*Modeling Rational Agents: From Interwar Economics To Early Modern Game Theory*, Nicola Giocoli. Edward Elgar, 2003, x + 464 pages[1].

The fame of *Modeling Rational Agents* precedes it. Nicola Giocoli's book won the Best Monograph prize, 2004, from the European Society for the History of Economic Thought, and – in an earlier manifestation as his doctoral thesis – the Joseph Dorfman Best Dissertation Award, 2002, from the History of Economics Society. It does not disappoint the expectations thus aroused. Giocoli's account is powerful and fascinating, and elegantly presented.

Giocoli starts by suggesting that we can distinguish between the *body of knowledge* and the *image of knowledge* of a discipline, and that the two interpenetrate and interact. The *body* concerns the theoretical and empirical knowledge acquired by the discipline, as well as its methods and open questions. The *image* concerns what the discipline thinks it is and should be, how it presents and justifies itself, both to itself and to the world. Giocoli's thesis is that over, very roughly, the century from the 1890s to the 1980s, a transformation took place in the *image* of neoclassical economics, accompanied by corresponding changes in its *body*. The image change that Giocoli identifies is from a 'system of forces' (SOF) to a 'system of relations' (SOR) view of what economics is about. According to the SOF view the focus of analysis is on the economic processes generated by market and non-market forces, including, but not limited to, those leading towards equilibrium. The SOR image, in contrast, focuses on studying the properties and implications of the logically possible existence of an equilibrium, ignoring the processes required to generate and underpin it. This change in focus, he argues, is accompanied by a change in the discipline's understanding of rationality, from one that stresses optimising behaviour, to a more rarefied notion of logical consistency.

The focus of this story is a particular puzzle, namely the failure of neoclassical economics to adopt game theory, and, in particular, the concept of Nash equilibrium, in the immediate post-war period, given the present-day consensus that Nash equilibrium embodies the discipline's most fundamental idea. The answer that Giocoli gives is that game theory and Nash equilibrium were ideas whose time had not yet come. Only once the transformation of the dominant self-image of economics from SOF to SOR had been completed, and the consistency approach to rationality displaced the older view, based on the maximisation of a utility function, was neoclassical economics ready to hear what the game theorists were saying.

The book consist of two parts, articulated by an 'interlude', and each consisting of two chapters, plus an introduction and conclusion. The introduction sets out the thesis just described, and then outlines mathematical formalism from Hilbert to Bourbaki, and the logical positivism of the Vienna Circle. These constitute the 'humus' in which two trends germinate – a trend

[1] An earlier and much shorter version of this review appeared in the *European Society for the History of Economic Thought Newsletter* No 9, Summer 2004, pp 25-26.

within economics from Fisher, Pareto and Slutsky to Hicks, Allen and Samuelson, via Hayek, the Swedish school and Hutchison, and a mathematical trend exemplified by von Neumann and Morgenstern, and John Nash.

The first part of the book discusses neoclassical attempts to escape from psychology (chapter 2) and perfect foresight (chapter 3). These, respectively, refer to the projects of freeing economic agents of any dependency on 'mental variables' and psychological processes, and of relaxing the classical requirement of perfect knowledge on the part of agents for the achievement of an intertemporal equilibrium of the system as a whole. Giocoli argues that the two projects were inconsistent and led to a stalemate lasting from the late 1930s until well after World War II, which was resolved only by the replacement of the SOF by the SOR approach as the dominant self-image of economics.

The second part of the book discusses von Neumann and Morgenstern's (chapter 4), and then Nash's (chapter 5), versions of game theory, and explores the puzzle, indicated above, of the fall and subsequent rise of game theory and Nash equilibrium in the post-war period. In a sub-plot to this account, Giocoli examines the writings of von Neumann, Morgenstern and Nash to see where they stood on the SOF-SOR issue – and finds an ambivalence with some strong evidence of a preference for the SOF version. This leads to the intriguing counterfactual speculation as to what might have happened had their contributions been sold vigorously to the profession as embodying an SOF vision. Neoclassical economics might, he suggests, have found an alternative resolution to the crisis of the SOF view which did not lead to a victory of SOR.

In the remainder of this review, I would like to do two things, both prompted by the observation that, remarkably, a book dealing with the evolution of the discipline of economics from the interwar period to the 1980s has nothing to say about Keynes. Firstly, the contrast between the SOF and SOR versions of equilibrium is not the whole story: there is a significant alternative to both that Giocoli ignores. Secondly, I wish to argue that Giocoli's account is also incomplete in another respect: he neglects macroeconomics, and once this is considered the resolution of the SOF-SOR rivalry looks different in important ways. These suggested extensions to *Modeling Rational Agents* are themselves a testament to the power and fruitfulness of Giocoli's approach.

I want now to turn to a consideration of a central theme of the book, namely, the neoclassical concept of equilibrium. Both SOR and SOF views embody notions of equilibrium, but, according to Giocoli, in the SOF image the focus is on 'the explanation of how and why a certain equilibrium has been reached', in contrast to the SOR image, the goal of which is the demonstration of the existence of an equilibrium, though (in Hutchison's words) 'not of [its] actual, empirical existence but of [its] conceivable, logically or mathematically non-contradictory "existence"' (p. 5)

Giocoli identifies the principal theme of the development of economics in the 1930s as

> "the last important attempt to preserve, if not enhance, the traditional image of economics as a discipline dealing with systems of forces, that is, as a discipline which investigates the actual working of the economic system and, in particular, its equilibrating processes … [T]he key theoretical issues became the modeling of the disequilibrium processes … The program developed inside a more general theme, that of turning the static neoclassical equilibrium theory into a dynamic one." (pp. 135-6)

The SOF view was thus a view of economics as the study of the working of the economic system: the investigation of the equilibrating processes spontaneously invoked when the system was out of equilibrium. Giocoli argues that this attempt to draw dynamics from the static equilibrium theory was unsuccessful, partly because of 'unavoidable inconsistencies between the willingness to investigate the disequilibrium behavior of the economic system and the desire to preserve the notion of equilibrium as the central category of the analysis' (p. 137).

Giocoli touches here on some of the key issues concerning the way the equilibrium concept has been deployed in the neoclassical mainstream. Two things, I think, are clear from his account. Firstly, even the SOF version implies that the economic system can be understood as an equilibrium: the image of the economy as a whole is one of a static equilibrium, the maintenance of which is explained by the operation of equilibrating forces, forces which only operate once the equilibrium has been disturbed by exogenous forces. This leaves us with a profoundly static and ahistorical image of society: there is no theoretical basis here for immanent development or novelty. The recognition that the model might not be entirely adequate is addressed not by replacing it with an alternative, but by adding dynamics on to the static core, notably by relaxing the perfect information assumption and introducing various models of learning and expectations adjustment.

Secondly, the SOR version is clearly significantly worse, focusing the entire attention of the researchers involved on the study of theoretically conceivable equilibrium states, divorced from any possibility of learning about the equilibrating processes which might lead to and sustain such states. This, I submit, cuts us off from all possibility of learning about the forces which actually underpin and shape our society.

But there is an alternative to both. Throughout the history of modern economics there has been struggle, sometimes open, sometimes hidden, between two notions of equilibrium.

In the neoclassical view, an economic system is at or near a normal state or condition such that small moves away from it set in motion forces returning the system to the attractor state. The system can be modelled as an equilibrium. For some purposes, the equilibrium can simply be assumed to hold. If greater detail is required, a distinction can be made between a short and long run: in the long run, the system may be considered as, at least

approximately, or for practical purposes, in the attractor state; in the short run, firstly, changes in exogenous variables shock the system away from the attractor state, and then divergence of the system from the attractor state itself sets in motion forces returning it to its normal condition.

In the alternative to this view, self-organising economic systems exhibit stability underpinned by a host of adaptive mechanisms, that is, they are homeostatic. The terms homeostasis and equilibrium are often used interchangeably, but the notion of equilibrium here is fundamentally different from the neoclassical concept. In the 'years of high theory' prior to World War II, the neoclassical paradigm was challenged by the emergence from within itself of a number of standpoints which began to undermine the static notion of equilibrium. Two of the most notable challengers were Keynes and Hayek. In works such as the *Sensory Order* and *Law, Legislation and Liberty* Hayek refers with approval to the notions of homeostasis and open systems in the writings of Bertalanffy and others.

> "In order to explain the economic aspects of large social systems, we have to account for the course of a flowing stream, constantly adapting itself as a whole to changes in circumstances … and not for a hypothetical state of equilibrium" (Hayek, F.A. *Law Legislation and Liberty*, Routledge, 1982, III: 159).

Keynes's *General Theory*, amongst other things, reintroduced many of Marx's insights, including the notion that the accumulation of capital over time must lead to a tendential fall in the rate of profit. Equilibrium here can only be a temporary halting place, an abstraction from the real flow, an assumption of *ceteris paribus* purely for analytical tractability.

What these paradigms are groping towards is a view in which time, change and history are fundamental, in opposition to the neoclassical view that equilibrium is the default, and disequilibrium a temporary disturbance which will spontaneously eliminate itself. In the former vision equilibrium is a temporary, short-run state in which growth and evolution are counterfactually assumed to be suspended. This temporary, provisional equilibrium is destined to be disrupted by the emergence of endogenous forces in the longer run. In the latter, neoclassical, view, stasis is the permanent, underlying condition, dynamics only arising temporarily after an exogenous shock, in the transition to a new equilibrium.

Giocoli's concern is to distinguish an earlier and a later phase of neoclassical economics and to account for the transition, while pointing up the deficiencies of the later SOR standpoint with respect to the earlier SOF view. My view, however, sketched out above, is that *both* the SOR and SOF images manifest a fundamental weakness intrinsic to the neoclassical outlook, namely the static neoclassical concept equilibrium. The alternative, which was already emerging at the time, and which it was important to render heterodox, was the movement towards understanding the economy as a system – a *general* theory, as Keynes says, is 'concerned with the behaviour of the economic system as a whole' (*The General Theory of Employment, Interest and Money*, Macmillan,

1973, xxxii) – and, as Hayek argues, towards replacing equilibrium with homeostasis.

Turning now to the second of the two points I wished to raise, I'd like briefly to touch on the insights we might gain by supplementing Giocoli's account with a consideration of macroeconomics. By concentrating entirely on microeconomic fields such as general equilibrium theory, Giocoli's account misses the retention of the SOF image postwar within macroeconomics and econometrics. Following the aborted Keynesian revolution of the 1930s, academic economics and policy making circles were colonised by a bowdlerised neoclassical Keynesianism, and, subsequently, by an equally neoclassical monetarism. The period saw the radical separation of micro- and macro-economics (a separation denoted, paradoxically, as a 'neoclassical synthesis').

In Giocoli's account it is difficult to understand why SOR should have triumphed over SOF. It is clear from Giocoli's account that the SOF paradigm did not founder because it was eclipsed by SOR: on the contrary, although SOF was in trouble from the end of the 1930s, as the attempted escapes from psychology and perfect foresight produced opposing results – one leading away from, and the other towards, including agent learning – it was not until the 1980s that SOR was established as the core of the neoclassical standpoint, allowing the rediscovery of game theory and Nash equilibrium. So what drove this process? Why did it become untenable for economists to present themselves as following an SOF image, and why did they feel they had to switch to the SOR programme?

This makes more sense once we understand that, with the growth of neoclassical macroeconomics and econometrics, the SOF view was retained unchallenged in the postwar period. The SOF and SOR were complementary: in micro, including general equilibrium theory, there was an increasing recourse to maths and logic, and stress on the investigation of what it would mean for the individual agent to exhibit rationality, while in macro and econometrics, including neoclassical Keynesianism, and monetarism, there was little interest in the rationality or otherwise of the individual agent, since it was aggregate behaviours that were the focus of concern. Macroeconomics was interested in disequilibrium behaviour: how would agents respond to shocks while they were still learning about them? This was needed to underpin the development and use of fiscal and monetary policy for economic stabilisation. Microeconomics could be presented as attempting to supply rigorous foundations for this by explaining exactly what agent rationality meant, and what it would mean for the economy to be in equilibrium. The two strands come together again with the emergence of the New Classical Macroeconomics (NCM) in the 1970s. Macro was then ready to accept games theory and use it, but by then games theory was no longer purely SOR, as Binmore and others point out. NCM attempted to build models which were internally consistent but which mimicked the progress of the economy. As Lucas makes clear in *Models of Business Cycles*, the focus of interest of the NCM was still the teasing out of dynamics from an equilibrium model, but now using the formalism of dynamic games theory. Although the NCM

makes no attempt to discuss the behaviour of the economy in disequilibrium, it attempts to dynamicise the model by incorporating exogenous shocks and then using game theory to model how agents will react to them, while invoking continuous Nash equilibrium conditions. It thus considerably expands the notion of equilibrium, calling on it to do much of the work done by disequilibrium in earlier schools of macroeconomic thought. It is thus problematic to fit the NCM into the pure SOR framework.

The budding off of a microeconomics moving towards SOR, while leaving an SOF macro untouched, made explicit what was already implicit in SOF, given the reductionist neoclassical strategy of basing everything on the individual optimising agent, set in a static social world, instead of the evolution of systems of relations between agents, as the systems theoretical vision would have done. Then, clearly, much work had to be done establishing the nature of this agent and the nature of the equilibrium constituting the minimal institutional framework within which these agents were to interact. The most stripped-down notion of the agent is one in which we know nothing of his desires, except that he pursues them consistently, and the most stripped-down social context is the Nash equilibrium in which everyone is behaving self-consistently, given self-consistent behaviour of everyone else.

I think this fascinating and provocative work can productively be linked to Mary Poovey's *History of the Modern Fact* (University of Chicago Press, 1998). The latter is an 'epistemological history' of political economy, a history of the ways political economists have sought to persuade, themselves and others, that what they are producing is reliable knowledge. Various phases of political economy are characterised, according to Poovey, by the metaphors and tropes, the rhetorical strategies which form, not only the language in which economics is communicated, but also the self-image of the discipline and hence the practice of economics itself. Without mentioning Poovey, this is precisely Giocoli's approach. SOF and SOR may both be understood rhetorically, as strategies to persuade us that economics is worth doing and the pronouncements of its practitioners worthy of attention. Both suffer from the perennial problem of the social sciences: the need to underpin their claim to the status of science, and both do so by reference to, and a claim to share the prestige of, a non-social science – in the case of SOF this is classical mechanics with its associated differential calculus, for SOR mathematical formalism, combinatorics and set theory. To set this out explicitly raises interesting questions for further research, but to have set the scene for asking them is itself a very significant achievement.

Andy Denis
City University, London, and CPNSS, LSE

Word count: 2954.