Researchers gain new insight into the foreign exchange market (w/ video)

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Physicist Guannan Zhao, Ph.D. student at the University of Miami, and his collaborators have developed a mathematical model to describe the timing of price changes of currencies and the overall dynamics of the Foreign Exchange (FX) market. Zhao presented his findings in a keynote address on Saturday, March 12, at the second International Conference on Financial Theory and Engineering (ICFTE 2011), in Shanghai, China.

The FX market is the largest financial market in the world. It is made up of buyers and sellers from all over the globe. Their combined actions determine the value of currencies at any given time. Understanding how the market behaves can be useful to researchers studying theoretical pricing, help investors develop new trading strategies and act as a guide to avoid future crises.

The major participants in FX market are mostly big international, commercial banks, which have a retail currency exchange service and active FX trading business. Consequently, the researchers examined data gathered by HSBC Bank, in London, collected throughout individual days, on the timescale of seconds. This high frequency data allowed the scientists to study the market with great accuracy. The key finding is a multi-agent mathematical model that describes the timing of the price changes in the FX market.

"We studied data from the FX market and found an interesting fact: That the waiting time between price changes of different currencies follows a mathematical power law, and this power law is universal for all

different kinds of currency pairs," says Zhao, a Ph.D. student in Physics, at the College of Arts and Sciences and a member of the of the Complexity research group, at UM. "We built up a model to explain the statistical pattern in the waiting time distribution. This model helps us understand the high frequency extremes in markets because it captures the general mechanics of FX trading and mimics its collective behavior."

Since currencies are traded against one another, the researchers looked at eight currency pairs. With data accurate to the second, they were able to describe the behavior of the price changes for each pair, any time of the day. For example, between 7:00 and 17:00, on May 13, 2010 London time, the least active pair was the EURNOK (the price of Euros with Norwegian krones), with 861 ask price changes in 10 hours, and the most active pair was the GBPUSD (the price of British pound sterling with U.S. dollars) with 14,862 ask price changes.

Another interesting finding is the appearance of synchronicity in the behavior of pairs of currency rates. Like dancers in an elaborate choreography, living things seem to act in harmony. A school of fish gracefully moving through the water, people applauding at a concert, and fireflies flashing at night; all are examples of collective complex behavior, with crowds of individuals acting in sync.

"Synchronicity is a by-product of complexity and the key signature of what stops Life from being completely disorganized. It is what makes cells act together to form what we call an organ, such as a heart or a brain. It is what makes societies work for the common good instead of pure individualism. In other words, it is what makes life 'work' on all levels," says Neil Johnson, professor of physics and director of UM's Complexity research group, who is Zhao's Ph.D. supervisor and collaborated with him in this research project. "Synchronicity is never perfect, but it is better than pure random disorder."

The researchers looked at the overall dynamics of the FX market and found that synchronicity occurs in the form of currency pairs changing their rates within the same time frame. In the study, synchronicity was detected as a "collective rush to trade in a particular way at the same time." The researchers also observed that synchronicity increases with increased activity. The phenomenon can be seen as a double peak shape in the morning and early afternoon, with the low activity level at around 11:00 a.m., London time.

The researchers are working to further improve their model of price changes of currencies and hence create a full mathematical description of the synchronicity which they observe across the global FX market.

Provided by University of Miami