The Future of Economics is Through Complexity Not Simplicity

Albert Einstein (1954) said 'Everything should be made as simple as possible, but not one bit simpler.' It is essential in the course of trying to understand the vast number of processes that surround us that we simplify everything to an acceptable degree and no more. However, it has become increasingly obvious and worrying that due to simplicity, traditional economic doctrine has deviated too far from the process it sets out to explain. Hence this essay will explore complexity within economic systems and its significance.

Complexity and systems are both super concepts. A super concept is one that usually originated from one discipline but is able to transcend the boundaries of that discipline and be applied to others. Although this essay aims to analyse complexity within economics, it is essential to have a brief introduction to the system.

Systems

Before we can analyse the concept of complexity within economics we must first understand the definition of an economic system. A system is in principle a set of entities along with the connections and interactions between them (Wilson, 2010, p. 145). The countries of the world are entities of the earth as a system, which in turn is an entity of the solar system. Therefore a system itself could be an entity of a larger system, thus creating a hierarchal structure in which the interactions and connections of the entities within each level is measured in a different way. This leads to the term 'system of interest'. It would be irrational to consider the world economy if one is interested in the interactions between individual humans, therefore it is necessary to outline factors such as the scale, constraints, and number of entities within a system of interest. The systems of interest within economics depends upon its constraints and can range from the supply and demand of a single good to the interactions observed in the world economy.

Complexity

Warren Weaver proposed three different types of systems that can be observed within a range of disciplines. He stated that these systems are split into simple, disorganised and organised complexity (Weaver, 1948, p. 534). A simple system is one with few entities and can be mapped out with simple algebraic manipulation. An example of this in economics would be the law of supply and demand of a single good.

The system in disorganised complexity is one that has many entities which have little or no interactions between them. This bears a striking resemblance to the assumptions made by Neo-classical economics where a person acts as a 'utility maximising individual' in isolation (Orell, 2010, p.28). Providing that these assumptions hold, the random nature of this system can be calculated through statistical and other mathematical estimations as demonstrated by prominent economists such as Jevons, Walras and Pareto.

The third and most interesting system is that of organised complexity. In this system a large number of entities interact with each other and their environment. What differentiates this system from the first two is that this is the only system that can be applied to the actual economy. Humans are intrinsically affected by others around them and society in general. We also know that we can never assume the linear conditions of ceteris paribus upon any system because time passes and variables

shift with time. In this case neither statistical analysis nor mathematical manipulation will be able to fully predict the behaviour of organised complex systems.

Properties of a Complex Economic System

Emergence and Non-linearity

In the same way that the chemical properties of a molecule is the emergent properties of its nuclear structure, complex macroeconomic phenomena are the emergent properties of the simple interactions of their microeconomic components (Gintis, 2006). In this sense we are unable to mathematically derive the complex emerging properties from the organised interactions of its entities and hence the reductionist method does not work. One of the main explanations for this is the existence of non-linear relationships between entities. The smallest changes within entities or the interaction between the entities at a critical point could lead to a cascading disaster or a phase change, where the structure of the whole system undergoes a unpredictable change and a new structure emerges. An example of non-linear interaction is Turgot's law of diminishing returns, which states that output received is less than proportionate to the amount of inputs.

Equilibrium, Dynamics and Endogeneity

Classical economists looked to physicists and attempted to apply the same concepts of equilibrium to economics. Similar to the law of conservation of energy, supply and demand theory follows similar reasoning where the existence of an invisible hand will always guide the isolated market (ceteris paribus) to a predefined equilibrium. To make economics predictable, numerous amounts of assumptions (simplifications) were put into place, many of which are still used today with slight variations (Orrell, 2010, p. 54).

However, systems are dynamic in nature and as time progresses so do the entities and the external and internal interactions which govern the system. Traditional economics recognises the dynamic changes that take place, however these will eventually be returned to the point of equilibrium by the invisible hand. The entities themselves of a complex systems propels the changes that constantly creates new points of equilibrium. For example the elasticity of demand for a product or the consumer taste is constantly changing with time, it is not surprising that the demand for personal computers today is hugely different to 20 or even 10 years ago. Therefore the study of complex systems focuses on the constant dis-equilibrium or continuously shifting micro-equilibrium points rather than a pre-defined equilibrium point.

To explain the phenomena of the dynamically changing equilibriums we must consider the endogenous factors such as the feedback loop (Beinhocker, 2006, p. 100). If A effects B which in turn affects C, which then affects A then a feedback loop is created. If the effect is greater with each interaction it is known as positive feedback. Despite its name this feedback is often the cause of many economic problems, for example if consumer confidence falls then demand falls leading to a decrease in supply and potential unemployment, which then further decreases consumer confidence. Negative feedback is the opposite where the effects of each interaction is less than that of the last. The interplay between the two feedbacks is just one of the few examples of a self-perpetuating process that complex systems possess (Orrell, 2010, p. 65).

From the above properties it is possible to see that complex systems are able to create multiple equilibriums which shift, leading to phase changes and new emerging properties. When combined we can observe a system that has memory and is able to evolve into new states based on the

interactions within the previous state. Not surprisingly these are also the properties that we observe in the real world because the world as a system is an organised complex system that possesses dynamism and emergent properties through non-linear relationships.

The Advent of Complexity Economics

An agent is defined as an individual who has asymmetric information and is capable of mistakes, bias and adaptation. Sugarscape (Epstein and Axtell, 1996) is a modelling application which takes these individual agents and places them in a system marked by grids in which sugar is the required resource to survive. The model includes basic characteristics such as eye-sight measured by how many grids the agent is able to see and metabolism measured by how many sugar units it consumes to move one grid. Characteristics of each agent is heterogeneous and each agent is effectively a single independent entity. The agents are then released into a landscape containing variable amounts of sugar and will attempt to survive with its given characteristics. From this very basic system it is possible to view a few emergent properties such as spatial interaction between resources and agents. However by introducing additional constraints and characteristics such as lending, trading and hierarchy it is possible to observe additional properties (Beinhocker, 2006, p. 80).

The arrival of high capacity computers and computational economics has allowed us to create models that are able to treat each entity as a separate individual. Acting as an enabler and platform, computer technology has created a new collaborative space for fields such as evolutionary economics, social dynamics, behavioural game theory and interaction economics. These fields and their collaborations are the components of contemporary economic study today known as complexity economics and may procure the answer to problems regarding the understanding of complex systems (Gintis, 2006).

Returning to the original objective, this essay does not disregard simplicity as a means to consolidate our understanding of systems, in fact simplification is an effective way to understand the interdependent system with vast quantities of entities and interactions. The critical point is that we do not simplify a system just to conform with the desirable attributes of predictability, but rather to create a 'generative economy' where we first strive to understand the interactions of a system. With our understanding of complexity and the feasibility of computers possessing high processing power, complexity economics may become the future of economic analysis.

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