

This PDF is a selection from an out-of-print volume from the National Bureau of Economic Research

Volume Title: Measuring Business Cycles

Volume Author/Editor: Burns, Arthur F. and Wesley C. Mitchell

Volume Publisher: NBER

Volume ISBN: 0-870-14085-X

Volume URL: <http://www.nber.org/books/burn46-1>

Publication Date: 1946

Chapter Title: Preface, tables of content, front matter

Chapter Author: Arthur F. Burns, Wesley C. Mitchell

Chapter URL: <http://www.nber.org/chapters/c2979>

Chapter pages in book: (p. -27 - 0)

NATIONAL BUREAU OF ECONOMIC RESEARCH

Studies in Business Cycles

No. 2

MEASURING BUSINESS CYCLES

NATIONAL BUREAU OF ECONOMIC RESEARCH  
1964

OFFICERS

Albert J. Hettinger, Jr., *Chairman*  
Arthur F. Burns, *President*  
Frank W. Fetter, *Vice-President*  
Donald B. Woodward, *Treasurer*  
Solomon Fabricant, *Director of Research*  
Geoffrey H. Moore, *Associate Director of Research*  
Hal B. Lary, *Associate Director of Research*  
William J. Carson, *Executive Director*

DIRECTORS AT LARGE

Robert B. Anderson, *New York City*  
Wallace J. Campbell, *Nationwide Insurance*  
Erwin D. Canham, *Christian Science Monitor*  
Solomon Fabricant, *New York University*  
Marion B. Folsom, *Eastman Kodak Company*  
Crawford H. Greenewalt, *E. I. du Pont de Nemours & Company*  
Gabriel Hauge, *Manufacturers Hanover Trust Company*  
A. J. Hayes, *International Association of Machinists*  
Albert J. Hettinger, Jr., *Lazard Frères and Company*  
Nicholas Kelley, *Kelley Drye Newhall Maginnes & Warren*  
H. W. Laidler, *League for Industrial Democracy*  
Charles G. Mortimer, *General Foods Corporation*  
George B. Roberts, *Larchmont, New York*  
Harry Scherman, *Book-of-the-Month Club*  
Boris Shishkin, *American Federation of Labor and Congress of Industrial Organizations*  
George Soule, *South Kent, Connecticut*  
Joseph H. Willits, *Langhorne, Pennsylvania*  
Donald B. Woodward, *A. W. Jones and Company*

DIRECTORS BY UNIVERSITY APPOINTMENT

V. W. Bladen, *Toronto*  
Francis M. Boddy, *Minnesota*  
Arthur F. Burns, *Columbia*  
Lester V. Chandler, *Princeton*  
Melvin C. de Chazau, *Cornell*  
Frank W. Fetter, *Northwestern*  
R. A. Gordon, *California*  
Harold M. Groves, *Wisconsin*  
Gottfried Haberler, *Harvard*  
Maurice W. Lee, *North Carolina*  
Lloyd G. Reynolds, *Yale*  
Paul A. Samuelson, *Massachusetts*  
*Institute of Technology*  
Theodore W. Schultz, *Chicago*  
Willis J. Winn, *Pennsylvania*

DIRECTORS BY APPOINTMENT OF OTHER ORGANIZATIONS

Percival F. Brundage, *American Institute of Certified Public Accountants*  
Nathaniel Goldfinger, *American Federation of Labor and Congress of Industrial Organizations*  
Harold G. Halcrow, *American Farm Economic Association*  
Murray Shields, *American Management Association*  
Willard L. Thorp, *American Economic Association*  
W. Allen Wallis, *American Statistical Association*  
Harold F. Williamson, *Economic History Association*  
Theodore O. Yntema, *Committee for Economic Development*

DIRECTORS EMERITI

Shepard Morgan, *Norfolk, Connecticut*  
N. I. Stone, *New York City*  
Jacob Viner, *Princeton, New Jersey*

RESEARCH STAFF

|                       |                      |                     |
|-----------------------|----------------------|---------------------|
| Moses Abramovitz      | Victor R. Fuchs      | Jacob Mincer        |
| Gary S. Becker        | H. G. Georgiadis     | Ilse Mintz          |
| William H. Brown, Jr. | Raymond W. Goldsmith | Geoffrey H. Moore   |
| Gerhard Bry           | Challis A. Hall, Jr. | Roger F. Murray     |
| Arthur F. Burns       | Millard Hastay       | Ralph L. Nelson     |
| Phillip Cagan         | Daniel M. Holland    | G. Warren Nutter    |
| Joseph W. Conard      | Thor Hultgren        | Richard T. Selden   |
| Frank C. Dickinson    | F. Thomas Juster     | Lawrence H. Seltzer |
| James S. Earley       | C. Harry Kahn        | Robert P. Shay      |
| Richard A. Easterlin  | Irving B. Kravis     | George J. Stigler   |
| Solomon Fabricant     | Hal B. Lary          | Norman B. Ture      |
| Albert Fishlow        | Robert E. Lipsey     | Herbert B. Woolley  |
| Milton Friedman       | Ruth P. Mack         | Victor Zarnowitz    |

1. present  
imparti  
that the  
2.  
3.  
or to its  
research  
4. N  
submitt  
their us  
main co  
the suit  
5. A  
member  
be appo  
of three  
The nar  
summar  
member  
signifies  
ber of t  
mittal o  
of the  
days sha  
at least  
Board w  
on the p  
6. N  
cial com  
report.  
tion, tog  
and suc  
if he so  
read the  
committe  
7. A  
in each

# MEASURING BUSINESS CYCLES

ARTHUR F. BURNS  
and  
WESLEY C. MITCHELL

*analysis  
cyclical*

NATIONAL BUREAU OF ECONOMIC RESEARCH  
NEW YORK 1946

THE  
in this  
*Problems*  
'tentati  
oped. sl  
besides

I ha  
a given  
ness and  
might b  
was pro  
the wor  
represe  
and 'co  
upon t  
*Annals*  
cal beha  
of the fo  
phases o  
the serie

To  
and just  
ing wit  
brunt o  
eral assi  
became  
Arthur  
method  
proven

Whi  
to study  
experim

REPRINTED 1947, 1964

COPYRIGHT, 1946  
BY NATIONAL BUREAU OF ECONOMIC RESEARCH, INC.

ALL RIGHTS RESERVED  
MANUFACTURED IN THE U.S.A. BY  
H. WOLFF, NEW YORK

*Relation of the Directors to the Work and Publications*  
*of the*  
*National Bureau of Economic Research*

1. The object of the National Bureau of Economic Research is to ascertain and to present to the public important economic facts and their interpretation in a scientific and impartial manner. The Board of Directors is charged with the responsibility of ensuring that the work of the Bureau is carried on in strict conformity with this object.

2. To this end the Board of Directors shall appoint one or more Directors of Research.

3. The Director or Directors of Research shall submit to the members of the Board, or to its Executive Committee, for their formal adoption, all specific proposals concerning researches to be instituted.

4. No report shall be published until the Director or Directors of Research shall have submitted to the Board a summary drawing attention to the character of the data and their utilization in the report, the nature and treatment of the problems involved, the main conclusions and such other information as in their opinion would serve to determine the suitability of the report for publication in accordance with the principles of the Bureau.

5. A copy of any manuscript proposed for publication shall also be submitted to each member of the Board. For each manuscript to be so submitted a special committee shall be appointed by the President, or at his designation by the Executive Director, consisting of three Directors selected as nearly as may be one from each general division of the Board. The names of the special manuscript committee shall be stated to each Director when the summary and report described in paragraph (4) are sent to him. It shall be the duty of each member of the committee to read the manuscript. If each member of the special committee signifies his approval within thirty days, the manuscript may be published. If each member of the special committee has not signified his approval within thirty days of the transmittal of the report and manuscript, the Director of Research shall then notify each member of the Board, requesting approval or disapproval of publication, and thirty additional days shall be granted for this purpose. The manuscript shall then not be published unless at least a majority of the entire Board and a two-thirds majority of those members of the Board who shall have voted on the proposal within the time fixed for the receipt of votes on the publication proposed shall have approved.

6. No manuscript may be published, though approved by each member of the special committee, until forty-five days have elapsed from the transmittal of the summary and report. The interval is allowed for the receipt of any memorandum of dissent or reservation, together with a brief statement of his reasons, that any member may wish to express; and such memorandum of dissent or reservation shall be published with the manuscript if he so desires. Publication does not, however, imply that each member of the Board has read the manuscript, or that either members of the Board in general, or of the special committee, have passed upon its validity in every detail.

7. A copy of this resolution shall, unless otherwise determined by the Board, be printed in each copy of every National Bureau book.

*(Resolution adopted October 25, 1926 and revised February 6, 1933 and February 24, 1941)*

## Studies in Business Cycles

- 1 *Business Cycles: The Problem and Its Setting*  
By Wesley C. Mitchell
- 2 *Measuring Business Cycles*  
By Arthur F. Burns and Wesley C. Mitchell
- 3 *American Transportation in Prosperity and Depression*  
By Thor Hultgren
- 4 *Inventories and Business Cycles, with Special Reference to  
Manufacturers' Inventories*  
By Moses Abramovitz
- 5 *What Happens during Business Cycles: A Progress Report*  
By Wesley C. Mitchell
- 6 *Personal Income during Business Cycles*  
By Daniel Creamer with the assistance of Martin Bernstein
- 7 *Consumption and Business Fluctuations: A Case Study of  
the Shoe, Leather, Hide Sequence*  
By Ruth P. Mack
- 8 *International Financial Transactions and Business Cycles*  
By Oskar Morgenstern
- 9 *Federal Receipts and Expenditures during Business  
Cycles, 1879-1958*  
By John M. Firestone
- 10 *Business Cycle Indicators: Volume I, Contributions to the Analysis  
of Current Business Conditions; Volume II, Basic Data on Cyclical  
Indicators*  
Edited by Geoffrey H. Moore
- 11 *Postwar Cycles in Manufacturers' Inventories*  
By Thomas M. Stanback, Jr.
- 12 *A Monetary History of the United States, 1867-1960*  
By Milton Friedman and Anna Jacobson Schwartz

## Preface

**T**HE BASIC features of the plan for measuring business cycles presented in this book were outlined in the last six pages of *Business Cycles: The Problem and Its Setting*, published by the National Bureau in 1927. My 'tentative working plans' of that date were embryonic. They have developed slowly under the solicitous attention of numerous coworkers, and besides secular growth, have undergone some structural changes.

I had thought of analyzing the movements of "all the time series for a given country on the basis of a standard pattern derived from the business annals of that country, not on the basis of the various patterns which might be derived from study of the several series themselves." This plan was promptly amended to include analysis on both bases. We found that the words 'prosperity' and 'depression', to which I clung in 1927, misrepresent some business-cycle phases, and replaced them by 'expansion' and 'contraction'. As our statistical findings accumulated, we refined upon the rough chronologies provided by the collection of *Business Annals* that Willard L. Thorp had compiled for us. To picture the cyclical behavior of a series, I had proposed to draw a separate chart for each of the four phases of a business cycle. We found it better to plot the four phases on a single chart, and to add a 'specific-cycle pattern' based upon the series' own troughs and peaks.

To determine what aspects of cyclical behavior should be measured, and just how each measure should be made, required much experimenting with the wide variety of data we wished to use. For six years, the brunt of this developmental work was borne by Simon Kuznets and several assistants, of whom Cicely Applebaum was chief. When Dr. Kuznets became absorbed in estimating national income and its components, Arthur F. Burns took over. He instituted a searching critique of our methods and rigorous tests of our findings, out of which came many improvements in our conceptions and procedures.

While I shared in building up our technique, my chief function was to study and interpret the results it yielded. In that capacity, I wrote two experimental reports at different stages of our progress, explaining our

methods and summarizing what they seemed to show about the cyclical behavior of the activities we had studied. These efforts were useful mainly in a negative way. They demonstrated first that we needed to enlarge our sample of time series in various directions; second that much more intimate knowledge of economic activities than I possessed was necessary to understand their reactions to business cycles; third that our findings could not be adequately presented in a single volume as I had naively expected. The upshot was that we enlarged our staff. The detailed interpretation of our findings was undertaken by a group of collaborators who were or became specialists in such fields as agriculture, construction work, transportation, merchandising, inventories, prices, labor problems, foreign trade, international finance, and banking. I stuck to the task of trying to see how the results in all the fields fitted together, depending on others to supply knowledge I lacked. Meanwhile, Dr. Burns familiarized himself with the uses of our measures by preparing a preliminary analysis of our findings about construction work, and then devoted himself to a final critique and revision of our statistical methods.

The present volume is mainly his work. Though the basic features of my original design have been retained, Dr. Burns has made our technique of measuring cyclical behavior a much better kit of tools than it was when put into his hands. All of the tests of our measures were planned and executed by him. So also were the chapters on the time unit and our treatment of secular and random components. With minor exceptions, the drafts I contributed have been so much improved by him that they have become virtually his products. I have taken advantage of my seniority to insist against his wish that the relative shares we have had in preparing this book be represented by putting Dr. Burns' name first on the title page.

The dozen chapters form three broad groups. Chapters 1-5 describe our methods, first in general terms, then in full detail. Chapters 6-8 elaborate upon three themes treated briefly in the third chapter: our insistence upon using monthly data whenever they can be had, and our peculiar ways of dealing with secular and random movements. Chapters 9-12 examine critically the justification for using averages to express the typical characteristics of cyclical behavior.

We have sought to make the book useful to several groups of readers. While the discussion is focussed throughout upon the National Bureau's technique, certain alternative methods of time-series analysis come in for examination. Also, the abundant illustrations of our results possess substantive as well as methodological interest. Students who desire earnestly to understand business cycles must feel a professional interest in the design and efficiency of the tools used in observing cyclical behavior. On the one hand, these observations show what should be explained; on

the o  
such  
other

\* Sec. IV  
\* Perha  
\* Omit  
\* Omit

D  
friend  
are m  
lated  
eral s  
C  
forme  
manu  
as bes  
Chap  
O  
parts  
passed  
to M  
Moore  
critic  
erton  
Geor  
of Co  
analys  
Hann  
W  
sistan

the other hand, they afford means for testing explanatory hypotheses. For such specialists, there is no short cut. To facilitate use of the book by others, we offer a tabular guide.

A Reader's Guide

|   | <i>Chapters<br/>recommended</i>                     |
|---|---|
| Laymen and economists with a general interest in business cycles . . . . .  | 1-2   |
| Students of business cycles   |   |
| Who have little or no concern with the empirical foundations of the subject, but would like to see what 'economic statisticians' may contribute to 'theory' . . . . . | 1-4 <sup>a</sup> , 9 <sup>b</sup> , 12 <sup>c</sup> |
| Who have wider interests but are only incidentally concerned with statistical techniques . . . . .  | 1-4 <sup>a</sup> , 9-12                             |
| Statisticians whose primary interest is   |   |
| Time-series analysis . . . . .  | 2, 3, 5-8   |
| Measurement of economic magnitudes . . . . .  | 4   |
| Testing hypotheses regarding time series . . . . .  | 2, 9-12 <sup>d</sup>                                |

<sup>a</sup> Sec. IV of Ch. 9 may be omitted.  
<sup>b</sup> Perhaps add Sec. VII-VIII of Ch. 10, and Sec. VII of Ch. 11.  
<sup>c</sup> Omit Sec. III.  
<sup>d</sup> Omit Sec. III-IV.

Dr. Burns and I have received generous and varied help from many friends. Acknowledgments of specific suggestions on technical points are made at the appropriate points in the text, and need not be recapitulated here. But this is the place to mention obligations of a more general sort.

Chester I. Barnard, W. Leonard Crum, and Oswald W. Knauth formed the Committee of National Bureau Directors who examined our manuscript. All three raised questions of which we have taken account as best we could. Mr. Barnard's critique incited us to add a section to Chapter I on 'The Symbols Used in Observing Business Cycles'.

Our present and former colleagues in the National Bureau have read parts or all of the successive versions through which the manuscript has passed, and aided in various ways to better it. We are especially indebted to Milton Friedman, Simon Kuznets, Frederick C. Mills, Geoffrey H. Moore, Julius Shiskin, and W. Allen Wallis. We have benefited also from criticisms or suggestions by Moses Abramowitz, James W. Angell, G. Herberton Evans, Gottfried Haberler, Edward E. Lewis, Oskar Morgenstern, George Stigler, Albert Wohlstetter, and Leo Wolman. Harold Hotelling of Columbia University kindly advised us on some points of statistical analysis. Martha Anderson put her editorial skill at our disposal, and Hanna Stern prepared the Index.

We owe an especially heavy debt of gratitude to our statistical assistants. Karl Laubenstein was mainly responsible for compiling data

and verifying sources. H. Irving Forman, Sophie Sakowitz and Denis Volkenau, aided at times by several computers, carried through the extensive calculations. Sophie Sakowitz helped also in the preparation of the printers' copy, and assumed the main burden of reading the proofs. H. Irving Forman drew all the charts in the volume, and assisted with the proofs. Sally Edwards typed our bulky and difficult manuscripts with a diviner's art. Without the care, patience, and skill of all five, our task would have been far harder and less pleasant.

WESLEY C. MITCHELL

PREFACE

WORKS

- I
- II
- III
- IV
- V
- VI
- VII
- VIII

PRELIM

- I
- II
- III
- IV
- V
- VI
- VII
- VIII
- IX

PLANS

- I
- II
- III
- IV
- Appendix

Denis  
he ex-  
ion of  
proofs.  
I with  
s with  
r task

## Contents

|   | <i>Page</i> |
|---|-------------|
| PREFACE . . . . .   | vii         |
| CHAPTER 1   |             |
| WORKING PLANS . . . . .   | 3-22        |
| I The Point of Departure . . . . .                                  | 3           |
| II Questions Raised by the Definition . . . . .                     | 5           |
| III 'Inductive Verification' of Business-cycle Hypotheses . . . . . | 8           |
| IV The Data Needed for Observing Cyclical Behavior. . . . .         | 10          |
| V Requirements that Technique Must Meet . . . . .                   | 11          |
| VI The Symbols Used in Observing Business Cycles . . . . .          | 14          |
| VII Range Covered by the Observations . . . . .                     | 17          |
| VIII The Program as a Whole . . . . .                               | 21          |
| CHAPTER 2   |             |
| PRELIMINARY SKETCH OF THE STATISTICAL ANALYSIS. . . . .             | 23-36       |
| I Basic Features of the Analysis . . . . .                          | 23          |
| II Reference Dates, Reference Cycles and Specific Cycles. . . . .   | 24          |
| III Timing, Duration and Amplitude of Specific Cycles . . . . .     | 26          |
| IV Measures of Secular Movements . . . . .                          | 28          |
| V Cyclical Patterns . . . . .                                       | 29          |
| VI Measures of Conformity to Business Cycles . . . . .              | 31          |
| VII Averages and Average Deviations . . . . .                       | 33          |
| VIII Charts of Cyclical Patterns. . . . .                           | 34          |
| IX Comparison with Customary Techniques . . . . .                   | 36          |
| CHAPTER 3   |             |
| PLAN OF TREATING SECULAR, SEASONAL AND RANDOM MOVEMENTS             | 37-55       |
| I The 'Cycle of Experience' as the Unit of Analysis . . . . .       | 37          |
| II Limitations of the Technique . . . . .                           | 40          |
| III Need to Economize Effort . . . . .                              | 41          |
| IV Treatment of Seasonal Variations . . . . .                       | 43          |
| Appendix: Notes on the Elimination of Seasonal Variations . . . . . | 51          |

| CHAPTER 4   |  | <i>Page</i> |          |
|---|--|-------------|----------|
| DATING SPECIFIC AND BUSINESS CYCLES . . . . .               |  | 56-114      | III      |
| I   | Dating Specific Cycles . . . . .                                       | 56          | IV       |
| II  | Diffusion of Specific Cycles . . . . .                                 | 66          | V        |
| III   | Different Methods of Deriving a Reference Scale . . . . .              | 71          | VI       |
| IV  | A Tentative Schedule of Reference Dates . . . . .                      | 76          | VII      |
| V   | Difficulties in Setting Reference Dates Illustrated . . . . .          | 81          | VIII     |
| VI  | Dependability of the Reference Dates . . . . .                         | 94          |          |
| CHAPTER 5   |  |             | EFFECTS  |
| THE BASIC MEASURES OF CYCLICAL BEHAVIOR . . . . .           |  | 115-202     | I        |
| I   | Positive and Inverted Specific Cycles . . . . .                        | 115         | II       |
| II  | Timing of Specific Cycles . . . . .                                    | 116         | III      |
| III   | Duration of Specific Cycles . . . . .                                  | 128         | IV       |
| IV  | Amplitude of Specific Cycles . . . . .                                 | 131         | V        |
| V   | Measures of Secular Movements . . . . .                                | 141         | VI       |
| VI  | Specific-cycle Patterns . . . . .                                      | 144         | VII      |
| VII   | Reference-cycle Patterns . . . . .                                     | 160         | VIII     |
| VIII  | Relation between Reference- and Specific-cycle Patterns . . . . .      | 170         | IX       |
| IX  | Conformity to Business Cycles: Behavior during Fixed Periods . . . . . | 176         | X        |
| X   | Conformity to Business Cycles: Timing Differences Recognized . . . . . | 185         | XI       |
| XI  | Analysis of Quarterly and Annual Data . . . . .                        | 197         |          |
| CHAPTER 6   |  |             | ROLE OF  |
| EFFECTS OF THE TIME UNIT ON CYCLICAL MEASURES . . . . .     |  | 203-269     | I        |
| I   | The Problem of This Chapter . . . . .                                  | 203         | II       |
| II  | Why the Time Unit Matters . . . . .                                    | 204         | III      |
| III   | The Direction of Movements in Time Series . . . . .                    | 210         |          |
| IV  | The Number of Specific Cycles . . . . .                                | 215         | SECULAR  |
| V   | Duration of Specific Cycles . . . . .                                  | 220         | I        |
| VI  | Timing of Specific Cycles . . . . .                                    | 223         | II       |
| VII   | Amplitude of Specific Cycles in Annual Data . . . . .                  | 229         | III      |
| VIII  | Amplitude of Specific Cycles in Quarterly Data . . . . .               | 241         | IV       |
| IX  | The Secular Component of Specific Cycles . . . . .                     | 245         | V        |
| X   | Specific-cycle Patterns . . . . .                                      | 246         | VI       |
| XI  | Different Forms of Annual Data . . . . .                               | 252         | VII      |
| XII   | Reference-cycle Measures . . . . .                                     | 261         | VIII     |
| XIII  | Conclusions . . . . .  | 268         |          |
| CHAPTER 7   |  |             | CYCLICAL |
| EFFECTS OF TREND ADJUSTMENTS ON CYCLICAL MEASURES . . . . . |  | 270-309     | I        |
| I   | Materials Used in the Tests . . . . .                                  | 271         | II       |
| II  | The Number of Specific Cycles . . . . .                                | 273         | III      |
|   |  |             | IV       |

CONTENTS

xiii

| <i>Page</i> |  | <i>Page</i>  |
|-------------|--|--|
|             | III  | Timing and Duration of Specific Cycles . . . . . 276           |
| 56-114      | IV   | Amplitude of Specific Cycles . . . . . 280                     |
|             | V  | Reference-cycle Measures . . . . . 294                         |
| 56          | VI   | Variability of Cyclical Measures . . . . . 299                 |
| 66          | VII  | The Time Unit and Trend Adjustments . . . . . 302              |
| 71          | VIII   | Conclusions . . . . . 307                                      |
| 76          |  |  |
| 81          |  |  |
| 94          |  |  |
|             | CHAPTER 8  |  |
|             | EFFECTS OF SMOOTHING ON CYCLICAL MEASURES . . . . .      | 310-369  |
|             | I  | Range of the Tests . . . . . 310                               |
|             | II   | The Number of Specific Cycles . . . . . 312                    |
| 15-202      | III  | Timing and Duration of Specific Cycles . . . . . 316           |
|             | IV   | Amplitude of Specific Cycles . . . . . 326                     |
| 115         | V  | The Secular Component of Specific Cycles . . . . . 335         |
| 116         | VI   | Specific-cycle Patterns . . . . . 336                          |
| 128         | VII  | Reference-cycle Patterns . . . . . 349                         |
| 131         | VIII   | Measures of Conformity to Business Cycles . . . . . 357        |
| 141         | IX   | Variability of Cyclical Measures . . . . . 361                 |
| 144         | X  | Uncertainties in Identifying Specific Cycles . . . . . 363     |
| 160         | XI   | Conclusions . . . . . 367                                      |
| 170         |  |  |
| 176         |  |  |
| 185         |  |  |
| 197         |  |  |
|             | CHAPTER 9  |  |
|             | ROLE OF AVERAGES IN THE ANALYSIS . . . . .               | 370-383  |
|             | I  | Variability of Cyclical Behavior . . . . . 370                 |
|             | II   | Function of Averages and Average Deviations . . . . . 380      |
| 3-269       | III  | Problems Raised by Averages . . . . . 382                      |
|             |  |  |
| 203         | CHAPTER 10   |  |
| 204         | SECULAR AND DISCONTINUOUS CHANGES IN CYCLICAL BEHAVIOR . | 384-417  |
| 210         | I  | Duration and Amplitude of Specific Cycles . . . . . 384        |
| 215         | II   | Reference-cycle Patterns . . . . . 393                         |
| 220         | III  | Other Cyclical Measures . . . . . 398                          |
| 223         | IV   | Duration and Amplitude of Business Cycles . . . . . 401        |
| 229         | V  | Business Cycles and Economic Stages . . . . . 403              |
| 241         | VI   | Business Cycles before and after 1914 . . . . . 406            |
| 245         | VII  | Conclusions from Tests . . . . . 412                           |
| 246         | VIII   | Preparation for Later Work . . . . . 413                       |
| 252         |  |  |
| 261         |  |  |
| 268         |  |  |
|             | CHAPTER 11   |  |
|             | CYCLICAL CHANGES IN CYCLICAL BEHAVIOR . . . . .          | 418-465  |
|             | I  | Long Cycles Marked Off by Long Waves in Building . . . . . 418 |
| 0-309       | II   | Long Cycles as Deviations from Trends . . . . . 427            |
|             | III  | Long Cycles Marked Off by Long Waves in Prices . . . . . 431   |
| 271         | IV   | Long Cycles as Triplets of Business Cycles . . . . . 440       |
| 273         |  |  |

|   |             |
|---|-------------|
|   | <i>Page</i> |
| V Long Cycles Marked Off by Booms . . . . .               | 448         |
| VI Long Cycles Marked Off by Severe Depressions . . . . . | 455         |
| VII Conclusions and Plans for Later Work . . . . .        | 464         |

CHAPTER 12

|  |         |
|--|---------|
| STABLE AND IRREGULAR FEATURES OF CYCLICAL BEHAVIOR . . . . . | 466-508 |
| I Individual Features of Successive Cycles . . . . .         | 466     |
| II Stable Features of Successive Cycles . . . . .            | 474     |
| III Influence of Extreme Items on Averages . . . . .         | 491     |
| IV Causal Interpretation of Averages . . . . .               | 503     |
| V Test of Consilience among the Results . . . . .            | 506     |

APPENDICES

|  |     |
|--|-----|
| A Division of Reference Cycles into Stages . . . . . | 509 |
| B Some Supporting Data . . . . .                     | 517 |
| C Sources of Data . . . . .                          | 540 |
| INDEX . . . . .                                      | 551 |

|              |          |
|--------------|----------|
| <i>Table</i> |          |
| 1            | Se<br>th |
| 2            | Pe       |
| 3            | N        |
| 4            | C        |
| 5            | Sa<br>du |
| 6            | Sa<br>U  |
| 7            | Sa<br>Se |
| 8            | Sa<br>St |
| 9            | Sa<br>C  |
| 10           | Sa<br>St |
| 11           | Sa<br>C  |
| 12           | Sa<br>U  |
| 13           | B        |
| 14           | C<br>d   |
| 15           | D<br>d   |
| 16           | R        |
| 17           | N<br>n   |
| 18           | St<br>23 |
| 19           | Se<br>40 |
| 20           | P        |

Page  
448  
455  
464

56-508

466  
474  
491  
503  
506

509  
517  
540

551

## List of Tables

| <i>Table</i> |  | <i>Page</i> |
|--------------|--|-------------|
| 1            | Series Classified According to the Process Represented, Country, and the Time Unit . . . . .   | 20          |
| 2            | Periods Covered by American and Foreign Series . . . . .   | 20          |
| 3            | Number of Business Cycles Covered by American and Foreign Series . . . . .   | 21          |
| 4            | Coke Production, United States, 1914-1933 . . . . .  | 25          |
| 5            | Sample of Table S1: Timing and Duration of Specific Cycles, Coke Production, United States, 1914-1932 . . . . .                          | 26          |
| 6            | Sample of Table S2: Amplitude of Specific Cycles, Coke Production, United States, 1914-1932 . . . . .                                    | 27          |
| 7            | Sample of Table S3: Secular Movements, Coke Production, United States, 1914-1932 . . . . .   | 28          |
| 8            | Sample of Table S4: Specific-cycle Patterns, Coke Production, United States, 1914-1932 . . . . .   | 29          |
| 9            | Sample of Table S5: Rate of Change from Stage to Stage of Specific Cycles, Coke Production, United States, 1914-1932 . . . . .           | 30          |
| 10           | Sample of Table R1: Reference-cycle Patterns, Coke Production, United States, 1914-1933 . . . . .  | 30          |
| 11           | Sample of Table R2: Rate of Change from Stage to Stage of Reference Cycles, Coke Production, United States, 1914-1933 . . . . .          | 31          |
| 12           | Sample of Table R3: Conformity to Business Cycles, Coke Production, United States, 1914-1933 . . . . .                                   | 32          |
| 13           | Bituminous Coal Production, United States, 1905-1939 . . . . .   | 59          |
| 14           | Chronology of Specific Cycles in Employment, Ten Manufacturing Industries, United States, 1919-1938 . . . . .                            | 68          |
| 15           | Dates of Cyclical Peaks and Troughs, Successive Versions of Three Indexes of 'Industrial Production', United States, 1919-1938 . . . . . | 75          |
| 16           | Reference Dates and Durations of Business Cycles in Four Countries . . . . .   | 78          |
| 17           | Number of Monthly or Quarterly American Series Available at Decennial Dates since 1860 . . . . .   | 82          |
| 18           | Short-term Fluctuations around the Cyclical Turns of 1937 and 1938, 23 American Series . . . . .   | 86          |
| 19           | Sequence of Cyclical Turns in the 1937 Recession and the 1938 Revival, 40 American Series . . . . .                                      | 88          |
| 20           | Production, Employment and Prices in Three Countries, 1914-1918 . . . . .  | 91          |

| <i>Table</i> | <i>Page</i> | <i>Table</i> |                      |
|--------------|-------------|--------------|----------------------|
| 21           | 98          | 45           | Sam<br>Un            |
| 22           | 101         | 46           | Sam<br>Ign           |
| 23           | 102         | 47           | Sam<br>Rec           |
| 24           | 103         | 48           | Me                   |
| 25           | 105         | 49           | Illu<br>the          |
| 26           | 106         | 50           | How<br>Pha           |
| 27           | 108         | 51           | Con<br>Dat           |
| 28           | 119         | 52           | Con<br>For<br>Pa     |
| 29           | 124         | 53           | Cha<br>can           |
| 30           | 129         | 54           | Join<br>and          |
| 31           | 133         | 55           | Nut<br>Six           |
| 32           | 136         | 56           | Dur<br>Pro           |
| 33           | 142         | 57           | Ave<br>Dat           |
| 34           | 145         | 58           | Frec<br>Dat          |
| 35           | 146         | 59           | Join<br>nua          |
| 36           | 147         | 60           | Frec<br>Am           |
| 37           | 150         | 61           | Ave<br>Am            |
| 38           | 159         | 62           | Ave<br>Ser           |
| 39           | 161         | 63           | Star<br>resp<br>Iron |
| 40           | 163         | 64           | Frec<br>tude<br>Cyc  |
| 41           | 167         | 65           | Ave<br>Ann           |
| 42           | 177         | 66           | Co<br>Spe            |
| 43           | 184         | 67           | Ave<br>cific         |
| 44           | 189         |              |                      |

LIST OF TABLES

xvii

| <i>Page</i> | <i>Table</i>   | <i>Page</i> |
|-------------|--|-------------|
| 98          | 45 Sample of Table R1: Reference-cycle Patterns, Railroad Bond Yields, United States, 1857-1933 . . . . .  | 190         |
| 101         | 46 Sample of Table R3: Conformity to Business Cycles, Timing Differences Ignored, Railroad Bond Yields, United States, 1857-1933 . . . . .   | 192         |
| 102         | 47 Sample of Table R4: Conformity to Business Cycles, Timing Differences Recognized, Railroad Bond Yields, United States, 1857-1933 . . . . .  | 193         |
| 103         | 48 Methods Used in Analyzing Quarterly and Annual Series . . . . .   | 198         |
| 105         | 49 Illustrations of the Dependence of Specific Cycles in Annual Data on the Months of Cyclical Turn . . . . .  | 206         |
| 106         | 50 How Months of Cyclical Turn Determine Whether Brief Cyclical Phases Remain or Disappear in Calendar-year Summations . . . . .   | 208         |
| 108         | 51 Comparison of the Directions of Movement of Monthly and Annual Data, Six American Series . . . . .  | 212         |
| 119         | 52 Comparison of the Directions of Movement of Two Series in Annual Form with the Directions of the Same Series in Monthly Form: Every Pair of Six American Series . . . . .         | 215         |
| 124         | 53 Characteristics of Cyclical Phases Skipped by Annual Data, Six American Series . . . . .  | 218         |
| 129         | 54 Joint Distribution of Durations and Amplitudes of All Cyclical Phases and Those Skipped by Annual Data . . . . .  | 219         |
| 133         | 55 Number of Specific Cycles in Monthly, Quarterly and Annual Data, Six American Series . . . . .  | 220         |
| 136         | 56 Duration of Specific Cycles Measured by Different Methods, Pig Iron Production, United States, 1879-1933 . . . . .  | 221         |
| 142         | 57 Average Duration of Specific Cycles in Monthly, Quarterly and Annual Data, Six American Series . . . . .  | 222         |
| 145         | 58 Frequency Distribution of Leads or Lags of Specific Cycles in Monthly Data, Six American Series . . . . .   | 224         |
| 146         | 59 Joint Distribution of Corresponding Leads or Lags of Monthly and Annual Data . . . . .  | 225         |
| 147         | 60 Frequency of Leads or Lags and Average Timing of Specific Cycles, Six American Series: Monthly, Quarterly and Annual . . . . .  | 226         |
| 150         | 61 Average Timing of Specific Cycles Computed in Different Ways, Six American Series: Monthly, Quarterly and Annual . . . . .  | 228         |
| 159         | 62 Average Timing of Specific Cycles during Brief Periods, Six American Series, Monthly and Annual . . . . .   | 230         |
| 161         | 63 Standings at Peaks and Troughs, Cycle Bases, and Amplitudes of Corresponding Specific Cycles in Monthly, Quarterly and Annual Data, Pig Iron Production, United States . . . . .  | 232         |
| 163         | 64 Frequency Distribution of the Differences between Absolute Amplitudes, Cycle Bases, and Relative Amplitudes of Corresponding Specific Cycles in Monthly and Annual Data . . . . . | 234         |
| 167         | 65 Average Amplitude of Corresponding Specific Cycles in Monthly and Annual Data, Six American Series . . . . .  | 236         |
| 177         | 66 Coefficients of Rank Correlation between Amplitudes of Corresponding Specific Cycles in Monthly and Other Data, Six American Series . . . . .                                     | 237         |
| 184         | 67 Average Amplitude of Corresponding, Noncorresponding and All Specific Cycles in Monthly and Annual Data, Six American Series . . . . .  | 238         |
| 189         |  |             |

| <i>Table</i> |   | <i>Page</i> | <i>Table</i> |
|--------------|---|-------------|--------------|
| 68           | Average Amplitude of Specific Cycles during Brief Periods, Six American Series, Monthly and Annual . . . . .  | 239         | 90           |
| 69           | Variability of Amplitudes of Specific Cycles in Monthly and Annual Data, Six American Series . . . . .  | 240         | 91           |
| 70           | Average Per Month Amplitude of Corresponding, Noncorresponding and All Specific Cycles in Monthly and Annual Data, Six American Series . . . . .                                | 241         | 92           |
| 71           | Standings at Cyclical Turns and Amplitudes of Monthly Data Compared with Similar Measures of Corresponding Specific Cycles in Quarterly Data . . . . .                          | 242         | 93           |
| 72           | Frequency Distribution of the Differences between Amplitudes of Corresponding Specific Cycles in Monthly, Quarterly and Annual Data . . . . .                                   | 243         | 94           |
| 73           | Average Amplitude of Specific Cycles in Monthly and Quarterly Data, Six American Series . . . . .   | 244         | 95           |
| 74           | Average Secular Movement of Monthly, Quarterly and Annual Data, Six American Series . . . . .   | 246         | 96           |
| 75           | Average Specific-cycle Patterns of Monthly, Quarterly and Annual Data, Six American Series . . . . .  | 249         | 97           |
| 76           | Position of Fastest and Slowest Rates of Change in Specific-cycle Patterns, Six Monthly American Series . . . . .   | 252         | 98           |
| 77           | Duration and Amplitude of Successive Specific-cycle Contractions in Monthly and Twelve Forms of Annual Data, Pig Iron Production, United States, 1883-1933 . . . . .            | 256         | 99           |
| 78           | Characteristics of Cyclical Phases Skipped by Calendar- and Fiscal-year Data, Three American Series . . . . .   | 258         | 100          |
| 79           | Average Measures of Specific Cycles in Monthly and Four Forms of Annual Data, Three American Series . . . . .   | 259         | 101          |
| 80           | Number of One-year Phases in Annual Reference Cycles, Four Countries . . . . .  | 262         | 102          |
| 81           | Average Reference-cycle Patterns of Monthly, Quarterly and Annual Data, Six American Series . . . . .   | 263         | 103          |
| 82           | Conformity to Business Cycles of Monthly, Quarterly and Annual Data, Six American Series . . . . .  | 266         | 104          |
| 83           | Conformity to Business Cycles of Monthly and Four Forms of Annual Data, Three American Series . . . . .   | 267         | 105          |
| 84           | Change per Decade of Monthly Ordinates of Secular Trend, Six American Series . . . . .  | 273         | 106          |
| 85           | List of Specific Cycles in Unadjusted and Trend-adjusted Data, Six American Series . . . . .  | 274         | 107          |
| 86           | Size and Frequency of Leads or Lags of Specific-cycle Turns in Trend-adjusted Data at Corresponding Turns of Unadjusted Data, Five American Series with Upward Trends . . . . . | 277         | 108          |
| 87           | Average Timing of Specific Cycles in Trend-adjusted Data at Corresponding Turns of Unadjusted Data, Six American Series . . . . .   | 279         | 109          |
| 88           | Average Duration of Specific Cycles in Unadjusted and Trend-adjusted Data, Six American Series . . . . .  | 280         | 110          |
| 89           | Absolute Amplitude of Specific Cycles in Unadjusted and Trend-adjusted Data, Pig Iron Production, United States, 1879-1933 . . . . .  | 281         | 111          |
|              |   |             | 112          |

LIST OF TABLES

xix

| <i>Page</i> | <i>Table</i>   | <i>Page</i> |
|-------------|--|-------------|
| 239         | 90 Frequency Distribution of the Differences between Amplitudes of Corresponding Specific Cycles in Unadjusted and Trend-adjusted Data . . . . .           | 281         |
| 240         | 91 Relation between Amplitudes of Full Specific Cycles in Unadjusted and Trend-adjusted Data under Different Conditions . . . . .                          | 283         |
| 241         | 92 Average Amplitude of Corresponding Specific Cycles in Unadjusted and Trend-adjusted Data Computed by Different Methods, Six American Series . . . . .   | 285         |
| 242         | 93 Comparison of Relative Amplitudes of Corresponding Specific Cycles in Unadjusted and Trend-adjusted Data . . . . .                                      | 286         |
| 243         | 94 Average Amplitude of Corresponding Specific Cycles in Unadjusted and Trend-adjusted Data on Positive and Inverted Plans, Five American Series . . . . . | 288         |
| 244         | 95 Average Amplitude of Corresponding and All Specific Cycles in Unadjusted and Trend-adjusted Data, Six American Series . . . . .                         | 289         |
| 246         | 96 Rates of Rise and Fall of Specific Cycles in Unadjusted Data Compared with Corresponding Measures of Trend-adjusted Data, Six American Series . . . . . | 291         |
| 249         | 97 Average Per Month Amplitude of Corresponding and All Specific Cycles in Unadjusted and Trend-adjusted Data, Six American Series . . . . .               | 291         |
| 252         | 98 Average Specific-cycle Patterns of Unadjusted and Trend-adjusted Data, Six American Series . . . . .  | 292         |
| 256         | 99 Average Reference-cycle Patterns of Unadjusted and Trend-adjusted Data, Six American Series . . . . .   | 294         |
| 258         | 100 Conformity to Business Cycles of Unadjusted and Trend-adjusted Data, Six American Series . . . . .   | 296         |
| 259         | 101 Average Deviations from Average Measures of Cyclical Behavior, Five American Series, Unadjusted and Trend-adjusted . . . . .                           | 300         |
| 262         | 102 Average Measures of Specific Cycles in Railroad Bond Yields, United States: Unadjusted and Trend-adjusted Data, 1868-1899 and 1899-1918 . . . . .      | 301         |
| 263         | 103 Number of Specific Cycles in Unadjusted and Trend-adjusted Data, Six American Series, Monthly and Annual . . . . .                                     | 303         |
| 266         | 104 Cyclical Measures of Unadjusted and Trend-adjusted Data, Two American Series, Monthly and Annual . . . . .   | 304         |
| 267         | 105 Full List of Rises and Declines in Monthly Smoothed Data, Pig Iron Production, United States, 1878-1932 . . . . .                                      | 314         |
| 273         | 106 Shifts in the Timing of Specific Cycles Produced by Smoothing, Four American Series . . . . .  | 316         |
| 274         | 107 Effects of Fourteen Smoothing Formulas on the Timing of Specific Cycles, Call Money Rates on New York Stock Exchange, 1887-1893 . . . . .              | 319         |
| 277         | 108 Timing of Raw and Smoothed Data of Six Artificial Series Compared with Timing of the Underlying Pure Cycles . . . . .                                  | 319         |
| 279         | 109 Effect of Smoothing on Cyclical Turns That Are 'Smooth' in Raw Data, Three American Series . . . . .   | 323         |
| 280         | 110 Timing and Duration of 'Brief' Specific-cycle Phases, Four American Series, Raw and Smoothed . . . . .   | 324         |
| 281         | 111 Chronology of Specific-cycle Turns in the Contraction of 1907-1908, Ten American Series, Raw and Smoothed . . . . .                                    | 325         |
| 281         | 112 Average Duration of Specific Cycles in Raw and Smoothed Data, Four American Series . . . . .   | 325         |

| <i>Table</i>  | <i>Page</i> | <i>Table</i> |
|---|-------------|--------------|
| 113 Average Amplitude of Specific Cycles in Raw and Smoothed Data, Four American Series . . . . .   | 327         | 137          |
| 114 Amplitude of Specific Cycles in Raw and Smoothed Data, Pig Iron Production, United States, 1878-1933 . . . . .                                      | 328         | 138          |
| 115 Coefficients of Rank Correlation between Amplitudes of Corresponding Specific Cycles in Raw and Smoothed Data, Four American Series . . . . .       | 329         | 139          |
| 116 Average Per Month Amplitude of Specific Cycles in Raw and Smoothed Data, Four American Series . . . . .   | 329         | 140          |
| 117 Influence of the Duration of Cyclical Phases on the Gap between Amplitudes of Corresponding Phases in Raw and Smoothed Data . . . . .               | 331         | 141          |
| 118 Effects of Fourteen Smoothing Formulas on Amplitude of Specific Cycles, Call Money Rates on New York Stock Exchange, 1887-1893 . . . . .            | 332         | 142          |
| 119 Average Amplitude of Specific Cycles, Call Money Rates on New York Stock Exchange before and after Inauguration of Federal Reserve System . . . . . | 333         | 143          |
| 120 Amplitude of Specific Cycles in Raw and Smoothed Data of Six Artificial Series Compared with Amplitude of the Underlying Pure Cycles . . . . .      | 335         | 144          |
| 121 Average Measures of Secular Movements of Raw and Smoothed Data, Four American Series . . . . .  | 336         | 145          |
| 122 Average Specific-cycle Patterns of Raw and Smoothed Data, Four American Series . . . . .  | 337         | 146          |
| 123 Average Rate of Change from Stage to Stage of Specific Cycles, Four American Series, Raw and Smoothed . . . . .                                     | 340         | 147          |
| 124 Position of Fastest and Slowest Rates of Change in Specific-cycle Patterns, Four American Series, Raw and Smoothed . . . . .                        | 341         | 148          |
| 125 Weighted Average Rate of Change from Stage to Stage of Specific Cycles, Four American Series, Raw and Smoothed . . . . .                            | 342         | 149          |
| 126 Average Specific-cycle Patterns of Raw and Smoothed Data of Six Artificial Series Compared with Patterns of the Underlying Pure Cycles . . . . .    | 344         | 150          |
| 127 'Special' Cyclical Patterns, Pig Iron Production, United States, 1879-1933 . . . . .  | 347         | 151          |
| 128 Average Reference-cycle Patterns of Raw and Smoothed Data, Four American Series . . . . .   | 350         | 152          |
| 129 Average Rate of Change from Stage to Stage of Reference Cycles, Four American Series, Raw and Smoothed . . . . .                                    | 352         | 153          |
| 130 Ranks of Average Rates of Change from Stage to Stage of Reference Cycles, Four American Series, Raw and Smoothed . . . . .                          | 353         | 154          |
| 131 Average Patterns of Small Groups of Reference Cycles, Four American Series, Raw and Smoothed . . . . .  | 354         | 155          |
| 132 Conformity to Business Cycles of Raw and Smoothed Data, Four American Series . . . . .  | 358         | 156          |
| 133 Stage-by-stage Indexes of Conformity to Business Cycles, Four American Series, Raw and Smoothed . . . . .   | 359         | 157          |
| 134 Average Deviations from Average Cyclical Measures, Four American Series, Raw and Smoothed . . . . .   | 360         | 158          |
| 135 Effect of Smoothing on Average Deviations from Average Cyclical Measures . . . . .  | 362         | 159          |
| 136 Effect of a 'Dubious' Cycle on Average Duration and Amplitude of Specific Cycles, Three American Series . . . . .                                   | 364         | 160          |
|   |             | 161          |

LIST OF TABLES

xxi

| <i>Page</i> | <i>Table</i>   | <i>Page</i> |
|-------------|--|-------------|
| 327         | 137 Effect of a 'Dubious' Cycle on Average Specific-cycle Patterns, Three American Series . . . . .  | 365         |
| 328         | 138 Effect of a 'Dubious' Cycle on Average Rate of Change from Stage to Stage of Specific Cycles, Three American Series . . . . .                | 367         |
| 329         | 139 Average Duration of Business Cycles and Their Variability, Four Countries . . . . .  | 371         |
| 329         | 140 Averages and Ranges of Selected Cyclical Measures of Seven American Series . . . . .   | 375         |
| 331         | 141 Average Timing of Specific-cycle Turns and Their Variability, Seven American Series . . . . .  | 376         |
| 332         | 142 Average Specific-cycle Patterns and Their Variability, Seven American Series . . . . .   | 378         |
| 333         | 143 Average Reference-cycle Patterns and Their Variability, Seven American Series . . . . .  | 379         |
| 335         | 144 Extreme Ordinates of Straight-line Trends Fitted to Durations and Amplitudes of Successive Specific Cycles, Seven American Series . . . . .  | 385         |
| 336         | 145 Average Duration and Amplitude of Three Successive Groups of Specific Cycles, Seven American Series . . . . .                                | 385         |
| 337         | 146 Correlation between Specific-cycle Measures and Their Order in Time, Seven American Series . . . . .   | 390         |
| 340         | 147 Tests of Secular Change in Durations and Amplitudes of Specific Cycles, Seven American Series . . . . .                                      | 393         |
| 341         | 148 Average Patterns of Three Successive Groups of Reference Cycles, Seven American Series . . . . .   | 395         |
| 342         | 149 Square of Correlation Ratio between Reference-cycle Standings and Time, Seven American Series . . . . .                                      | 395         |
| 344         | 150 Tests of Secular Change in Reference-cycle Patterns, Seven American Series . . . . .   | 396         |
| 347         | 151 Average Duration and Amplitude of Expansions and Contractions of Three Successive Groups of Specific Cycles, Seven American Series . . . . . | 397         |
| 350         | 152 Average Timing of Specific Cycles and Rates of Change during Three Successive Groups of Reference Cycles, Seven American Series . . . . .    | 399         |
| 352         | 153 Summary of Variance Tests in Preceding Tables . . . . .  | 400         |
| 353         | 154 Average Duration of Three Successive Groups of Business Cycles, Four Countries . . . . .   | 401         |
| 354         | 155 Tests of Secular Change in Durations of Business Cycles, United States, 1854-1933 . . . . .  | 402         |
| 358         | 156 Ranks of Amplitudes of Cyclical Expansions and Contractions, Three Indexes of American Business Activity, 1879-1933 . . . . .                | 403         |
| 359         | 157 Analysis of Durations of Business Cycles Classified According to Mills' Stages of Industrialization . . . . .                                | 405         |
| 360         | 158 Average Duration and Amplitude of Specific Cycles before and after 1914, Seven American Series . . . . .                                     | 407         |
| 362         | 159 Average Timing of Specific Cycles and Rates of Change during Reference Cycles before and after 1914, Seven American Series . . . . .         | 409         |
| 364         | 160 Average Duration of Business Cycles before and after 1914, Four Countries . . . . .  | 412         |
|             | 161 Average Duration and Amplitude of Long Cycles in Building Construction, Twenty-five Annual American Series . . . . .                         | 419         |

| <i>Table</i> |  | <i>Page</i> | <i>Table</i> |
|--------------|--|-------------|--------------|
| 162          | Average Duration and Amplitude of Specific Cycles during the Upswings and Downswings of Long Cycles in Building Construction, Twenty-five Annual American Series . . . . .   | 421         | 182          |
| 163          | Relations in Time between Business Cycles and Long Building Cycles, United States, 1853-1933 . . . . .   | 422         | 183          |
| 164          | Average Duration and Amplitude of Specific Cycles in Seven Series and Average Duration of Business Cycles during the Upswings and Downswings of Long Cycles in American Building Construction . . . . .                    | 426         | 184          |
| 165          | Peak and Trough Dates of Kondratieff's Long Waves and the Long Waves in Wholesale Prices of Four Countries . . . . .   | 432         | 185          |
| 166          | Average Duration and Amplitude of Specific Cycles during the Upswings and Downswings of Long Waves in Wholesale Prices, Seven American Series . . . . .  | 436         | 186          |
| 167          | Average Duration of Business Cycles during the Upswings and Downswings of Long Waves in Wholesale Prices, Four Countries . . . . .   | 437         | 187          |
| 168          | Frequency Distribution of Durations of Business Cycles, Four Countries . . . . .   | 441         | 188          |
| 169          | Relations in Time between Business Cycles and Schumpeter's 'Juglar Cycles', United States, 1848-1932 . . . . .   | 441         | 189          |
| 170          | Average Duration and Amplitude of Specific Cycles in Seven Series and Average Duration of Business Cycles Occupying First or Last Place within Schumpeter's 'Juglar Cycles' in the United States . . . . .                 | 445         | A1           |
| 171          | Number of Minor or Business Cycles within Kitchin's Major Cycles: United States, 1873-1920 and Great Britain, 1848-1921 . . . . .  | 449         | A2           |
| 172          | Average Duration and Amplitude of Specific Cycles in Six Series and Average Duration of Business Cycles Occupying First or Last Place within Kitchin's Major Cycles, United States, 1883-1920 . . . . .                    | 451         | B1           |
| 173          | Average Amplitude of Specific Cycles Occupying First, Middle or Last Place within Periods Marked Off by Severe Depressions from 1873 to 1933, Seven American Series . . . . .  | 459         | B2           |
| 174          | Amplitude of Specific Cycles Occupying Successive Places within Periods Bounded by Troughs of Severe Depressions, 1879-1933, Four American Series . . . . .  | 461         | B3           |
| 175          | Average Duration of Specific Cycles in Seven American Series and of American and British Business Cycles Occupying First, Middle or Last Place within Periods Marked Off by Severe Depressions from 1873 to 1933 . . . . . | 463         | B4           |
| 176          | Cyclical Measures of Pig Iron Production and Prices, United States, 1879-1933 . . . . .  | 467         | B5           |
| 177          | Amplitude of Successive Reference Cycles, Seven American Series, 1879-1933 . . . . .   | 481         | B6           |
| 178          | Amplitude of Specific Cycles Corresponding to Successive Business Cycles, Seven American Series, 1885-1914 . . . . .   | 483         | B7           |
| 179          | Arrays of Average Durations and Amplitudes of Specific Cycles Based on Four Samples from Seven American Series . . . . .   | 484         | B8           |
| 180          | Average Cyclical Measures Covering Successive Periods of Five Business Cycles and All Fifteen Cycles from 1879 to 1933, Seven American Series . . . . .  | 486         | B9           |
| 181          | Coefficients of Rank Correlation between Average Cyclical Measures of Seven American Series in Different Periods . . . . .   | 488         |              |

LIST OF TABLES

| <i>Page</i> | <i>Table</i>   | <i>Page</i> |
|-------------|--|-------------|
| 421         | 182 Tests of the Statistical Significance of Differences among Average Cyclical Measures of Seven American Series . . . . .                      | 489         |
| 422         | 183 Frequency Distribution of Amplitudes of Specific Cycles, Seven American Series . . . . .   | 489         |
| 426         | 184 Frequency Distribution of Leads or Lags of Specific Cycles, Seven American Series . . . . .  | 490         |
| 432         | 185 Frequency Distribution of Durations of American Business Cycles and Specific Cycles in Seven Series . . . . .                                | 490         |
| 436         | 186 Influence of the Highest and Lowest Values on the Average Duration, Timing and Amplitude of Specific Cycles, Seven American Series . . . . . | 493         |
| 437         | 187 Several Positional Arithmetic Means: Duration, Timing and Amplitude of Specific Cycles, Seven American Series . . . . .                      | 494         |
| 441         | 188 Several Positional Arithmetic Means of Specific-cycle Patterns, Seven American Series . . . . .  | 498         |
| 441         | 189 Several Positional Arithmetic Means of Reference-cycle Patterns, Seven American Series . . . . .   | 499         |
| 445         | 190 Several Positional Arithmetic Means: Duration and Amplitude of Small Groups of Specific Cycles, Seven American Series . . . . .              | 502         |
| 449         | A1 Division of Monthly Reference Cycles into Nine Stages, Four Countries . . . . .   | 510         |
| 451         | A2 Average Interval between Reference-cycle Stages during Selected Periods, United States . . . . .  | 516         |
| 459         | B1 Measures of Successive Specific Cycles Treated on Positive Plan, Seven American Series . . . . .  | 518         |
| 461         | B2 Measures of Successive Specific Cycles Treated on Inverted Plan, Seven American Series . . . . .  | 524         |
| 463         | B3 Measures of Successive Reference Cycles Treated on Positive Plan, Seven American Series . . . . .   | 529         |
| 467         | B4 Patterns of Successive Reference Cycles Treated on Inverted Plan, Seven American Series . . . . .   | 534         |
| 481         | B5 List of Cycles Included in Table 164 and Chart 60 . . . . .   | 537         |
| 483         | B6 List of Cycles Included in Table 166 and Chart 63 . . . . .   | 538         |
| 484         | B7 List of Cycles Included in Table 167 . . . . .  | 538         |
| 486         | B8 List of Cycles Included in Tables 170, 172, 173 and 175, and Charts 67, 69 and 71 . . . . .   | 539         |
| 488         | B9 List of Specific Cycles Included in Table 180 . . . . .   | 539         |

## List of Charts

| <i>Chart</i> |   | <i>Page</i> |
|--------------|---|-------------|
| 1            | Coke Production, United States, 1914-1933 . . . . .   | 25          |
| 2            | Sample Chart of Cyclical Patterns . . . . .   | 35          |
| 3            | Original and Seasonally Adjusted Data, Three American Series, 1919-1941 . . . . .   | 45          |
| 4            | Bituminous Coal Production, United States, 1905-1939 . . . . .  | 60          |
| 5            | Ratios of Original Data to Twelve-month Moving Averages, Bituminous Coal Production, United States, 1905-1914 . . . . .                   | 62          |
| 6            | Net Gold Imports by the United States from the United Kingdom, 1879-1914 . . . . .  | 63          |
| 7            | Six American Series that Lack Continuous Specific Cycles . . . . .  | 67          |
| 8            | Behavior of Forty American Series, 1932-1939 . . . . .  | 84          |
| 9            | Behavior of Twenty-three American Series, 1914-1918 . . . . .   | 92          |
| 10           | Frickey's Standard Pattern of Short-term Fluctuations in American Business Activity, 1866-1914 . . . . .                                  | 112         |
| 11           | Illustrations of Mechanical Rules for Comparing the Timing of Specific Cycles with the Reference Dates, Six American Series . . . . .     | 121         |
| 12           | Illustrations of Relaxed Rules for Comparing the Timing of Specific Cycles with the Reference Dates, Two American Series . . . . .        | 122         |
| 13           | Employment and Payrolls in Dyeing and Finishing Textile Plants, United States, 1919-1924 . . . . .  | 139         |
| 14           | Derivation of Specific-cycle Patterns, Bituminous Coal Production, United States, 1905-1939 . . . . .                                     | 152         |
| 15           | Patterns of Successive Specific Cycles and Their Average Pattern, Bituminous Coal Production, United States, 1907-1938 . . . . .          | 155         |
| 16           | Average Specific-cycle Patterns of Ten American Series . . . . .  | 156         |
| 17           | Variation of Average Rates of Change from Stage to Stage of Expansions and Contractions of Specific Cycles, Ten American Series . . . . . | 158         |
| 18           | Derivation of Reference-cycle Patterns, Bituminous Coal Production, United States, 1905-1939 . . . . .                                    | 164         |
| 19           | Patterns of Successive Reference Cycles and Their Average Pattern, Bituminous Coal Production, United States, 1905-1938 . . . . .         | 165         |
| 20           | Average Reference-cycle Patterns of Ten American Series . . . . .   | 169         |
| 21           | Average Cyclical Patterns of Ten American Series . . . . .  | 173         |

*Chart*

22 P  
B  
Sc

23 P  
ar

24 Se  
ar

25 R  
D

26 A  
Si

27 A  
nu

28 V  
ar

29 Pi  
of

30 Ba  
ar

31 Ca  
ar

32 A  
Ar

33 A  
Da

34 A  
T

35 Pi  
ad

36 R

37 A  
Si

38 A  
Da

39 A  
D

40 A  
ad

41 A  
C  
A

42 A  
U

43 Pi  
R

44 Se  
St

LIST OF CHARTS

xxv

| <i>Page</i> | <i>Chart</i>  | <i>Page</i> |
|-------------|---|-------------|
|             | 22 Patterns of Successive Reference Cycles and Their Average Pattern, Bituminous Coal Production, United States, 1905-1938: Drawn to a Schematized Time Scale . . . . . | 187         |
|             | 23 Pig Iron Production, United States, 1877-1933: Monthly, Quarterly and Annual . . . . .   | 209         |
|             | 24 Sequence of Cyclical Downturns in 1929, Six American Series, Monthly and Quarterly . . . . .   | 227         |
|             | 25 Relation between the Cycle-dampening Effect of Annual Data and the Duration of Specific-cycle Phases . . . . .   | 235         |
|             | 26 Average Specific-cycle Patterns of Monthly, Quarterly and Annual Data, Six American Series . . . . .   | 247         |
|             | 27 Average Patterns of Corresponding Specific Cycles in Monthly and Annual Data, Five American Series . . . . .   | 248         |
| 25          | 28 Variation of Average Rates of Change from Stage to Stage of Expansions and Contractions of Specific Cycles in Monthly and Annual Data, Six American Series . . . . . | 253         |
| 35          | 29 Pig Iron Production, United States, 1877-1933: Monthly and Six Forms of Annual Data . . . . .  | 254         |
| 45          | 30 Bank Clearings outside New York City, Deflated, 1875-1933: Monthly and Four Forms of Annual Data . . . . .   | 255         |
| 60          | 31 Call Money Rates on New York Stock Exchange, 1868-1933: Monthly and Four Forms of Annual Data . . . . .  | 257         |
| 62          | 32 Average Specific-cycle Patterns of Calendar- and Fiscal-year Data, Three American Series . . . . .   | 260         |
| 63          | 33 Average Reference-cycle Patterns of Monthly, Quarterly and Annual Data, Six American Series . . . . .  | 264         |
| 67          | 34 Average Reference-cycle Patterns of Calendar- and Fiscal-year Data, Three American Series . . . . .  | 268         |
| 84          | 35 Pig Iron Production, United States, 1877-1933: Unadjusted and Trend-adjusted . . . . .   | 272         |
| 92          | 36 Railroad Bond Yields, United States: Unadjusted and Trend-adjusted . . . . .   | 275         |
| 112         | 37 Average Specific-cycle Patterns of Unadjusted and Trend-adjusted Data, Six American Series . . . . .   | 293         |
| 121         | 38 Average Reference-cycle Patterns of Unadjusted and Trend-adjusted Data, Six American Series . . . . .  | 295         |
| 122         | 39 Average Specific-cycle Patterns, Bank Clearings outside New York City, Deflated: Unadjusted and Trend-adjusted Data, Monthly and Annual . . . . .                    | 305         |
| 139         | 40 Average Specific-cycle Patterns, Pig Iron Production, United States: Unadjusted and Trend-adjusted Data, Monthly and Annual . . . . .                                | 306         |
| 152         | 41 Average Reference-cycle Patterns, Bank Clearings outside New York City, Deflated: Unadjusted and Trend-adjusted Data, Monthly and Annual . . . . .                   | 307         |
| 155         | 42 Average Reference-cycle Patterns, Pig Iron Production, United States: Unadjusted and Trend-adjusted Data, Monthly and Annual . . . . .                               | 308         |
| 156         | 43 Pig Iron Production and Call Money Rates, United States, 1877-1933: Raw Data and Macaulay's Graduation . . . . .   | 313         |
| 158         | 44 Seven Smoothing Formulas Applied to Call Money Rates on New York Stock Exchange, 1886-1894 . . . . .   | 317         |

| <i>Chart</i>  | <i>Page</i> | <i>Chart</i>         |
|---|-------------|----------------------|
| 45 Six Artificial Series Combining Cyclical and Random Components: Raw Data, Their Cyclical Component, and Macaulay's Graduation . . .                          | 321         | 70 Av<br>wi          |
| 46 Average Specific-cycle Patterns of Raw and Smoothed Data, Four American Series . . . . .   | 338         | 71 Av<br>Pla<br>187  |
| 47 Average Specific-cycle Patterns of Raw and Smoothed Data of Six Artificial Series Compared with Patterns of the Underlying Pure Cycles . .                   | 345         | 72 Av<br>Pla<br>187  |
| 48 Special and Standard Average Cyclical Patterns, Pig Iron Production, United States . . . . .   | 349         | 73 Pat<br>age        |
| 49 Average Reference-cycle Patterns of Raw and Smoothed Data, Four American Series . . . . .  | 351         | 74 Pat<br>Pat<br>bas |
| 50 Differences between Average Reference-cycle Patterns of Raw and Smoothed Data, Four American Series . . . . .  | 353         | 75 Me                |
| 51 Average Patterns of Small Groups of Reference Cycles, Four American Series, Raw and Smoothed . . . . .   | 355         | 76 Me                |
| 52 Effect of a 'Dubious' Cycle on Average Specific-cycle Patterns, Three American Series . . . . .  | 366         | 77 Ave<br>Sta        |
| 53 Behavior of Seven American Series, 1857-1933 . . . . .   | 373         |                      |
| 54 Average Cyclical Patterns of Seven American Series . . . . .   | 377         |                      |
| 55 Secular Changes in the Duration and Amplitude of Specific Cycles, Seven American Series . . . . .  | 386         |                      |
| 56 Average Patterns of Three Successive Groups of Reference Cycles, Seven American Series . . . . .   | 394         |                      |
| 57 Average Specific-cycle Patterns before and after 1914, Seven American Series . . . . .   | 410         |                      |
| 58 Average Reference-cycle Patterns before and after 1914, Seven American Series . . . . .  | 411         |                      |
| 59 Average Patterns of Four Successive Groups of Reference Cycles, Railroad Traffic and Investment, United States, 1870-1933 . . . . .                          | 415         |                      |
| 60 Average Specific-cycle Patterns during the Upswings and Downswings of Long Cycles in Building Construction, Seven American Series . . .                      | 423         |                      |
| 61 Average Reference-cycle Patterns during the Upswings and Downswings of Long Cycles in Building Construction, 1879-1933, Seven American Series . . . . .      | 424         |                      |
| 62 Average Reference-cycle Patterns during the Upswings and Downswings of Wardwell's Major Cycles, 1891-1914, Seven American Series . . .                       | 430         |                      |
| 63 Average Specific-cycle Patterns during the Upswings and Downswings of Long Waves in Wholesale Prices, Seven American Series . . . . .                        | 434         |                      |
| 64 Average Reference-cycle Patterns during the Upswings and Downswings of Long Waves in Wholesale Prices, 1879-1933, Seven American Series                      | 435         |                      |
| 65 Indexes of Wholesale Prices, Four Countries, 1790-1940 . . . . .   | 439         |                      |
| 66 Average Patterns of Reference Cycles Occupying First, Second or Third Place within Successive Triplets of Cycles, 1879-1933, Seven American Series . . . . . | 443         |                      |
| 67 Average Patterns of Specific Cycles Occupying First or Last Place within Schumpeter's 'Juglar Cycles', Seven American Series . . . . .                       | 446         |                      |
| 68 Average Patterns of Reference Cycles Occupying First or Last Place within Schumpeter's 'Juglar Cycles', Seven American Series . . . . .                      | 447         |                      |
| 69 Average Patterns of Specific Cycles Occupying First or Last Place within Kitchin's Major Cycles from 1883 to 1920, Six American Series . . .                 | 452         |                      |

LIST OF CHARTS

xxvii

| <i>Page</i>     | <i>Chart</i>   | <i>Page</i> |
|-----------------|--|-------------|
| ents: . . . 321 | 70 Average Patterns of Reference Cycles Occupying First or Last Place within Kitchin's Major Cycles from 1883 to 1920, Seven American Series . . . . .                               | 453         |
| mer- . . . 338  | 71 Average Patterns of Specific Cycles Occupying First, Middle or Last Place within Periods Marked off by Troughs of Severe Depressions, 1879-1933, Seven American Series . . . . .  | 456         |
| Arti- . . . 345 | 72 Average Patterns of Reference Cycles Occupying First, Middle or Last Place within Periods Marked off by Troughs of Severe Depressions, 1879-1933, Seven American Series . . . . . | 457         |
| ion, . . . 349  | 73 Patterns of Successive Reference Cycles Compared with Their Average Pattern, 1879-1933, Seven American Series . . . . .   | 469         |
| Four . . . 351  | 74 Patterns of Successive Reference Cycles Compared with Their Average Pattern, 1882-1929, Seven American Series (Patterns made on inverted basis) . . . . .                         | 475         |
| and . . . 353   | 75 Mean and Median Specific-cycle Patterns, Seven American Series . . . . .  | 500         |
| mer- . . . 355  | 76 Mean and Median Reference-cycle Patterns, Seven American Series . . . . .   | 501         |
| ree . . . 366   | 77 Average Cyclical Patterns of Crop and Pig Iron Production, United States and Great Britain . . . . .  | 504         |
| . . . 373       |  |             |
| . . . 377       |  |             |
| les, . . . 386  |  |             |
| ven . . . 394   |  |             |
| can . . . 410   |  |             |
| eri- . . . 411  |  |             |
| ail- . . . 415  |  |             |
| ngs . . . 423   |  |             |
| ngs . . . 424   |  |             |
| can . . . 430   |  |             |
| ngs . . . 434   |  |             |
| ngs . . . 435   |  |             |
| ries . . . 439  |  |             |
| ird . . . 443   |  |             |
| can . . . 446   |  |             |
| hin . . . 447   |  |             |
| ace . . . 452   |  |             |
| th- . . . 452   |  |             |

