Keynes, Hayek and Complexity

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1. Introduction

In the spirit of the overall topic of the conference, in this paper I consider the extent to which economic theory includes elements of the complex systems approach. I am setting to one side here the developments over the past decade in applying complex systems analysis to economic problems. This is not because this recent work is not important. It most certainly is. But I want to argue that there is a very distinct tradition of what we would now describe as a complex systems approach in the works of two of the greatest economists of the 20th century.

There is of course a dominant intellectual paradigm within economics, that known as 'neo-classical' economics. This paradigm is by no means an empty box, and is undoubtedly useful in helping to understand how some aspects of the social and economic worlds work.

But even in its heyday, neo-classical economics never succeeded by its empirical success in driving out completely other theoretical approaches, for its success was simply not sufficient to do so. Much more importantly, economics over the past twenty or thirty years has become in an increasing state of flux.

All the results in general equilibrium, the brilliant and core achievement of neo-classical economics, were established by the mid-1970s. Since then, all the advances which have been made, from the bounded rationality of Akerlof and Stiglitz to the behavioural

economics of Khaneman and the experimental economics of Vernon Smith, have involved a willingness to step outside the strict confines of the world of fully rational, maximising agents. Claims to a general, universal theory of how agents behave are being abandoned. As Akerlof stated in his Nobel lecture: 'in this new style [of economics], the economic model is customized to describe the salient features of reality that describe the special problem under consideration'.

In one sense this is very liberating for economics, enabling it to become more realistic and to tackle more problems in a more convincing way. But it is also a source of confusion and doubt within the discipline. Essentially, economics is a theory of individual behaviour, of the cognitive abilities of agents to gather information and the rules which they use to process it. The world of the fully rational, maximising agent provided a bedrock of security, for it lay claim to be a general theory of behaviour. All agents at all times could be presumed to follow these rules. Many people in economics still cling to this, like a comfort blanket. But its validity is being undermined, not least within economics itself by the empirical findings of experimental and behavioural economics.

In common with everyone else at this conference, I believe that the complexity approach is increasing quite dramatically our ability to understand the social and economic world. But it can seem alien to many economists, no matter what doubts they may harbour individually about the validity of the core paradigm of their discipline.

So the purpose of the paper is three-fold. First, and least important, to show purely for intellectual curiosity that there is indeed a tradition of complexity within economics. Second, to reassure economist readers that it is perfectly respectable to adopt a complex systems approach. This is what some of the most famous economists of the previous century were doing, even though they did not describe it as such at the time. Third, to hope that others may be inspired by the insights of these great economists to develop empirically successful models using the modern tools of the complex systems approach.

In Section 2, I outline very briefly some of the key features of a complex system, and in Section 3 I consider examples of this within conventional economic theory. In Section 4, I provide examples from the works of Keynes and Hayek which bear unmistakeably the footprints of complexity.

2. Some key features of complex systems

This section is not intended in any way to contribute to the literature of what actually are the features of complex systems. It is simply to set out some the key features so that these can be subsequently identified in economic theory.

Perhaps the single most important feature is that the macroscopically observable properties of a complex system emerge from the interactions of its constituent parts. In the context of economics, this implies that there is a need in any theoretical model for micro-foundations. In other words, a need for rules which describe the behaviour of the individual agents in the system. The specification of such rules does not of course by itself guarantee that the agent interaction will be such as to generate the emergence of complexity. But in modelling a complex system, such micro-behaviour of agents must be specified.

A further feature is a low (or even zero) ability to predict the state of the system at any given point in the future. There may very well be stable statistical distributions from which describe the range of behaviours of the macroscopic factors, so that we can reasonably estimate the proportion of time which the system spends in any particular state. But we cannot predict consistently at particular points in time with any reasonable accuracy.

An important implication of this is that the understanding which individual agents have of the world is inevitably imperfect. They cannot be ascribed the cognitive powers of gathering and processing information which exist in conventional economic theory

A final feature is that complex systems will typically exhibit multiple possible histories. By definition there can only ever be one actual history, but at any point in time the system has the potential to move in a variety of different ways.

So the features to look for are:

- Emergence
- Low level of predictability at a point in time
- Limited cognition of individual agents
- Multiple possible histories

3. Complex systems and conventional theory

The foundations of conventional theory were developed around 1870 by Jevons and Walras, at the heyday of classical, equilibrium physics. The theory reflects the principles of the physics of that era. The full implications took a century to work out. The late 1960s and 1970s saw a number of very important papers which brought the programme of research on general equilibrium to an end. But the approach developed by Jevons and Walras remains at the core of conventional theory.

General equilibrium theory remains the jewel in the crown of conventional economics, and it is indeed a formidable intellectual accomplishment. General equilibrium theory, as its name might imply, is concerned with the behaviour of all markets in an economy. A key aspect of this has been to establish the least restrictive set of conditions that must hold for the existence of equilibrium to be guaranteed. In other words, the conditions under which it can be proved there exists a set of prices such that demand and supply will be in balance in every single market.

It is not the purpose of this paper to enter into a critique of general equilibrium theory. A point which might usefully be noted is that its scientific status is questionable, since it contains no testable propositions. The results of the 1970s established that market

demand and supply curves can in principle take any shape, even if the individual demand curves of each agent are well-behaved by the precepts of economic theory. Further, factors of production are not necessarily paid their marginal product.

It might be thought that the fact that the theory is concerned with the establishment of an equilibrium means that almost by definition it cannot be regarded as a complex system. However, starkly outside the approach of general equilibrium is the work of scholars such as Brian Arthur[1], yet nevertheless equilibrium solutions obtain in such models.

Arthur's model of path dependency and lock-in in the process of the adoption of new technologies is based upon the non-linear probability theory of Polya urns. And, for a variety of replacement rules, fixed points exist in Polya urn processes. In other words, equilibrium configurations exist. With the simplest possible replacement rule, in which a ball drawn at random from the urn is replaced along with another of the same colour, the equilibrium approached in the limit is that the urn is made up entirely of balls of one of the two colours, although we cannot tell in advance which it will be. For other replacement rules, however, different equilibria exist with different divisions of the colours.

Arthur, in his classic paper, used this model in the context of the adoption of competing new technologies. An important feature of the model is that, once an agent adopts one of the technologies, he or she is not permitted subsequently to switch to the other. This reflects the fact that in the urn process, individual balls are not permitted to change colour. More balls are introduced into the urn, so that then proportions of the two colours changes.

All theories are of course approximations to reality, and for the adoption of technologies, it seems reasonable to assume that, at least in the relatively short-run and in some markets, it is not easy for agents to switch once they have made an initial choice. There is, of course, a different tradition in agent-based modelling in economics which derives

[1] For example, WB Arthur (1989)

from the work of Föllmer[2] and Kirman[3], in which agents choose between different states of the world but are subsequently allowed to change their minds. This approach is probably more realistic in many situations. And of course in such models the system never settles down to an equilibrium.

However, Arthur's model certainly satisfies all four of the criteria set out above to define a complex system, even though it contains equilibrium solutions. So the fact that general equilibrium theory is concerned with equilibrium does not of itself means that it cannot be regarded as a complex system.

Indeed, in general equilibrium the system has emergent properties. Each individual agent is simply maximising utility given his or her (fixed) preferences and given the vector of prices. No agent intends all markets to clear, but this can in principle emerge from the reactions of agents to prices. In a one period world, this solution is also a Pareto optimum[4]. No agent can be made better off without making at least one other agent worse off. Again, agents do not intend to bring this about. It emerges from their individual actions. Further, it has become recognised that there will usually be multiple solutions in general equilibrium[5]. We cannot say, for given tastes and preferences of agents, which of these will actually obtain.

There are formidable problems for the theory in specifying the mechanism by which an equilibrium, even it can be shown to exist, actually comes into being. But in principle general equilibrium has emergent properties and multiple possible solutions.

The fundamental feature of general equilibrium which means that it cannot be classified as a complex system is the level of cognition ascribed to agents. Agents are in possession of full information. The implications of this can be illustrated in Kenneth Arrow and

[2] H Follmer 1974
[3] A Kirman, 'Ants, Rationality and Recruitment', *Quarterly Journal of Economics*, 108, 137-56, 1993
[4] in a multi-period world, this is in general not true: Newbery and Stiglitz (1982)
[5] for example, Silvestre (1993)

Gerard Debreu's original existence proof[6] in general equilibrium once the future is permitted to exist. All previous existence proofs had been for timeless, single period economies. Arrow and Debreu showed that a set of prices which cleared all markets could be guaranteed to exist if each agent prepared a complete list of all future states of the world which might obtain, and everyone must hold identical and correct beliefs regarding the prices which would exist in each potential state of the world at every point in the future. Subsequently, there has been a very partial relaxation of the enormous stringency of these conditions, but clearly we are a very long way from not just the world of complexity and limited cognition, but from anywhere at all.

4. Keynes and Hayek

The features of complexity appear much more strongly in the works of these two great economists than they do in orthodox theory. In standard theory, the traces of complexity we have described are intellectual curiosities detectable in a system of thought which is in essence antithetical to the principles of complexity.

In Keynes and Hayek, this is not the case at all. Instead, features of complexity are an integral part of their individual views of how the economy operates in reality. Agents are interacting in a dynamic environment with many dimensions. Their ability to comprehend the environment is limited. In so far as classical equilibrium is part of their theoretical models, most of the time the economy is operating out of equilibrium, often a long way out.

It must be stressed straightaway that even today, well over half a century since Keynes and Hayek were at the peak of their powers, there is considerable disagreement amongst economists on the interpretation of much of their work. The debate is confused rather

6 KJ Arrow and G Debreu, 'Existence of a Competitive Equilibrium for a Competitive Economy', *Econometrica*, 22 , 265-90, 1954

than enlightened by the fact that both of them adopted different arguments on key aspects of economics at different stages of their careers. I am offering here my own interpretation, that the underlying vision which they each offer in their various ways fits in with the modern concept of the economy as a complex system.

I should also say that I am not a believer in what might termed the exegetical tendency in social science, whereby the truth is held to be revealed by deep study of the works of some past master, be it Marx, Keynes, Hayek or whoever[7]. Neither Keynes nor Hayek offered a satisfactory theory of the cycle by modern scientific standards, though with the benefit of hindsight Keynes' work in this particular area is distinctly the better of the two. But the key point is that their works on the business cycle contain many aspects which we would now regard as key features of complex systems.

I illustrate this point by considering their views on the business cycle. The two features of capitalist economies which distinguish them from all other societies are, first, a trend of slow but steady positive economic growth and, second, persistent and often large fluctuations from year to year around the trend. The latter fluctuations are referred to as the business cycle.

Both Keynes and Hayek believed that the business cycle is an endogenous phenomenon. In other words, it arises from features which are internal to the workings of the economy. Modern believers in rational agents are obliged, as in real business cycle theory, to postulate the existence of exogenous shocks as the cause of the cycle. A modern interpretation of their theories is that they regarded imperfect cognition by individual agents as the source of the cycle.

Their works were a product of their times, and both were unable to escape completely from the grip of the conventional concept of equilibrium. Both believed they were

[7] As a student at Cambridge I attended lectures by Richard Kahn and Joan Robinson, almost the last survivors of the group which had worked personally with Keynes. We imagined them holding spiritualist séances in Keynes' old rooms in King's College, knocking under the table and intoning 'Maynard, are you there? Speak to us Maynard!'.

working within a framework in which a stable full employment equilibrium exists in principle. But they observed that many aspects of the economic world did not seem to correspond to such a view. In particular, both Keynes and Hayek observed the catastrophic falls in output which had taken place in many Western economies in the early 1930s. They attempted to explain why the economy appears to spend much of its time away from such an equilibrium.

We can see this clearly with Keynes. His major work, *The General Theory of Employment Interest and Money*, was published in 1936 and represents his attempt to account for the high unemployment of the time. In inter-war Britain for example, the unemployment rate averaged 9.4 per cent, peaking at 15.3 per cent in 1932. In the United States, the average was 11.1 per cent, with a high of 24.7 per cent in 1933[8]. Prima facie, the labour market was not in equilibrium, with supply vastly exceeding demand. His concern was to attempt to understand why this was the case, why it was that labour markets in the capitalist economies experienced prolonged periods of substantial departure from equilibrium.

Keynes was at pains to retain as many of the postulates of conventional economics as possible. For example, in chapter 2 of the *General Theory*, he stresses that he is retaining a fundamental postulate of the classical theory of employment, namely that the wage is equal to the marginal product of labour.

In chapter 1, which consists of a single paragraph only, he states that 'the postulates of the classical theory are applicable to a special case only and not to the general case, the situation which it assumes being a limiting point of the *possible positions of equilibrium* [my italics]'. In other words, Keynes believed that his theory established the existence of multiple equilibria in labour markets. The classical theory, in which labour markets cleared, was simply a special case of his more general theory, just one of the numerous equilibria which could exist.

[8] estimates of unemployment rates in the inter-war period do vary slightly between sources. This data is taken from A Maddison, *Dynamic Forces in Capitalist Development*, Oxford University Press, 1991

Keynes chose as the focus for his theoretical attack the work of his Cambridge colleague Pigou[9], the designated heir of Marshall who had founded the Cambridge economics faculty. Pigou had written the *Theory of Unemployment* in 1933. Subsequent to Keynes' book, Pigou argued that a unique full employment equilibrium could still be shown to exist in Keynes' theoretical model because of the real balance effect[10]. According to this, consumption does not depend simply upon income as Keynes argued, but also on real net wealth. If high unemployment arises for whatever reason, there will be downward pressure on wages, and hence on costs and so on prices. The real value of assets denominated in money terms will rise. Consumption will therefore increase, and full employment be restored.

There are many refinements of the real balance effect in economic theory subsequent to the Pigou/Keynes interchange, which need not concern us here. The important point for this paper is not whether Keynes actually succeeded in constructing a theoretical model in which multiple equilibria for unemployment could exist. It is that it was his definite intention to do so.

There are further aspects to the *General Theory* which are even more obviously in keeping with the complex systems approach. A great deal of conventional theory is timeless, and is concerned to describe the properties of whatever equilibrium can be shown to exist. If a change in a model parameter is postulated which creates a different equilibrium, the two can be compared. Nothing at all is said about the transition between the two, in terms of either the shape of or the speed along the path.

For Keynes, economies most definitely existed in time. He was concerned to show that equilibria existed in his model. But much of the time not only were economies not in

[9] Pigou introduced into economics the very important concept of the distinction between private and social marginal costs and benefits, and the idea that governments can use taxes and subsidies to correct for any such externalities. This still forms the basis of a great deal of policy analysis throughout the world. Perhaps even more interestingly, he has been suggested as the 'Fifth Man', the recruiter of the Soviet spy network at Cambridge in the inter-war years which did so much to damage British and Western intelligence during the Cold War

[10] AC Pigou, 'The Classical Stationary State', *Economic Journal*, 53, 343-351, 1943

equilibrium, but the extent of their deviation away from it varied in time. For example, in chapter 5 ('Expectation and Employment') he wrote 'An uninterrupted process of transition to a new long-period position can be complicated in detail. But the actual course of events is more complicated still. For the state of expectation is liable to constant change, a new expectation being superimposed long before the previous change has fully worked itself out'. In other words, although in principle economies may be moving at any point in time from one equilibrium to another, they will spend almost all of their time out of equilibrium.

Keynes regarded expectations as the key to the fluctuations in output which are observed in all the market-oriented developed economies. Individual agents – firms – take decisions on output in the light of their individual expectations. These are based on very limited knowledge of their environment. Further, individual expectations are formed not in isolation, but with regard to what others are thought to believe. In modern terms, Keynes' firms are connected on a network across which different expectations either percolate or are contained.

Keynes distinguished very clearly between short-run (chapter 5 of the *General Theory*) and long-run expectations (chapter 12 'The State of Long Term Expectation'). The former relate to the decision about how much to produce in the immediate future with a given level of capital stock. The second relate to decisions on whether or not to change the amount of capital stock, in other words investment.

In terms of short-run expectations, Keynes postulated that these were formed by an individual agents using a very simple rule of thumb: 'it is sensible for producers to base their expectations on the assumption that the most recently realised results will continue, except in so far as there are definite reasons for expecting a change'. In other words, Keynes' firms are not assumed to perform complicated optimising decisions when setting their level of output. Instead, they operate with limited knowledge of the environment, and use a simple rule of thumb.

The limits to agent cognition are made even more apparent in Keynes' view of long-run expectations. In chapter 12, he writes that 'the outstanding fact is the extreme precariousness of the basis of knowledge on which our estimates of prospective yield [of a new investment] have to be made … If we speak frankly, we have to admit that our basis of knowledge for estimating the yield ten years hence of a railway, a copper mine, a textile factory, the goodwill of a patent medicine, an Atlantic liner, a building in the City of London amounts to little and sometimes to nothing; or even five years hence'.

In other words it is as if - a favourite phrase of economists - firms have very low or zero cognition when taking decisions on whether or not to vary the size of the capital stock. He re-emphasises this view in chapter 22 ('Notes on the Trade Cycle'), where he writes that 'the basis for such expectations is very precarious. Being based on shifting and unreliable evidence, they are subject to sudden and violent changes', and refers to the 'uncontrollable and disobedient psychology of the business world'.

For Keynes, the long-run expectations of firms were the most important determinant of the business cycle through their impact on investment[11]. The long-run expectation of a firm at any point in time is not the result of a rational calculation of the amount of profit which an investment is expected to yield. Rather it is a sentiment, the degree of optimism or pessimism which the agent holds about the future.

Keynes did not specify a formal model of how such expectations are generated, but there appear to be two components. Most importantly, sentiment is altered across the network of firms as a whole by 'waves of irrational psychology'. Keynes also writes of changes in sentiment being generated as the 'outcome of mass psychology of a large number of ignorant individuals'. This is the key feature of long run expectations. In addition, an agent seems to have the ability to change its optimism/pessimism spontaneously without regard to external factors, including the sentiments of other agents. Keynes writes of

[11] We now know, thanks to over half a century of national accounts, that in practice it is indeed the fluctuations in investment which in general make the major quantitative contribution to movements in total output over the course of the business cycle.

'spontaneous optimism' and a 'spontaneous urge to action rather than inaction'. This is the context in which his famous phrase 'animal spirits' appears.

In modern terminology, we have agents on a network which at any point in time are in one of k states of the world, where k is the degree of optimism/pessimism. There is some kind of threshold rule by which individual agents alter their state of the world according to the state of the world of their neighbours. This could certainly generate the 'waves' to which Keynes refers. In addition, each agent has an individual probability of changing his or her mind spontaneously, as for example in the Kirman ants model[12]. So the interactions between agents are of decisive importance for the actual macroscopic outcome which emerges.

Hayek's major general contribution to social science was to emphasise the limits to knowledge in social and economic systems. This was the source of a profound disagreement between him and Keynes. Keynes believed not only that he had discovered why labour markets did not clear, but that he, and like-minded others, could solve the problem. So, for example, towards the end of the *General Theory*, he writes 'I conclude that the duty of ordering the current volume of investment cannot safely be left in private hands'.

Hayek, in contrast, believed that there are inherent limits to knowledge which no amount of intellect can overcome. His 1974 Nobel lecture, for example, is entitled 'The Pretence of Knowledge'. In it he writes, along with much else, that 'the social sciences, like much of biology but unlike most fields of the physical sciences, have to deal with structures of *essential* complexity, i.e. with structures whose characteristic properties can be exhibited only by models made up of relatively large numbers of variables'.

Empirical evidence which supports Hayek's view in the context of the business cycle is the track record on economic forecasts of output growth, even just one year ahead. We

[12] Op.cit.

now have a track record of over 30 years of such forecasts, carried out by both public and private bodies. In general, the forecasting record exhibits a certain degree of accuracy in that the average error over time is smaller than the size of the variable being predicted. But the error is still large compared to the actual data, and most of the accurate forecasts are made when economic conditions are relatively stable. Exactly when they are most needed, at turning points in the economy, forecasts are at their least accurate. And the forecasting record shows no sign of getting better over time, despite the incentives for policymakers to get it right[13].

Hayek wrote a great deal on the business cycle and he changed his views over time as he realised weaknesses in his previous hypotheses. It has to be said that his theories here were never articulated as clearly as Keynes' in the *General Theory*, but they should be considered in the context of his general views on the limits to knowledge and the importance of the emergence of spontaneous order.

A potential problem in thinking about Hayek and the business cycle is that he was cited approvingly by Robert Lucas[14], the seminal thinker behind modern (and failed) attempts to produce a rational expectations account of the cycle. Hayek essentially believed that the starting point of business cycle theory should be the framework of general equilibrium. It was not sufficient, important though this might be, to point out empirical evidence on why this theory fails to explain the cycle. It was necessary to extend the theory in order to achieve an explanation. This *ex post* guilt by association of Hayek with the rational expectations school needs to be set aside when considering the complexity features of his business cycle theories.

13 for a discussion of this, see, for example, P.Ormerod and C.Mounfield, 'Random Matrix Theory and the Failure of Macro-economic Forecasting', *Physica A*, 280, 497-504, 2000.

[14]R. E. Lucas, 'Understanding Business Cycles', in Brunner, K. and Meltzer, A. (eds.) *Stabilization of the Domestic and International Economy*, Amsterdam, North-Holland, 1977

In essence his view as to why the cycle exists is first, that agents have different expectations about the future. Second, and partly in consequence of this, agents find that outcomes differ from their expectations, and revise their actions as a result.

So in his 1937 article 'Economics and Knowledge'[15], for example, Hayek writes that 'It appears that the concept of equilibrium merely means that the foresight of the different members of the society is in a special sense correct. It must be correct in the sense that every person's plan is based on the expectation of just those actions of other people which those other people intend to perform and that all these plans are based on the expectation of the same set of external facts, so that under certain conditions nobody will have any reason to change his plans'.

He argued that such individual plans might indeed have to be revised by external shocks. But, more importantly, the individual plans may not have been, indeed are unlikely to have been, compatible from the outset, so that revisions are inevitable. Heterogeneous agents in this view of the world are operating with limited knowledge of their environment and their foresight is imperfect. Again, it is the interactions between agents, this time in terms of the incompatibility of their individual plans, which brings about the particular macroscopic outcome for the system as a whole.

Ultimately, Hayek regarded the business cycle as a monetary phenomenon, and attempted several times to articulate his views. Perhaps the best known of these is his 1929 *Monetary Theory and the Trade Cycle*, not least because it was famously attacked by Sraffa, a Cambridge colleague of Keynes, in the *Economic Journal* in 1932[16]. An excellent modern discussion of this debate is given by Cottrell[17]

Hayek saw the source of the cycle in a divergence between the money rate of interest and what he termed the 'natural' rate, the rate which would ensure that savings and

[15] FA Hayek, 'Economics and Knowledge', *Economica*, 4, 33-54, 1937
[16] P Sraffa, 'Dr Hayek on Money and Capital', *Economic Journal*, March 1932
[17] A Cottrell, 'Hayek's Early Cycle Theory Re-Examined', *Cambridge Journal of Economics*, 18, 197–212, 1994

investment would equilibrate. This divergence could obviously arise by mistakes of bankers, but he believed there was a much deeper reason. Namely, that firms at some stage become overly optimistic about the future, and revise upwards their expectations of profitability. This is remarkably similar to the concept of the 'marginal efficiency of capital' which Keynes put forward in the *General Theory* in 1936.

The key points are that, first, firms' expectations prove to be wrong and the unintended consequence is the emergence of an economic expansion which ultimately proves unsustainable. Individual firms may have complete information on their local circumstances, but they are unable to appreciate the collective consequences of their individual decisions. Second, firms do not learn from previous experience to avoid similar mistakes in the future, these false expectations are an inherent feature of the economic system. Third, the central bank does not learn how to offset these expectations in order to smooth out the cycle and restore equilibrium.

5 Closing remarks

Complex systems exhibit a range of distinguishing characteristics. For example, a low level of predictability of the system at any particular point in time. This in turn implies that the individual agents which comprise the system have limited knowledge of their environment. The macroscopic properties of complex systems emerge from the interactions of the agents, and it may not, indeed usually is not possible to deduce them even from a complete knowledge of the behaviour of the individual agents. Further, there will typically be multiple possible histories in such systems.

Conventional economic theory is in essence antithetical to a complex systems view of the world. It is populated by rational agents each with high cognitive powers, and is mainly concerned to discuss the properties of equilibrium solutions to the system. Nevertheless, there are traces of features of complex systems scattered here and there. Most strikingly, general equilibrium theory exhibits multiple equilibria and an emergent phenomenon: no individual agent in general equilibrium intends all markets to clear.

In contrast, the works of Keynes and Hayek have much more in common with the modern complex systems approach. Their theoretical models describe worlds in which agents have limited knowledge and foresight regarding their environment and in which the interactions between agents are of decisive importance for the macroscopic outcome. This outcome emerges from the interactions and cannot be deduced from a description of how an individual agent behaves.

This dynamic view of the world, fundamental to Keynes' *General Theory*, was edited out by mainstream economics after his death in the so-called IS-LM synthesis. And Hayek's work was for many years to all intents and purposes ignored by economics. The closing decades of the 20th century and the opening ones of the present one have seen a resurgence of interest in Hayek, as the empirical evidence from experimental and behavioural economics builds. Agent behaviour in the real world appears to be much closer to Hayek's view, with agents having limited cognition and facing inherent limits to their knowledge, than it does to the rational agent postulate of conventional economics.

So the complex systems approach is part of a fine tradition within economic theory, embracing as it does two of the greatest economists of the 20th century.