

Book Reviews

Endogenous Growth Theory

Philippe Aghion and Peter Howitt

Cambridge, MA, MIT Press, 1998, xiii + 694 pp., US\$59.95, ISBN 0-262-01166-2

This book is a must for anyone interested in the frontiers of economic research into technological change and growth, innovation and science policy. It reviews and synthesises much of the formal work on these topics, and it suggests promising areas for further research. The authors aim to show that endogenous growth theory is most fruitful when constructed from a Schumpeterian perspective. They also emphasise that their modelling approach can be used to analyse many related phenomena in other areas of economics. However, potential readers should be warned of the high mathematical skills required to understand the numerous models contained in the book. It is written primarily as a textbook for upper-level US graduate economics courses and as a reference work for researchers. In spite of this, I suggest that with some perseverance, many readers will find the book to be a treasure chest of ideas.

Chapter 1 reviews 'old' and 'new' growth theories which do not adopt the Schumpeterian paradigm. It includes discussion of the Solow model and its modern extensions, the 'AK' approach to endogenous growth modelling as well as Romer's main contributions, all of which focus on capital accumulation. The chapter finishes with a number of problems. Problems are added to most chapters. They supplement or extend the material in the main part of the text. It is a nice feature of the book that solutions are given at the end. They add about 150 pages to the main text of about 500 pages. Chapter 2 introduces a simple Schumpeterian model of growth through creative destruction. A key feature of Schumpeterian models is that innovations make old technology or products obsolete, which can imply that growth can be excessive, i.e. welfare reducing, because of externalities to research.

Chapter 3 integrates the two basic approaches to the modelling of economic growth introduced in the previous two chapters, i.e. capital accumulation and innovation, into a single framework. This requires the adoption of a multisector approach in order to introduce the dynamics of intersectoral spillovers. The authors regard both capital accumulation and innovation as complementary and essential for long-run growth and state that the forces that determine both cannot be dichotomised. Many formal endogenous growth models have ignored this somewhat obvious point.

Having introduced the basics, the following chapters focus on particular growth-related topics. Chapter 4 studies the interaction between growth and unemployment, in particular whether faster technological progress speeds up the destruction of old jobs by more or less than the creation of new jobs. However, discussion of skill-based technological change is postponed until later in the book. Chapter 5 highlights the advantages of the multisector Schumpeterian modelling approach over one sector endogenous growth models in relation to the growth effects of energy, natural resource depletion and

environmental pollution. The main conclusion is that because technology for creating new knowledge is generally cleaner than that for creating physical capital, growth can be sustainable in a Schumpeterian framework.

Chapter 6 opens the black box of R&D by abandoning the notion that it is homogenous, and by introducing the distinction between 'fundamental' and 'secondary' research. One interesting implication is that in some models, too much fundamental R&D at the expense of secondary innovation can make research sterile by depriving it of feedback from experience, resulting in lower growth. This possibility depends crucially on the nature of technology spillovers. It also has important implications for education policy, i.e. whether public support should be focused on higher education or primary, secondary and vocational training.

Chapter 7 attempts to reconcile the traditional Schumpeterian view that competition is bad for growth because it erodes technology rents with the modern 'Darwinian' view, based on recent empirical evidence, that competition is good for growth. Using an extended version of the basic Schumpeterian model of chapter 2, a complex picture emerges where the effects of competition on growth can be positive for a number of reasons. It suggests several empirical hypotheses and potential tests of the Schumpeterian approach which are awaiting future research.

Chapter 8 looks at the vexed relationship between economic growth and business cycles, which for Schumpeter were closely related. Arguments for causation running from cycles to growth, as well as from growth to cycles, are presented. Schumpeter suggested important reasons for both causations, i.e. on the one hand, business cycles, and particularly recessions, may reduce organisational inefficiency and resource misallocation, resulting in higher growth, while on the other hand major innovations (Schumpeterian waves) may cause cyclical downturns. An important finding associated with the latter is that adoption of a new 'general purpose technology' may result in a large and prolonged downturn before the positive effects dominate. However, severe problems associated with the measurement of output from innovative activity might produce the illusion of a slump when in fact the economy is growing at a healthy pace. Our state of knowledge about the relationship between growth and cycles is still very scant and unsatisfactory. The chapter also shows that growth theorists have barely begun to take the notion of organisational capital seriously.

Distributional questions are introduced in chapter 9. With heterogenous endowments or preferences it is possible that inequality reduces growth, and that redistribution policies favouring the poorly endowed enhance growth. The reverse causation from growth to inequality is also explored, and the validity of the Kuznets hypothesis is questioned. This leads to the discussion of skill-biased technological change. The idea that organisational change might be a source of increased wage inequality is briefly introduced as an important issue for further research. Lastly, the chapter looks at the political dimensions of 'creative destruction'. Vested interests are introduced into a Schumpeterian model to explore why some societies adopt new technologies more rapidly than others.

Chapter 10 summarises much of the current state of knowledge about the role of education in the growth process. There are two major alternative views. Education can be modelled like another factor of production (as in the neoclassical and Lucas approaches), or it can be assumed to play a special role in the creation, adoption and diffusion of technology (the Nelson-Phelps approach). Suffice to say that education plays an important role in economic growth, but that the precise mechanism is still unclear. More theoretical and empirical research is needed to advance our knowledge of this central aspect of growth. The last part of the chapter reviews the recent literature on the

micro-foundations of education policy. The main conclusion is that the impact of education policy on growth and the earnings structure depends heavily on the design of policy, i.e. the organisation of education funding and the targeting of public resources.

Chapter 11 considers the implications of opening up the main models of earlier chapters to international trade, touching on many current trade-related policy issues. The perhaps central finding is that when a Schumpeterian growth model is integrated into conventional trade theory, the rate of technological progress and the pattern of international trade are jointly endogenously determined. In such a model of dynamic comparative advantage, conclusions about the welfare effects of trade liberalisation are ambiguous. Because of this, the authors emphasise the need for more empirical research. In particular, the extent and scope of knowledge spillovers are central to the policy implications, and more empirical evidence on the importance of such spillovers is urgently needed. On a critical note I would like to add that knowledge spillovers are still treated very much like a black box in the book. Greater recognition has to be given in future studies to the different types of knowledge spillovers and their different, and maybe contradictory, impacts. However, I highly recommend the chapter to anyone interested in a balanced discussion of the possible impacts of trade liberalisation.

Chapter 12 is devoted to a discussion of empirical testing of endogenous growth models and 'answers to the many critics'. It should be required reading for any growth researcher with an empirical inclination. After the initial impact of endogenous growth theory in the late 1980s there has been a swing back towards neoclassical growth theory. The evidence presented in this chapter provides a convincing challenge to this mainstream consensus.

Empirical testing of endogenous growth theories is severely restricted by the difficulties of measuring knowledge. The authors devote a special appendix to 'some problems in measuring knowledge-based growth' (pp. 435–48). They highlight the fact that because of our inability to measure properly the inputs and outputs to the creation and use of knowledge, standard measures of GNP and productivity give a very misleading picture of the state of the economy. The underlying problem is that the conceptual foundations of national accounting are inadequate because they take knowledge as unchanging and freely available. It is a shame that the authors fail to acknowledge basically all of the previous work on this topic, e.g. the study by Porat and Rubin¹ which introduced the concept of the 'secondary information sector' (which is evoked in spirit but not by name), the OECD's national accounting initiative for an information economy, or the more recent OECD studies on the measurement of the knowledge economy. This neglect highlights the fact that major issues associated with growth in the information and knowledge economy are only now being (partially and tentatively) acknowledged by growth theorists.

The last two chapters are up-to-date reviews of the literature on R&D management and R&D policy. In a sense they are 'add-ons' to the main focus of the book on endogenous growth. The authors hope that they will stimulate further work on the relationship between the microeconomics of R&D (in particular the theory of internal organisation) and growth. It is sobering to note that economic theorists are only now beginning to wake up to this challenge. Chapter 13 focuses on the private management of innovation. I find it somewhat irritating that the concept of 'absorptive capacity' is mentioned so late in the book, and that the related concept of social capital is not mentioned at all. In my view they should have been introduced in the discussion of knowledge spillovers. The final chapter is devoted to the contentious issue of public aid to innovation, i.e. government intervention in the form of targeted as well as untargeted R&D subsidies and the design of patent legislation.

Finally, I have some more complaints about research neglected by the authors. There is no mention of the literature on National Innovation Systems.² The authors seem to have been fairly selective when referring to non-formal theory. However, the fact that empirical as well as some non-formal research is mentioned at all in a book written by top-level economic theorists is an encouraging sign. More surprising and harder to understand is that Nelson and Winter's³ well-known evolutionary theory of economic change and growth is nowhere mentioned in the book.

To sum up, I hope that the small selection of conclusions mentioned in this review has whetted some of this journal's readers appetite for the book. It discusses literally hundreds of models. However, it is fair to say that it leaves one with the impression that almost anything can be 'proven' in theory. There are still enormous gaps in our understanding of economic growth in the information age, and there is plenty of room for further important theoretical and empirical research, as well as non-formal research which might help us pin down the important factors and causal relationships. This book provides some of the pieces of the puzzle. There is a need to further integrate the separate analytical efforts discussed in different chapters in order to uncover some of the major missing pieces, and to integrate more insights from non-formal theory to widen the scope of formal analysis.

Notes and References

1. Marc Porat and Michael Rubin, *The Information Economy* (in nine volumes), Office of Telecommunications, Special Publication 77-12, US Department of Commerce, Government Printing Office, Washington, D.C., 1977.
2. See, for example, Richard Nelson (ed.), *National Innovation Systems: A Comparative Study*, Oxford University Press, Oxford, 1993.
3. Richard Nelson and Sidney Winter, *An Evolutionary Theory of Economic Change*, The Belknap Press of Harvard University Press, Cambridge, MA, 1982.

*Hans-Jürgen Engelbrecht
Massey University
Palmerston North, New Zealand*

Handbuch Recht und Praxis der Telekommunikation

Martin Geppert, Ernst-Olaf Ruhle and Fabian Schuster

Baden-Baden, Germany, Nomos, 1998, 712 pp., DM 98.00, ISBN 3-7890-5020-2

The *Handbook for Law and Practice in Telecommunications* by Geppert, Ruhle and Schuster was published in German in March 1998, 3 months after the full liberalisation of the German telecommunications market and some 20 months after the legal framework for a re-regulated market was laid down in a Law on Telecommunications (Telekommunikationsgesetz, TKG). This timing made it possible to take into consideration first experiences with the implementation of the TKG and the realisation of its main purpose, the establishment of competition in telecommunication markets. The German process of deregulation is characterised by a step-by-step approach. Over a period of almost 9 years many preliminary and temporary pieces of legislation were needed to realise the separation of private and public spheres in telecommunications, and the abolition of monopolies for all services and for the network infrastructure. This