

## FESTSCHRIFT FOR PROFESSOR ALAN KIRMAN

Bank of England, 16-17th March

### Summary

Professor Alan Kirman's research began with general equilibrium and game theory, then progressed to look at how particular agents and markets function in practice. He advocates modelling markets and the economy as complex adaptive systems, in which aggregate behaviour emerges from the interactions between agents with limited knowledge. He has argued that our decision making process is perhaps closer to ants than to *homo economicus*.

To celebrate Alan's vast contribution to economics, the Rebuilding Macroeconomics network and the Bank of England hosted a [Festschrift](#) to discuss his insights and their relevance for macroeconomics today. Recordings of the event are [here](#).

#### Modern macroeconomics

The framework for the event was set in a discussion between Alan and Joe Stiglitz about what economists might learn from different methods in natural sciences. Modern economics emerged as an imitation of classical mechanics and developed into an axiomatic science while physics moved into statistical mechanics. Economists chose to start with equilibrium and explore its properties, rather than explain how an economy self-organises into its equilibrium (the 'invisible hand'). Sonnenschein, Mantel and Debreu (SMD) showed that from the axioms of individual rationality there is no way to show that any specific aggregate equilibrium will necessarily be reached.

Adam Smith's insights about the emergence of science and social organisation are outside of this framework. Indeed, Smith challenged many of the conditions required for equilibrium (as well as having a much richer view of human behaviour). The assumptions required to prove equilibrium preclude many of our most interesting socio-economic questions. Market imperfections are in fact the rule, rather than the exception. Marshall preferred biology as the appropriate analogy for economics (led by evolutionary biology and genetics today) to recognise that the world constantly changes structure rather than necessarily being a stationary stochastic process.

The insistence on individual components (microfoundations) is misleading because non-trivial systems have different properties at different levels of analysis. We cannot deduce that ants create an anthill by studying the behaviour of ants in isolation: social organisation is excluded from the analysis. Individual rationality does not explain interaction or aggregate properties (except under the strictest assumptions such as a representative agent). Contracts which are perfectly rational for individual agents may not be rational or optimal for society as a whole.

Macroeconomics has become an attempt to apply General Equilibrium to observed aggregate phenomena. The 'Robinson Crusoe' economy is intended to reveal how a macroeconomy behaves, but this is not a social system and so does not address the coordination problem. And in representative agent models, there is no trade (other than with ourselves, which makes no sense). Sam Bowles broadened Alan's interpretation of SMD to show the 'liberal trilemma' of preference neutrality, voluntary participation and Pareto efficiency to be incompatible, and perhaps justifies some social limitations on behaviour.

## **Interaction and markets**

Presentations focussed on empirical evidence as to how the economy in general, and some markets in particular, actually function. Rama Cont and other speakers noted that markets, whether for finance or fish, and economies broadly tend to operate in far from equilibrium conditions, and that different agents should be individually modelled as autonomous, active, and interactive entities, capable of making and adjusting their decisions. Strategic behaviour among heterogeneous interacting agents with incomplete information generates a network where the actions of one agent has consequences for other agents.

Information and interaction are two sides of the same coin. In finance, the assumption of market efficiency provides a convenient shortcut to build the edifice of mathematical finance without taking interaction into account. Yet Stiglitz and Grossman showed that if the Efficient Markets Hypothesis is true then there is no incentive to gather the information that makes it efficient. Cont showed how even interaction between algorithms in financial market can create tacit collusion with unforeseen consequences for market prices.

An alternative approach is to treat the economy as a complex adaptive system in which aggregate behaviour emerges from the interaction between simpler economic agents. Agent-based modeling and broader complexity ideas are useful to economics by addressing: agent heterogeneity, bounded rationality, social networks, and out of equilibrium dynamics. Bob Axtell noted that such an approach had displaced mathematical equations in analysing traffic, epidemiology and armed conflict and there were several calls to build on complexity economics as an alternative to mainstream equilibrium economics. Pia Andres applied these ideas to the green transition and found that export product complexity and diversity play a key role in determining transition risk for different countries.

Giovanni Dosi suggested that demand and supply curves populate economic analysis with double axiomatic notions of equilibria, both 'in the head' of individual agents and in the environments in which they operate. Ed Hopkins explored the equilibrium point as one never reached. Mauro Gallegati said that mainstream economists have ended up being more concerned with the characteristics of the states of an economy instead of how those states are reached. John Kay concluded that economics is probably the only example in the history of science where a *reductio ad absurdum* argument is made and the absurdity is adopted as true.

New models move in the right direction by adding heterogeneity, but ignore the fundamental problem of how we coordinate to reach equilibrium. Agents in Heterogeneous Agent New Keynesian (HANK) models require so much information that we end up effectively replacing a decentralised economy and coordination with a few social planners. This is not an issue of too much maths, but thinking about the fundamental hypothesis of interest at the start of the analysis. We need to ask how we coordinate to an equilibrium (or other outcome) rather than compare different equilibria outcomes.

## **Future direction**

We need to start from a different place. Rather than adding convenient patches to an inadequate old framework of assuming we are always in equilibrium and that the economic system is always a stationary stochastic process. We act in a world of deep uncertainty by forming expectations which we can never truly verify. Our beliefs drive actions which change the economic system and in turn our beliefs, making the system non-stationary over our lifetimes. How we coordinate our actions to deliver desirable outcomes ought to be the dominant agenda for macroeconomics, rather than assume they are coordinated.

Spill-overs from our actions are the essence of an economic system rather than imperfections. Keynes recognised that the system is sometimes out of equilibrium and activity had to be coordinated to reach a desired outcome. This is a different path of enquiry than assuming the system is in equilibrium, only that some rigidities (e.g., menu costs, staggered contracts) are delaying its full adjustment. Such rigidities are conveniences rather than realistic. Behavioural responses are not biases with respect to

a false ideal, but evolutionary responses to our real world context. Darwin showed that evolution does not necessarily lead to optimality, instead opening up many other possible outcomes.

What might be a policy consequence of focussing on coordination? Mary Morgan reminded us that economists have a duty to address societal questions. Consider the current monetary policy debate. Unemployment is expected to rise, or even be a cost, to bring inflation down. But the consequences of a rise in average unemployment will be very different across groups and places. For some parts of the labour force the extent and concentration of the rise will have deleterious consequences for labour supply, perhaps even adding to inflation and some loss in potential output. It is not enough to assume that all workers can easily move or change skills or that their community is unaffected.

The conference took place at the time of the Silicon Valley Bank failure. This bank was thought to be too small to be systemic, yet the trumpeted bail-in rules failed at their first test because regulators were concerned about the interactions elsewhere. Even if this were a systemically important bank, regulations based around stress tests ask whether institutions can survive at a stressed scenario in isolation. The question of how a bank transitions from its current state into the stressed state and the consequences for the rest of the financial system are beyond this form of analysis.

Finally, the greatest risk of all - climate change - cannot be interpreted as an intertemporal allocation problem. The climate is not a stationary stochastic process, and, worse, it is influenced by our own actions. A commitment to equilibrium models lies behind a commitment to the integrated assessment models (IAMs) of climate analysis. Yet there is so much deep uncertainty and the costs are (arguably) infinite, that justification for our actions (or not) cannot be judged by balancing margins.

### **Conclusion**

Arrow and Debreu's acclaimed General Equilibrium theory was the culmination of a long evolution of analytical economics and provided a proof of the existence of equilibria and two Welfare Theorems. Yet proof of a theorem is not the same thing as proof of reality. We cannot prove something about our social world, we can only argue as to whether it seems to correspond to reality. Indeed, Frank Hahn said thirty years ago, "while there will be work for the computer scientist, I very much doubt that economists will be able to establish general propositions in any but very special examples."

Throughout the conference, references were made to George Box's famous remark that all models are wrong, but some are useful. Macroeconomics has been attached to one approach. Alan has emphasised that we need to ask the fundamental question of how the coordination of our activities at the aggregate level emerges from our interaction with each other, which may or may not lead to equilibria or generate a stationary environment.

Our problem is that we have been looking for a framework to replace the current one within which we can analyse and 'solve' economic problems. In the past, we have tended to accept Samuelson's argument that without the basic hypothesis of 'ergodicity' or structural stability we cannot make meaningful scientific statements about the system's evolution. But the world in which we exist is not ergodic, as many people have said, and we have to accept that meaningful statements in the scientific sense cannot be made, but that does not mean that we can say nothing about the economy. We hope to bring this work to the attention of a broad community to ensure that Alan's work finds its proper influential place in economics.

Angus Armstrong, Rebuilding Macroeconomics, IGP, UCL

William Hynes, New Approaches to Economic Challenges, OECD

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