

The two chapters of Part II (both written with P. A. Chiappori), by focusing on the nature of the stochastic processes triggering sunspot equilibria, address a key point. Here the authors show that, instead of being triggered by an extrinsic signal whose origin is not always clear, sunspot equilibria may be viewed as self-fulfilling over-reactions to small variations of intrinsic variables. In this perspective, some sunspot phenomena are more focal than others. One leading candidate is the stochastic process governing money supply, discussed by Lucas in his 'Expectations and the neutrality of money' (*Journal of Economic Theory*, 4 (1972)). It is well known that, if attention is restricted to the class of price functions linear in the stock of money (a strong 'neutrality assumption', since it does not stem from Lucas definition of rational expectations), then the Lucas model predicts a unique solution (stationary in probabilistic terms). Chapter 4 shows that, in addition to the Lucas solution, a continuum of (non-stationary) solutions exists, all invalidating the strong 'neutrality assumption'. This questions the referential status of the Lucas solution. The issue is further developed in Chapter 5, where it is shown that the non-Lucas solutions have the theoretical status of sunspot solutions where the sunspot variable is represented by the realization of the exogenous money supply. Both chapters provide very important examples of a world in which two conflicting theories, one Keynesian-like and the other monetarist-like, can be alternatively self-fulfilling.

Part III presents an extension of the themes of Part I to an n -dimensional, one-step forward-looking, economy. Among other things, Chapter 6 shows that, because of the multiplicity of equilibria that can arise in an n -dimensional world, a particular category of sunspots emerges in which sunspots may work as selection criteria. Chapter 7 (written with P. A. Chiappori and P. Y. Geoffard) focuses on a special class of equilibria generating small fluctuations around a deterministic steady state and provides a complete characterization and classification of the equilibria.

Part IV is devoted to extensions and variations. Chapter 8 (written with M. Woodford) studies the connection between determinacy and stability under adaptive learning of a deterministic cycle. Chapter 9 (jointly with J. Davila) is an exploration of the existence of SSE in one-step forward-looking models with memory. A broad perspective on the analysis of previous chapters is given in Chapter 10, where the connections between indeterminacy, sunspot multiplicity and learnability of rational expectations equilibria are scrutinized.

The papers collected in this volume testify to Guesnerie's highly authoritative and influential role in developing a research programme challenging the egemonic status reached by the rational expectations theory. The book is a very valuable reference for students of dynamic macroeconomic models.

Università Cattolica, Milan

GIORGIO NEGRONI

Machine Dreams: Economics Becomes a Cyborg Science. By PHILIP MIROWSKI. Cambridge University Press, Cambridge. 2002. xiv + 655 pp. £70. Paperback £24.95.

Philip Mirowski is known for his provocative interpretation of the history of neoclassical economics as an importation of concepts and metaphors from other sciences. In earlier works he has argued for the decisive influence of thermodynamics on nineteenth-century marginalist economics; in his latest book he argues that neoclassical economics from the Second World War to the present has lost its protoenergetic character by becoming more or less directly influenced by the theoretical developments surrounding the advent of the digital computer.

The core of the story is built around the intellectual career of John von Neumann, best known for his co-authorship of the *Theory of Games and Economic Behaviour*. For Mirowski, however, this work is not von Neumann's most significant contribution to economics; rather, he paints it as a transient stadium between the genius's quest for a

formalized mathematics and the development of the theory of automata. Game theory is to be understood as merely a ‘tentative exploration of various paradoxes of certain definitions of rationality’ (p. 134), while the theory of automata, discussing all forms of self-regulating information processing, provides the general approach to rationality. For Mirowski, cyborg sciences started here: with the discussion of natural or social phenomena as information processes of a finite computational machine. This, and not his theory of games, is von Neumann’s ‘most profound contribution to economics’ (p. 139).

It is also here that Mirowski spots the crucial theoretical fork. Von Neumann, with all of his interest in questions of rationality, showed no inclination to apply the theory of automata to questions of human cognitive architecture. His interests focused on questions of organization—in the realm of biology, in military operations and in social questions in general. And so it was not von Neumann, but the economics profession, that developed the idea of human cognition as algorithmic processes and turned it into a reinforced concept of economic rationality.

Machine Dreams recounts how the military organization of science in and after the Second World War facilitated that transformation. Created by a small group of ‘science managers’ under von Neumann tutelage, Operations Research provided a new field of interaction between scientists and the military. Novel hierarchies emerged; science was subordinated to a new division of labour; and most importantly, as Mirowski reminds us, large parts of science became financially dependent on the military. This holds in particular for the Air Force think-tank RAND, a harbourer of cyborgs, which in 1948 bought into one of the holy grails of neoclassical theory, the Cowles Commission. In this institutional dependence, Mirowski sees the decisive impulse to reconceptualize the neoclassical agent: ‘Cowles preserved its neoclassical price theory by recasting its a priori commitment to utilitarian psychology as though it were best described as the operation of a virtual computer’ (p. 222). Cyborg science went cognitive, a transformation that Mirowski finds as dislikeable as it is pivotal for contemporary economics.

Finally, algorithmic rationality infected game theory itself, changing von Neumann’s original project considerably. The Nash Equilibrium, for Mirowski the paradigm case of the ‘rationality of the paranoid’ (p. 343), stands for him in marked contrast to von Neumann and Morgenstern’s earlier work. Mirowski points to various sources that report von Neumann’s rejection of the equilibrium concept; further, he finds in Nash’s work all of the ingredients that had beset the Cowles Commission: ‘hyper-individualism, non-accessible utility functions, constrained maximization, and cognition as a species of statistical inference’ (p. 348). The Nash equilibrium, Mirowski concludes, is to be seen as a ‘logical extension of the Walrasian general equilibrium tradition into the Cold War context’ (p. 339), but not as a continuation of von Neumann’s project.

Mirowski leaves no uncertainty about his opinion that this tine of the fork is a cul-de-sac; and he shows that the ‘true cyborgs’—von Neumann’s acolytes—are with him on this. In the enthusiastically titled chapter ‘The Empire Strikes Back’, he shows how the cyborgs took issue with the concept of algorithmic rationality itself: first by questioning the computability of Arrow’s choice function, and thus the rational preference assumption of his Impossibility Theorem; and later by targeting the assumptions of common knowledge implicit in the Nash Equilibrium. Computability became a criterion of rationality—a torpedo big enough in Mirowski’s eyes to sink the Walrasian vessel.

In reaction to these complications, Mirowski claims, Herbert Simon developed his program of simulacra. Instead of trying to grasp the whole cognitive structure of human thinking in a grandiose theory of rationality, and therefore falling into the same trap that Cowles and the game theory revival allegedly did, Simon simulated piecemeal human behaviour, specific to task and environment. In doing so, he began the quest for overall consistency, or even for coherence towards a unified self. Thus, although he shared the conviction of the centrality of the computer with von Neumann, Simon ended up diametrically opposed to him, as a “‘humanist” and anti-foundationalist’ (p. 471) cyborg.

The computer and the theoretical development surrounding it have shaped neoclassical economics in a variety of ways. Mirowski's impressive archival research, which he presents in his inimitably tapered style, reports this with clarity and excitement. However, the major thesis of this book—that there is a *uniform* influence of the cyborg sciences on economics—suffers somewhat from the ambiguity of the cyborg concept itself. That might be due partly to the fact that the computer itself did not stand still during that period, as Mirowski puts it, and that therefore the concept was deliberately kept flexible. But beyond that, it is so overcharged with connotations that never really get clarified, and the reader so repeatedly loses track of who is and who is not in the cyborg camp, that the conceptual framework of this history must be taken with a grain of salt.

The purported uniformity of this history might instead serve another purpose: to create an antagonism between two schools of economic thought on yet another level. While Mirowski steadfastly holds on to his champion von Neumann, and particularly to his cyborg project, he makes clear in no uncertain terms his contempt for the Walrasian school, their supposed 'rationality of the paranoid' and their conceptualization of the cognitive realm as 'acidly corrosive to the constitution of the human being' (p. 656). At the end of the book, Mirowski sketches von Neumann's project of automata theory as a platform for institutional economics, free from neoclassical orthodoxy, just as his hero-genius supposedly did. Here the reader is finally presented with the antagonism that underlies the whole book—and it makes one ask oneself whether doctrine and history really always fit so neatly together. Writing a history that culminates in a doctrinal conclusion is a somewhat odd project, but makes for a provocative and often inspiring read—as does this book, without question.

London School of Economics

TILL GRUENE

Corporate Financing and Governance in Japan: The Road to the Future. By TAKEO HOSHI and ANIL K. KASHYAP. The MIT Press, Cambridge, Massachusetts. 2001. xx + 358 pp. £23.95.

For more than 150 years the Japanese economy has fascinated Western observers. However, over the last decade the basis of this fascination has changed. Before the 1990s, sustained episodes of extraordinary growth exerted the dominant attraction. Since then, a persistent, perplexing stagnation has taken centre stage. Yet whatever the period, foreigners have sought to understand and learn from Japan's economic experience. Takeo Hoshi and Anil Kashyap's new book now makes the learning process much easier. Their main concern is how (and how well) economic growth has (or has not) been financed in modern Japan. They break this large issue into four systematically treated components, examined over four epochs since 1868. The components are: (1) What financial assets do households accumulate when they save (e.g. currency, bank deposits, securities, etc.)? (2) To what extent and how are businesses externally financed (in particular, what is the extent of their reliance on bank loans rather than security sales through public financial markets, relative to internal or private sources of funding)? (3) What is the range of business services provided by banks (e.g. loans, asset management, security issuance and underwriting, advice on mergers and acquisitions, etc.)? (4) What is the nature and extent of bank involvement in corporate governance (in particular, how closely and effectively are managers monitored and what assistance is given to distressed borrowers)? These components are assessed over four periods: (1) the foundation of the modern economy, c.1868 (Meiji Restoration) to c.1937 (beginning of sustained war with China); (2) total war and occupation (c.1937–55); (3) the era of super growth (1955–75); (4) the era of transformation through deregulation (1975–98, still in progress).

Hoshi and Kashyap firmly believe that history and context matter. Unlike many writers, they see no mystery in the way the Japanese economy operates or is financed.