.

Now, I was trained as a theoretical physicist in the 1960s and 1970s, the glory years of elementary particle physics. Our heroes were Einstein, Dirac, Gell-Mann, and Feynman—Nobelists all, visionaries who conjured up new mental worlds and the equations that went with them. And these new mental worlds, miraculously, not only corresponded to the physical world we inhabit, but also accurately predicted the existence of weird and previously unobserved particles.

How could imagination and mathematics be so powerful in apprehending the world outside our heads?

Years later, I went to work at Goldman Sachs in the field of quantitative finance, the branch of economics concerned with calculating the fair value of securities. At first I was charmed by the resemblance between the papers I now studied and the physics papers I used to read and write. Then, as I read further, I discovered that economists love formal mathematics much more than physicists do. Many economic journals encourage—or even demand—a faux-rigorous style with multitudes of axioms and lemmas in numbers that tend to be inversely proportional to their efficacy in the real world.

Why are economists trained so formally? It makes sense to axiomatize a discipline when the axioms are true (or almost so) and have strong predictive power. That's the case for Euclidean geometry, for example, as well as Maxwell's electromagnetic theory, where many valid, useful, and accurate predictions follow from applying the laws of deduction to a few initial assumptions.

But economists seem to have embraced formality and physics envy without the corresponding benefits of accuracy or predictability. In physics, Maxwell's theory and quantum mechanics allow you to predict the way an electron spins about its own axis inside a hydrogen atom to an accuracy of 12 decimal places. Something that accurate isn't just a model—it's a law. In economics, by contrast, there are no laws at all, only models, and you're immensely lucky if you can predict up from down.

When people build models to value securities, they make all sorts of imaginative assumptions that are then formulated mathematically. For example, quantitative strategists at investment banks or hedge funds value currently fashionable collateralized default obligations (which provide default insurance on baskets of large numbers of bonds) by assuming that each bond-issuing company is represented by an imaginary variable. That variable evolves randomly through time—like smoke diffusing across a room—until it crosses an imaginary default boundary in the future, at which point the company will default on all of its debt. It's an elegant mental construct and not an unreasonable way to model the random chance of a company doing badly enough to default. But it's not literally true. It's still a model, a toy, a limited picture—despite the fancy mathematics. No wonder the picture often breaks down and causes havoc, as happened in credit markets last May.

Clearly, then, when someone shows you an economic or financial model that involves mathematics, you should understand that, despite the confident appearance of the equations, what lies beneath is a substrate of great simplification and—sometimes—great and wonderful imagination. That's not a bad thing—financial markets are all about imagination. But never forget that even the best financial model can never be truly valid because, unlike the

physical world, the mental world of securities and economics is much less amenable to the power of mathematics.

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