Barnett Gives Keynote at Special Conference Focusing on Twin UK Challenges of Brexit, COVID-19

Given the challenges facing the United Kingdom's economy as it enters the post-Brexit and post-COVID era, disaggregating uncertainties associated with those two major and distinctive events could be easier and more timely, based on the latest findings from a groundbreaking line of research developed by KU's Dr. William A. Barnett. His research has found that Shilnikov chaos may be relevant to understanding the ultimate outcome of the decision to leave the European Union.

In his keynote address ("Is the Brexit Bifurcation Causing Chaos in the United Kingdom?") at a major international conference in late July, Dr. Barnett, KU's Oswald Distinguished Professor of Macroeconomics, said that while the pandemic had provided a series of external stochastic shocks to the UK economy, Brexit on the other hand, as an internal policy choice, represented a bifurcation that has imposed and/or removed certain constraints from the European Union's pre-Brexit economic landscape.

"The Brexit bifurcation represents a rare and fascinating opportunity for a controlled experiment for economic research," he observed during his presentation at the event ("Post Brexit: Uncertainty, Risk Measurement and COVID-19 Challenges").

The talk built on decades of previous research dating back to the 1980s, regarding findings of mathematical chaos in both the US and UK economies. Dr. Barnett noted that some of the early research was informed and shaped by an important paper co-authored in 1987 by a prominent Stanford economist, Donald Harris, the father of current US Vice President Kamala Harris.

Chaotic dynamics follow paths within an attractor set having a particular kind of complex geometry called fractal geometry. Dr.

Barnett said that it is part of proven mathematical theory that the fractal geometry of the attractor set contains all of the information about the dynamical system's unknown structure.

"So it is important to remember that chaos in fact produces informative stochasticity, which is entirely distinct from uninformative white noise," he said.

He said that common examples of chaos with which most people would be familiar would include the climate, weather, and human brain waves. Chaotic dynamics should not be viewed as a negative, but a commonly positive property of nature. In fact, non-chaotic brain waves would be a symptom of mental illness, since the human brain could not find its memories without chaotic dynamical search and hence would produce delusions. As written by the famous Nobel Laureate in Chemistry, Viscount Ilya Prigogine, "We grow in direct proportion to the amount of chaos we can sustain and dissipate." (*Order Out of Chaos: Man's New Dialogue with Nature*, Bantam Books, 1984).

Chaos has always been an especially important component in systems theory and engineering, something about which Dr. Barnett knows a great deal from his days working on the Rocketdyne F-1 engine used in the US space program (for more details on his remarkable career path from rocket scientist to renowned economist, see Spring 2018 *KU Economist*, p. 2-3). He noted that his lecture was coming on the same day as Jeff Bezos' space flight from west Texas using an engine and technology that would not have been possible but for all of the testing protocols available during the heyday of the space program. He further explained that those original engines were able to be tested many thousands of times in an effort to identify small problems that could have ultimately turned catastrophic. In fact, the rocket engine used in Bezos' flight was based upon the technology developed by

Rocketdyne for its J-2 engine, used in the second stage of the Saturn vehicle for the Apollo program.

“But while engineers and physicists can run thousands of replications in controlled experiments, economists are not normally afforded that luxury,” he added.

But Shilnikov Chaos Theory has proven to be widely relevant to natural phenomena and provides a unique tool that very few economists have utilized. One important finding from some of Dr. Barnett’s previous Shilnikov research is that US interest rates have tended to drift downward unintentionally during recent decades, as a result of the change in the economic system’s dynamics caused by imposing an active interest rate feedback rule on the economy. In effect, what central bank policy has done is to turn the economy into a servomechanism displaying complex dynamics with drift.

He said that one potentially important conclusion coming out of that work is that it was becoming increasingly clear that there is a need for a second policy instrument beyond short-term interest rates to prevent the long-term downward drift in rates, as evident from how low short-term rates have become. This conclusion was derived from a well-known engineering algorithm on controlling chaotic dynamics. Without an anchor on long-term interest rates, the ability of the short run interest rate feedback policy to operate in a countercyclical manner, as intended, is lost at the zero lower bound on interest rates. In addition, with interest rates below their natural rate at the marginal product of capital, the economy is off of its optimal growth path.

Dr. Barnett and his coauthors have found that a previously published and widely accepted model relating to the UK’s economy permits study of the onset of the Shilnikov phenomenon under different parameterizations and policy formulations. During the 1970s and 1980s, the UK experienced volatile inflation and output growth during the era of passive monetary policy that had existed prior to 1992; whereas the post-1992 era of inflation-targeting policy led to lower inflation but continued output volatility. This latter regime (model with low inflation and a highly responsive central bank) is characterized by a large subset of the parameter space supporting Shilnikov chaos.

In response to a question, he said that it would not take many years of post-pandemic data to determine what had in fact happened to the UK fractal attractor set as a result of Brexit and thereby the consequences for UK economic risk. While earlier research on mathematical chaos required very large sample sizes, the Shilnikov approach does not.

"We don't need very large sample sizes to do this, which is something many economists have not, up until now, begun to appreciate. The work of physical scientists and mathematicians has allowed us to reduce the needed sample sizes to make this type of analysis available to economists," he added.

Dr. Barnett said that a good deal of similarly important research was occurring at the Institute for Nonlinear Dynamical Inference in Moscow, where he serves as Director. As one of his previous initiatives, he also founded the Society for Economic Measurement (SEM) in 2013. That society's long-run objective is to meet the data standards established for the physical sciences, notwithstanding the fact that economics, as a social science, is subject to certain inherent limitations. (SEM and the Center for Financial Stability, where Dr. Barnett also serves as Director of Advances in Monetary and Financial Measurement, were two of the event's co-sponsors.)

The three-day conference, which was specifically designed to focus on a broad array of policy and control issues and their interactions to economic phenomena following the UK's exit from both the COVID crisis and from the European Union, featured presentations from a number of other KU-affiliated speakers, including Assistant Professor Dr. Shahnaz Parsaeian ("Structural

Breaks in Seemingly Unrelated Regression Models"); Dr. Logan Kelly, current chair of economics at the University of Wisconsin-River Falls, who received his PhD from KU in 2007; and a number of current Jayhawk doctoral candidates in economics.