It's a gamble: Econophysicists meld science, economics

November 30 2006

Predicting financial markets is more of a gamble than traditional economists will admit, and making sense of such numbers is more like trying to decipher noise blasting from a loudspeaker, says one University of Houston econophysicist, who leads one of the world's most preeminent groups of its kind.

Joseph McCauley, a UH physics professor with a dual appointment as a senior fellow in the economics department at the National University of Ireland, Galway, leads the UH group. The team's main discovery, backed up by empirically based modeling of market dynamics, is that financial markets are unstable. Associate Professor Kevin Bassler, Professor Gemunu Gunaratne and Professor George Reiter – all of the physics department – round out the UH econophysics group that applies their newly discovered models and methods to solve problems in economics.

McCauley will be the only invited physicist to speak in an economic workshop – "Financial fragility and technological progress with heterogeneous agents and social interactions" – Dec. 14-15 in Trento, Italy. He will weigh in with his perspective on the subjects of macroeconomics (the overall aspects and workings of a national economy) and microfoundations (in which the macroeconomic model is built up from the actions of individual agents).

McCauley and his colleagues contend that a market is made up of "noise" in the strictest mathematical sense of a random and persistent disturbance that obscures clarity. Using techniques developed in physics

such as entropy – the study of randomness or disorder – challenges the common belief in economics that market statistics have structure and tend toward equilibrium.

"Traditional economics is based far less on empirical studies than its econophysics counterpart," McCauley said. "For instance, deregulation is an example of economists relying on a belief and not hard analyses. Also, histograms – a traditional economist's tool – do not represent normal distributions. Even Nobel Prize-winning economists approach market statistics with a wrong mathematical model already in mind, and the model always fails. Physics helps us understand the information that goes into these models better."

Gunaratne uses the analogy of a pollen grain being heated up in water to illustrate how the randomness of motion is analogous to what happens in a market. Just as a physicist observes the increase and decrease in the temperature of water as variables that agitate or slow the motion of a pollen grain in an experiment, an econophysicist applies these sorts of principles to other such variables in a financial market. In trying to understand this randomness, he said, it is apparent that markets are not bell-shaped curves with symmetry and normal distribution. Instead, financial markets are more like radio static, but with non-bell-shaped noise, with stock prices continually moving up and down in ways that puzzle standard statisticians.

Focusing primarily on the foreign exchange (FX), a 24-hour-a-day traded world market, McCauley, Gunaratne and Bassler say studying the FX yields better information as the largest, most liquid market that dominates other markets because of its sheer volume and volatility. They model both the market dynamics and option pricing by deducing correct models from real market statistics, which is the opposite of what economists do. Broadening the UH econophysics program, their colleague Reiter focuses more on models of the economy, including

production and consumption with results that show how individuals' preferences adapt to economic circumstances, a part of reality he said is missing from standard economic models.

"Whatever the specific focus, this relatively young subfield that merges the two disciplines of physics and economics helps us move toward applicable models for use in analyzing markets and economies more effectively and accurately," Bassler said.

Having established one of only a handful of Ph.D. programs across the globe with a specialization in econophysics, UH's physics department in the College of Natural Sciences and Mathematics has recognized a need for educating physics students in this area since the modeling, analytical and computational skills of physicists are exactly the skills needed to study financial markets and the dynamics of the economy in a practical way.

"We realize this is still met with skepticism in more traditional arenas, but we're convinced econophysics will play the leading role as world economies become increasingly more complex and harder to decipher, and the misleading notion of ‘self-regulating markets' will be slaughtered," McCauley said. "To the extent possible in the social realm, we want to create economic theory as science and avoid the ‘mathematized ideology' – as I've coined it – of mainstream economics that is currently the ideology used in the unregulated free market."

Source: University of Houston