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0521830192 - The Divergent Dynamics of Economic Growth: Studies in Adaptive Economizing, Technological Change, and Economic Development

Richard H. Day

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The Divergent Dynamics of Economic Growth

This book explains how changing technology and economizing behavior induce vast changes in productivity, resource allocation, labor utilization, and patterns of living. Economic growth is seen as a process by which businesses, regimes, countries, and the whole world pass through distinct epochs, each one emerging from its predecessor and creating the conditions for its successor. Viewed from a long-run perspective, growth must be characterized as an explosive process marked by turbulent transitions in social and political life as societies adapt to new opportunities, the demise of old ways of living, and the vast increase and redistribution of human populations. The book is based on a new and unique synthesis of classical economics and contemporary concepts of adaptation and economic evolution. Although it is grounded in analytical methods, the text has been stripped of all equations and with few exceptions is devoid of technical jargon.

Richard H. Day is Professor of Economics at the University of Southern California. He cofounded the distinguished *Journal of Economic Behavior and Organization* with Sidney Winter in 1980 and served as its editor until 2002. Professor Day's first book developed a class of recursive programming models for simulating production, investment, and technological change. This work became the basis of a dynamic theory describing economic change when agents are boundedly rational, when economic behavior is adaptive, when markets work out of equilibrium, and when economic structure evolves. Professor Day went on to investigate chaos and multiphase dynamics in competitive markets, stock market prices, business cycles, and growth when significant nonlinearities are incorporated. His findings were published in two volumes titled *Complex Economic Dynamics: Volume I: An Introduction to Dynamical Systems and Market Mechanisms* (1994); *Volume II: An Introduction to Macroeconomic Dynamics* (2000). His ongoing research investigates core macroeconomic issues for private enterprise and public policy as well as the implications of behavioral economics for macroeconomic theory, modeling, and policy.

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RICHARD H. DAY

University of Southern California



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Dedicated to My Sisters

LYLA AND SYLVIA

*Whom I adored as a child
and who have been a
continual source of
encouragement ever since*

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Preface

This volume is based on a series of essays written during the last four decades. In looking it over, I find that even the oldest paper included in the collection is even more relevant today than when first published. For example, one essay observed that

invention, innovation, and diffusion of new products, new inputs, new production, marketing, and decision-making methods . . . are leading now, as they have in the past, to overlapping, imbalanced waves of development, to counterpoints of growth and decline as old modes of production and consumption are abandoned in favor of more competitive alternatives and as established mores give way to new patterns of living.

These facts are sometimes recognized by politicians and general commentators, but often too late to plan effective action to alleviate their social effects. The recent onset of the energy crisis underscores this fact. It seems to have been recognized long after it was in the making; little seems to have been done to prepare for it; few agree on its importance, or, conceding its importance, few agree on what to do about it.¹

The crisis referred to occurred in the 1970s, but the assessment made of it in that early paper could apply with equal force to the current controversy over energy, which seems to have been as little anticipated and as little understood now as the one three decades ago. Indeed, technical change and social transformation are proceeding still more rapidly and with even more massive consequences than was the case a quarter of a century ago. Almost all regions of the world are now entrained in a worldwide process of economic development. Like it or not, globalization is a reality. Sooner or later, the dynamic view presented in these essays will have to be more widely utilized if we are to understand, anticipate, and survive the undesirable consequences

¹ Day (1980).

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of growth and if we are to learn either how to suppress or to live comfortably with the explosive growth in human numbers.

Early in my career I felt myself, quite immodestly I admit, to be creating a new synthesis of classical, neoclassical, and modern developments in economic thought with a class of “recursive programming models” based on adaptive economizing behavior. I felt my mission to have been that of providing a better characterization of economic change. As time went by, I realized that some of my predecessors and contemporaries had anticipated insights that had seemed entirely my own and had already written about them or were in the process of doing so: Alcián, Cooper, Simon, Cyert, March Hayek. Another such scholar is Sidney Winter, who observed in a recent conversation that such convergencies understandably occur to those who stand on the shoulders of the same giants. My giants in economics included Smith, Malthus, Cournot, Walras, Marshall, Keynes, Schumpeter, and Chamberlin.

I was also inspired by the mid-twentieth-century giants, including Samuelson, Frisch, Haavelmo, Koopmans, Georgescu-Roegen, Marschak, Goodwin, Modigliani, Arrow, Debreu, and Leontief, who were refining, generalizing, and extending economic theory and introducing new ideas and methods that could serve as a foundation for further improvements in understanding this immensely difficult subject – especially Leontief, my “Doktor Vater” – who once paid me the highest compliment I ever received: “We think alike,” he said.

Leontief, whose fame rested on the development of input–output analysis, wrote his thesis on dynamics and later produced several seminal essays devoted to issues involving economic growth and development.² He also championed the view that economics should be grounded in observation and data, not just in the estimation of model parameters but in the assumptions and structure of the theory itself. Many years later when I saw him not long before his death, I reminded him of that remark made at the conclusion of my thesis defense and told him how much it had meant to me. He replied, “It is important to think about things in the right way.” I think I have done so in this book, and it is a sufficient reward for a lifetime of work to believe that he would have thought so, too.

Thus, my approach developed out of the work of many others but emphasized aspects of the subject that were not recognized or stressed by the great body of the discipline for a long time. In recent years that has changed. The

² Leontief (1966).

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subject is once again being enriched by the development and application of many new ideas and methods. For that reason it is possible (and I hope) that the ideas and methods outlined in these essays will receive a warmer welcome and a wider audience now than they did when they first appeared. And I do believe that the synthesis of classical, neoclassical and adaptive, evolutionary points of view is still novel and has yet to be explored to the extent needed.

While my own ideas were developing – in some ways far removed from current fashion – I received crucial support at various times from several institutions and individuals: John Kenneth Galbraith, whose recommendation made possible my thesis research described in Chapter 4; Guy Orcutt and Charles Holt, Directors of the Social Systems Research Institute at the University of Wisconsin; the late Theodore Heidhues of the University of Göttingen; Jean-Pierre Aubin, founder and long-time director of the *Centre Recherche de Mathématique et la Decision*, the University of Paris IX-Dauphine; the late J. Barkley Rosser and Steve Robinson, Director and Associate Director, respectively, of the Mathematics Research Center at the University of Wisconsin; Kenneth Arrow and Dale Jorgenson, who arranged a productive stay at Harvard; Jay Forrester, who provided a congenial atmosphere in his Systems Dynamics Group at MIT; Gunnar Eliasson at the Institute of Social and Economic Research (IUI) in Stockholm; the Electric Power Research Group under the leadership of Al Halter; Al Hirschman, who made possible a year in academic nirvana at Princeton's Institute for Advanced Study; the late Richard Goodwin, Giulio Pianigiani, Lionello Punzo, and my friends and colleagues at the University of Siena; Ari Kapteyn, who was responsible for another year in academic nirvana at the Institute for Advanced Study in Wassenaar; the Fulbright Foundation for granting me a visiting distinguished professorship at the European University Institute in Florence; and for continuing support through thick and thin at the University of Southern California.

Several of the chapters are based on collaboration with my graduate students at the University of Wisconsin or subsequently at the University of Southern California. They are acknowledged in the usual way at the head of the chapters to which they contributed. But I want to emphasize the teamwork that involved them and others of their contemporaries who collaborated with me. At Wisconsin they included Che Tsao, Inderjit Singh, William K. Tabb, Masatoshi Abe, Peter Kennedy, John Austin, Malcolm Lindsay, Jon Nelson, Mohinder Singh Mudahar, Yiu-Kwan Fan, Milton Mitchel, and Hugo Cohen; at Southern California, Frederico Segura, Kenneth Hanson,

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Tzong-Yau Lin, Weihong Huang, Gang Zou, Zhigang Wang, Jean-Luc Walter, Zhang Min, and Oleg Pavlov.

Through it all I also had the assistance of extremely competent secretary/administrative assistant/word processors; at Wisconsin, Stephanie Bullis and Linda Anderson, and as with all of my work during the last two decades, Barbara Gordon Day who prepared this manuscript, tirelessly reconstituting it in response to numerous revisions and finding ways to encourage the necessary efforts on both our parts.

In editing the book virtually all of the mathematical notation and equations have been removed. Some technical terms remain, but most readers will have an intuitive understanding of them. In any case, I hope you are motivated to proceed in spite of them because the forces under consideration sooner or later influence all of us directly or indirectly.

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Chapter 5

Incorporates substantial parts of the following three papers with permission of the publishers:

“A Dynamic Model of Regional Agricultural Development,” with I. J. Singh, *International Regional Science Review*, 1, Spring 1975.

“A Microeconomic Chronicle of the Green Revolution,” with I. J. Singh, *Journal of Economic Development and Cultural Change*, 23, June 1975.

“Factor Utilization and Substitution in Economic Development: A Green Revolution Case Study,” with I. J. Singh, *Journal of Development Studies*, April 1975. (© The University of Chicago.)

The complete study was published as *Economic Development as an Adaptive Process: A Green Revolution Case Study*, Cambridge University Press, 1974 which was based on Inderjit Singh’s University of Wisconsin doctoral dissertation.

Chapter 6

Incorporates parts of the following papers with permission of the publishers:

“Recursive Programming Models of Industrial Development and Technological Change,” with M. Abe, W. Tabb, and C. Tsao, in Carter and Brody (eds.), *Input–Output Techniques*. (In honor of Wassily Leontief), Vol. 1: Contribution to Input–Output Analysis, North-Holland Publishing Company, 1970.

“A Class of Dynamic Models for Describing and Projecting Industrial Development,” with Jon Nelson, *Journal of Econometrics*, May 1973.

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“Behavioral, Suboptimizing Models of Industrial Production, Investment and Technological Change,” with Masatoshi A. Abe, Jon P. Nelson, and William K. Tabb, Chapter 4 in Day and Cigno, *Modelling Economic Change: The Recursive Programming Approach*, Elsevier North-Holland, Inc., 1978.

The empirical aspects of these papers were initially developed in the Wisconsin doctoral dissertations of the several coauthors.

Chapter 10

This essay was originally presented at the Columbia University Conference on “Managing Planet Earth,” April 1997. The computations were performed by Oleg Pavlov. Since it was written, a very detailed technical analysis has appeared in Chapters 19–24 of Day, 1999, *Complex Economic Dynamics*, volume 2, The MIT Press, Cambridge. A further development of the model that contains various improvements can be found in Day and Pavlov, 2001, “Qualitative Dynamics and Macroeconomic Evolution in the Very Long Run,” Chapter 4 in L. Punzo (ed.), *Cycles, Growth and Structural Change*, Routledge, London.