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The Elements of a Nonlinear Theory of Economic Dynamics

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PREFACE

The aim of this set of notes is to provide a framework for the application of the concepts and techniques of the modern theory of nonlinear dynamical systems to the analysis of models of economic dynamics. The first chapter surveys the need for a nonlinear theory of economic dynamics. Such a need arises not only in analysing endogenous theories of the business cycle, but also from the analysis of a number of dynamic economic models which seem to display perverse stability behaviour. Chapter two surveys the principal results and techniques of the theory of dynamical systems relevant to our applications. Chapter three applies these techniques to view the older endogenous cycle theories in a unified mathematical framework, which more readily allows a qualitative analysis of the economic cycle. In chapter four we analyse the locally unstable equilibrium of a macroeconomic model incorporating the government budget constraint and show that the model can exhibit stable limit cycle motion. In chapter five we show how centre manifold concepts may be applied to analyse a three dimensional dynamic economic model which is a simple extension of Goodwin's model of the dynamic interaction of workers and capitalists and which displays limit cycle behaviour. In chapter six we analyse a discrete time version of the classical cobweb model and show that the introduction of a simple nonlinearity can cause the model to exhibit that bounded, recurrent but nonperiodic motion known as chaos. In chapter seven we analyse from an entirely new point of view the dynamic instability problem which arises in a large number of perfect foresight and rational expectations models of interest in many areas of economic analysis. We take as the paradigmatic example of such behaviour one of the basic perfect foresight models of monetary dynamics and show that once appropriate nonlinearities are introduced and additional equilibrium concepts such as limit cycles and chaotic motion are admitted the "problem" may be resolved. In the final chapter we indicate a number of problems in the areas of economic dynamics which we believe could be seen in a new light if analysed with the techniques and concepts that we have applied in these notes.

After remaining in the wings of the economic stage for many years the nonlinear approach to dynamic analysis now seems to be moving towards centre-stage, judging from the large number of books and articles which have appeared in recent years. Other works which could be read in conjunction with this one include Medio (1979), Gabisch and Lorenz (1989), Lorenz (1989) and Ferri and Greenberg (1989).

This set of notes grew out of a thesis submitted to the University of New South Wales and is the result of my musings over several years on certain aspects of economic dynamics. Consequently I owe a debt to a number of people who, wittingly or unwittingly and for good or ill, have influenced the development of my thinking about economic theory.

Firstly I wish to thank my thesis supervisor Professor M.C. Kemp for encouraging, stimulating and guiding my interest in a wide range of areas in mathematical economics and for willingly allowing me to submit a thesis which is quite different to the one which we, and certainly he, had originally anticipated.

I owe a particular intellectual debt to Professor J.M. Blatt (formerly of the University of New South Wales) whose criticism of the economic theorist's heavy reliance on linear models in both his published work and at a number of seminars in the Economics Theory Workshop at the University of New South Wales has had an obvious influence on my thinking. Indeed it was whilst attending a joint seminar of the Economic Society of N.S.W. and the Australian Mathematical Society in 1977, at which Professor Blatt presented what became the first of his series of articles in Oxford Economic Papers, that I originally conceived the idea of a systematic study of economic dynamics via the methods of the theory of nonlinear dynamical systems.

I have benefitted from discussions with a number of people on various aspects of the work reported here. In particular I would like to thank the late Professor Richard Manning (SUNY, Buffalo), Professor Daniel Leonard (University of New South Wales) and Chris Boyd (Universite Catholique de Louvain, Belgium). I am indebted to Professor Hans-Walter Lorenz (Georg-August-Universitat Gottingen) for having taken the trouble to read through an early draft of these notes and having made a number of valuable suggestions.

I am also indebted to Professors Alfred Steinherr and Daniel Weiserbs of IRES, l'Univesite Catholique de Louvain for making possible my two visits to that institution. The stimulating research environment which I enjoyed there has had a decisive influence on the development of this work.

None of the above mentioned persons should be held responsible for any misconceptions and shortcomings that may appear in these notes.

Finally I would like to thank my wife, Lyn, and children, Claudine and Adrian, for tolerating the long hours I spent in my study and for providing such an ideal home environment.

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