

Report on the book manuscript

'A Stochastic Approach to Macroeconomics and Financial Markets' by M. Aoki and H. Yoshikawa

The book proposal under review elaborates on the line of research of Professor Aoki's previous monographs 'New Approaches to Macroeconomic Modeling: Evolutionary Stochastic Dynamics, Multiple Equilibria, and Externalities as Field Effects' and 'Modeling Aggregate Behavior and Fluctuations in Economics' published by CUP in 1996 and 2002, respectively. Introducing new tools for the analysis of agent-based models of economic interaction both volumes had an enormous impact on the profession. After reading over the draft material, I expect the third entry in this series to become similarly influential. This said, I am not only supportive of accepting this manuscript, but I am rather enthusiastic about the prospects it provides for a new type of macroeconomic modeling. Being quite determined in advocating a replacement of the currently fashionable macroeconomics of representative agents by an alternative approach based on stochastic interactions of a large number of agents, it will certainly make a stir in certain circles. However, all its proposed methodological innovations are well motivated and the potential use of statistical approaches to agent-based models is demonstrated in a series of highly original and insightful applications. The material of this manuscript once more shows Professor Aoki and his co-author Yoshikawa at the forefront of the burgeoning research on heterogeneous interacting agent models whose increasing influence is to a large part owing to Professor Aoki's restless scientific activity in this area.

Compared to the 1996 and 2002 books, the new manuscript shows a pronounced shift from the developments of appropriate methods for analysis of agent-based models to applications. The longer part of these applied chapters of the new volume is devoted to macroeconomics with the two last chapters turning to financial markets. The macro chapters (3 to 8) reveal a strong Keynesian orientation (which may come as a surprise to some readers of Professor Aoki's previous books) revisiting such key concepts as the liquidity trap, the role of uncertainty in macroeconomics and the possibility of a slowdown of economic growth due to saturation of demand. Often competing neoclassical and even neo-Keynesian theories are given a hard ride in passing, but the alternatives advanced by Aoki and Yoshikawa have a strong theoretical foundation and are supported by a wealth of empirical observations.

In the following I list a few remarks and suggestions for slight modification and extensions that came to my mind when reading through the sample material.

- (1) The first chapter starts with a concise and convincing discussion of agent-based approaches vis-à-vis the reductionist device of representative agent models. At certain places, I was reminded of the debate on reductionism in biology quite some time ago (cf. the influential book by Monod [1]) which might be quoted as an interesting parallel to the current discussions in economics. When introducing heterogeneity of firms through a Boltzmann-Gibbs distribution (p. 12 of this chapter), it might be worthwhile to point out that a very similar approach is used in the closely related work on statistical models of wealth distributions (see [2] for an up-to-date summary of this literature).
- (2) In the sample material, a number of equations are not readable (e.g. the first eq. on p. 25 of chapter 1 and various similarly distorted lay-outs of equations in later chapters).
- (3) Some figures are a bit too schematic, e.g. Fig. 1.2 of chapter 1. Instead of simply producing a zigzag line, it would be more insightful in this case to replace it by a simulation of a Ramsey economy with shocks.

- (4) The technical chapter 2 has some overlap with the contents of the 1996 and 2002 books. Though this is certainly necessary for a comprehensive treatment, it would be nice to clearly point out the relationships between the material presented here and that in these previous volumes.
- (5) What is perhaps more important is that the section on exchangeable random partitions (from p. 26 of chap. 2) is very hard to read. It seems to me that not all symbols used are properly defined and I think this part needs a revision prior to publication.
- (6) Similarly, the discussion of value functions and dynamic optimization in chap. 3 could be expanded. In particular, eq. (19) on p. 12 would need some more discussion.
- (7) In chapter 4, my impression is that the detailed analysis of the Japanese crises gets somewhat out of touch with the highly stylized model presented before. It is not really clear what the model could contribute to explaining some of the micro structural developments of the Japanese economy reported in this section.
- (8) In chap. 6, I am not clear how to read the notation in the parts following eq. (16) and (17): what do the entries (k,k) or (l,l) stand for in these equations?
- (9) p. 21 of chap. 6: line 5 from bottom: replace 'negative' by 'positive' in '..... $dE(Y)/ds$ is negative!' When different demand patterns are introduced as examples on p. 23, it might be worthwhile to clearly restate the dynamic laws underlying the subsequent simulations.
- (10) Another relationship to other strands of literature: the multi-sectoral dynamics of chap. 6 bears some resemblance to the huge literature on linear production models (Leontief, Sraffa, von Neumann ...). It would be nice to have the similarities and differences to this established body of literature pointed out.
- (11) The application of ultrametric distances to labor market dynamics (chap. 5 and 7) in my view is a truly ingenious and potentially very fruitful approach for modeling frictions in movements between different segments of the market. What I found a bit distorting is that in the present implementation of this approach, the ultra metric distance only influences the probability of hiring of an agent (worker) from the pool of unemployment persons. One may not the following consequence of the formalization in chap. 7: if, as an example, there are *only* workers available with a high ultrametric distance to the hiring firm, they would nevertheless be hired with probability one and no further frictions in their adoption to the new working environment would exist. This suggests to not only apply the ultrametric principle to probabilities, but also to training costs and other cost elements of hiring decisions. But this might a topic for future research. In any case, it is extremely reassuring that the model can reproduce and explain such important findings like the Beveridge curve and Okun's law. As another matter, the hierarchical structure of ultrametricity is somewhat related to that of multi-fractality which plays an important role in recent literature in financial economics [3].
- (12) p. 21 of chapter 7: Note that the long quote by Okun has already been cited earlier in this chapter.
- (13) In chap. 8 I had again problems to follow all formal derivations. My confusion starts with the boundary conditions stated on p. 13 which need some more explanation and continues on pp. 15/16 where some definitions of variables seem to be missing.
- (14) Chap. 9 expands on the share market model of Aoki (2002, chap. 11). It would, therefore, be nice to get some information on what modifications and additional results this chapter has compared to the previous treatment.

Most of these points are minor remarks. Altogether, I should, however, emphasize, that the present manuscript is already very close to being publishable and would only need small additional efforts to be put into its final form.

References:

- [1] Monod, J., *Le hasard et la nécessité*. Paris: Éditions du Seuil, 1970 (English: Chance and Necessity).
- [2] Chatterjee, A. et al., eds., *Econophysics of Wealth Distributions*. Berlin: Springer 2005
- [3] Mandelbrot, B., *Multi-Fractals and 1/f Noise*. Springer: Berlin, 1999.