

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

Volume Title: Cyclical Analysis of Time Series: Selected Procedures and Computer Programs

Volume Author/Editor: Gerhard Bry and Charlotte Boschan

Volume Publisher: NBER

Volume ISBN: 0-87014-223-2

Volume URL: [http://www.nber.org/books/bry\\_71-1](http://www.nber.org/books/bry_71-1)

Publication Date: 1971

Chapter Title: Front matter to "Cyclical Analysis of Time Series: Selected Procedures and Computer Programs"

Chapter Author: Gerhard Bry, Charlotte Boschan

Chapter URL: <http://www.nber.org/chapters/c2145>

Chapter pages in book: (p. -13 - -2)

Cyclical Analysis of Time Series:  
Selected Procedures  
and Computer Programs

GERHARD BRY

*New York University*

*Graduate School of Business Administration*

AND

CHARLOTTE BOSCHAN

*National Bureau of Economic Research*

Technical Paper 20



1971

NATIONAL BUREAU OF ECONOMIC RESEARCH  
NEW YORK

DISTRIBUTED BY  
COLUMBIA UNIVERSITY PRESS  
NEW YORK AND LONDON

Copyright © 1971 by  
National Bureau of Economic Research, Inc.  
261 Madison Avenue, New York, N.Y. 10016  
All Rights Reserved

Library of Congress Card No. 70-123122  
ISBN: 0-87014-223-2

Printed in the United States of America



# National Bureau of Economic Research

## OFFICERS

Arthur F. Burns, *Honorary Chairman*      Victor R. Fuchs, *Vice President—Research*  
Theodore O. Yntema, *Chairman*      F. Thomas Juster, *Vice President—Research*  
Walter W. Heller, *Vice Chairman*      Hal B. Lary, *Vice President—Research*  
John R. Meyer, *President*      Robert E. Lipsey, *Vice President—Research*  
Thomas D. Flynn, *Treasurer*      Edward K. Smith, *Vice President*  
Douglas H. Eldridge, *Vice President—Executive Secretary*  
Joan R. Tron, *Director of Publications*

## DIRECTORS AT LARGE

Atherton Bean, *International Multifoods Corporation*      Walter W. Heller, *University of Minnesota*  
Joseph A. Beirne, *Communications Workers of America*      Vivian W. Henderson, *Clark College*  
Arthur F. Burns, *Board of Governors of the Federal Reserve System*      John R. Meyer, *Yale University*  
Wallace J. Campbell, *Foundation for Cooperative Housing*      J. Irwin Miller, *Cummins Engine Company, Inc.*  
Erwin D. Canham, *Christian Science Monitor*      Geoffrey H. Moore, *Bureau of Labor Statistics*  
Robert A. Charpie, *The Cabot Corporation*      J. Wilson Newman, *Dun & Bradstreet, Inc.*  
Solomon Fabricant, *New York University*      James J. O'Leary, *United States Trust Company of New York*  
Frank W. Fetter, *Hanover, New Hampshire*  
Eugene P. Foley, *Dreyfus Corporation*      Robert V. Roosa, *Brown Brothers Harriman & Co.*  
Eli Goldston, *Eastern Gas and Fuel Associates*  
Boris Shishkin, *American Federation of Labor and Congress of Industrial Organizations*  
Crawford H. Greenewalt, *E. I. du Pont de Nemours & Company*      Lazare Teper, *International Ladies' Garment Workers' Union*  
David L. Grove, *International Business Machines Corporation*      Donald B. Woodward, *Riverside, Connecticut*  
Theodore O. Yntema, *Oakland University*

## DIRECTORS BY UNIVERSITY APPOINTMENT

Moses Abramovitz, *Stanford*      Robert J. Lampman, *Wisconsin*  
Charles H. Berry, *Princeton*      Kelvin J. Lancaster, *Columbia*  
Francis M. Boddy, *Minnesota*      Maurice W. Lee, *North Carolina*  
Tom E. Davis, *Cornell*      Lloyd G. Reynolds, *Yale*  
Otto Eckstein, *Harvard*      Robert M. Solow, *Massachusetts Institute of Technology*  
Walter D. Fisher, *Northwestern*      Henri Theil, *Chicago*  
R. A. Gordon, *California*      Thomas A. Wilson, *Toronto*  
Willis J. Winn, *Pennsylvania*

## DIRECTORS BY APPOINTMENT OF OTHER ORGANIZATIONS

Emilio G. Collado, *Committee for Economic Development*      Walter E. Hoadley, *American Finance Association*  
Thomas D. Flynn, *American Institute of Certified Public Accountants*      Douglass C. North, *Economic History Association*  
Nathaniel Goldfinger, *American Federation of Labor & Congress of Industrial Organizations*      Charles B. Reeder, *National Association of Business Economists*  
Harold G. Halcrow, *American Agricultural Economics Association*      Murray Shields, *American Management Association*  
Douglas G. Hartle, *Canadian Economics Association*      Willard L. Thorp, *American Economic Association*  
W. Allen Wallis, *American Statistical Association*

## DIRECTORS EMERITI

Percival F. Brundage      Gottfried Haberler      Albert J. Hettinger, Jr.  
George B. Roberts      Joseph H. Willits

## SENIOR RESEARCH STAFF

Gary S. Becker	Raymond W. Goldsmith	Irving B. Kravis	M. Ishaq Nadiri
Charlotte Boschan	Jack M. Guttentag	Hal B. Lary	Nancy Ruggles
Phillip Cagan	Daniel M. Holland	Robert E. Lipsey	Richard Ruggles
James S. Earley	F. Thomas Juster	John R. Meyer	Anna J. Schwartz
Solomon Fabricant	C. Harry Kahn	Jacob Mincer	Robert P. Shay
Milton Friedman	John F. Kain	Ilse Mintz	George J. Stigler
Victor R. Fuchs	John W. Kendrick	Geoffrey H. Moore *	Victor Zarnowitz

\* On leave.

## 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 National Bureau is carried on in strict conformity with this object.

2. The President of the National Bureau shall submit to the Board of Directors, or to its Executive Committee, for their formal adoption all specific proposals for research to be instituted.

3. No research report shall be published until the President shall have submitted to each member of the Board the manuscript proposed for publication, and such information as will, in his opinion and in the opinion of the author, serve to determine the suitability of the report for publication in accordance with the principles of the National Bureau. Each manuscript shall contain a summary drawing attention to the nature and treatment of the problem studied, the character of the data and their utilization in the report, and the main conclusions reached.

4. For each manuscript so submitted, a special committee of the Board shall be appointed by majority agreement of the President and Vice Presidents (or by the Executive Committee in case of inability to decide on the part of the President and Vice Presidents), 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 manuscript is submitted to him. It shall be the duty of each member of the special manuscript committee to read the manuscript. If each member of the manuscript committee signifies his approval within thirty days of the transmittal of the manuscript, the report may be published. If at the end of that period any member of the manuscript committee withholds his approval, the President shall then notify each member of the Board, requesting approval or disapproval of publication, and thirty days additional shall be granted for this purpose. The manuscript shall then not be published unless at least a majority of the entire Board who shall have voted on the proposal within the time fixed for the receipt of votes shall have approved.

5. No manuscript may be published, though approved by each member of the special manuscript committee, until forty-five days have elapsed from the transmittal of the report in manuscript form. 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 the special committee have passed on its validity in every detail.

6. Publications of the National Bureau issued for informational purposes concerning the work of the Bureau and its staff, or issued to inform the public of activities of Bureau staff, and volumes issued as a result of various conferences involving the National Bureau shall contain a specific disclaimer noting that such publication has not passed through the normal review procedures required in this resolution. The Executive Committee of the Board is charged with review of all such publications from time to time to ensure that they do not take on the character of formal research reports of the National Bureau, requiring formal Board approval.

7. Unless otherwise determined by the Board or exempted by the terms of paragraph 6, a copy of this resolution shall be printed in each National Bureau publication.

*(Resolution adopted October 25, 1926, and revised February 6, 1933,  
February 24, 1941, and April 20, 1968)*

IN MEMORY OF  
SOPHIE SAKOWITZ,  
WHO WORKED ALL HER LIFE IN THE FIELD OF  
BUSINESS CYCLE ANALYSIS



# CONTENTS

## FOREWORD

xiii

1.	NATURE, OBJECTIVES, AND USES OF PROGRAMMED BUSINESS CYCLE ANALYSIS	
	Nature and Objectives	1
	<i>Turning Point Determination</i>	2
	<i>Standard Business Cycle Analysis</i>	3
	<i>Recession and Recovery Analysis</i>	3
	Application to Regions, Industries, and Business Enterprises	4
2.	PROGRAMMED SELECTION OF CYCLICAL TURNING POINTS	
	Principles of Selecting Turning Points	7
	<i>Selecting Cycles</i>	8
	<i>Selecting Peaks and Troughs</i>	10
	Problems of Programmed Selection	14
	<i>General Considerations</i>	14
	<i>Alternative Approaches</i>	15
	<i>Approach Employed</i>	16
	Process of Selection	19
	<i>Extreme Observations</i>	19
	<i>Turns in the Twelve-Month Moving Average</i>	22
	<i>Turns in the Spencer Curve</i>	23
	<i>Immediate Neighborhoods of Final Turns</i>	24
	<i>Selection of Final Turning Points</i>	26
	Empirical Evaluation of Procedure	29
	<i>Description of Sample</i>	29
	<i>Criteria for Evaluation</i>	30
	<i>Program-Determined and Staff-Determined Turns</i>	31
	<i>Application to Reference Turns</i>	52
	Suggestions for Further Development	56
	Appendix to Chapter 2	
	SAMPLE RUN, SELECTION OF CYCLICAL TURNING POINTS, BITUMINOUS COAL PRODUCTION	



3. STANDARD BUSINESS CYCLE ANALYSIS  
OF ECONOMIC TIME SERIES

General Approach	64
<i>Treatment of Time Series Components</i>	65
<i>Specific Cycle and Reference Cycle Analysis</i>	66
<i>Subdivision of Cycles</i>	70
<i>Relatives and Averages</i>	74
Programmed Measures of Cyclical Characteristics	78
<i>Timing and Duration of Cycles</i>	80
<i>Amplitudes During Expansions and Contractions</i>	87
<i>Cycle Patterns</i>	100
<i>Conformity Measures</i>	105
<i>Measures of Secular Growth</i>	113
<i>Measures for Quarterly and Annual Series</i>	114

Appendix to Chapter 3 (A)

SAMPLE RUN, BUSINESS CYCLE ANALYSIS, NONAGRICULTURAL  
EMPLOYMENT

Appendix to Chapter 3 (B)

SAMPLE RUN, BUSINESS CYCLE ANALYSIS, UNEMPLOYMENT RATE

4. RECESSION AND RECOVERY ANALYSIS

Rationale and Approach	151
<i>Purpose and Uses</i>	151
<i>Recession Patterns</i>	155
<i>Recovery Patterns</i>	167
Variants of Uses and Approaches	177
<i>Nonforecasting Uses</i>	177
<i>Variants of Analysis</i>	189
Interpretation of Output	195
Postscript	199

Appendix to Chapter 4 (A)

SAMPLE RUN, RECESSION ANALYSIS

Appendix to Chapter 4 (B)

SAMPLE RUN, RECOVERY ANALYSIS

## TABLES

1	Procedure for Programmed Determination of Turning Points	21
2	Specific-Cycle Phases in Business Cycle Indicators, Programmed and Nonprogrammed Approaches, 1947-67	45
3	Cyclical Counterphases in Business Cycle Indicators, Programmed and Nonprogrammed Approaches, 1947-67	46
4	Cyclical Turning Points in Business Cycle Indicators, Programmed and Nonprogrammed Approaches, 1947-67	49
5	Turning Points in Cumulative Historical Diffusion Indexes, Based on Program-Selected and Staff-Selected Cyclical Turns of Components, 1948-65	54
6	Dates of Peaks and Troughs of Business Cycles in the United States, 1854-1961	69
7	Duration of Expansions, Contractions, and Full Cycles, Nonagricultural Employment and Unemployment Rate, 1933-61	85
8	Reference Cycle Amplitudes in the Unemployment Rate, Absolute and Relative Changes, 1933-61	93
9	Average Amplitudes in Nonagricultural Employment, Relative Changes	96
10	Average Amplitudes in the Unemployment Rate, Absolute Changes	97
11	Recession Analysis, Nonagricultural Employment, Percentage Change From Business Cycle Peaks, 1929-63	152
12	Recovery Analysis, Nonagricultural Employment, Percentage Change From Business Cycle Troughs, 1932-66	156
13	Rank Correlations Between Partial and Full Amplitudes, Nonagricultural Employment, Business Cycle Recessions, 1929-65	161
14	Rank Correlations Between Partial and Full Amplitudes, Nonagricultural Employment, Business Cycle Expansions, 1933-66	169
15	Recovery Analysis, Nonagricultural Employment, Percentage Change From Preceding Business Cycle Peak Levels, 1932-64	171
16	Recovery Analysis, Nonagricultural Employment, Change From Business Cycle Troughs as a Percentage of Levels at Preceding Business Cycle Peaks, 1932-64	172

- |    |   |     |
|----|---|-----|
| 17 | Characteristics of Recoveries Related to Preceding Recessions, Nonagricultural Employment, Reference Cycle Analysis, 1929-66  | 175 |
| 18 | Comparative Cyclical Behavior During Four Recoveries, Sales of a Manufacturing Company and Sales of All Manufactures, 1949-65 | 185 |
| 19 | Comparative Cyclical Behavior During Four Recessions, Sales of a Manufacturing Company and Sales of All Manufactures, 1948-62 | 188 |

## CHARTS

1	Nonagricultural Employment and Unemployment Rate, 1929-65	9
2	Problems of Turning Point Determination	11
3	Bituminous Coal Production and Moving Averages, 1914-38	20
4	Business Cycle Indicators, Turning Points Selected by Programmed and Nonprogrammed Approach, 1947-67	32
5	Cumulative Historical Diffusion Indexes Based on Program-Selected and Staff-Selected Cyclical Turns in the Components, 1948-65	53
6	Recovery Segments and Growth Segments of Expansions, Federal Reserve Index of Industrial Production, 1920-39 and 1946-65	72
7	Reference Cycle Patterns of Similar Amplitude	73
8	Reference Cycle Patterns, Nonagricultural Employment and Unemployment Rate, 1933-61	77
9	Timing of Turning Points Relative to Business Cycle Turns, Nonagricultural Employment and Unemployment Rate, 1929-61	82
10	Phases Included in Averages, Peak-to-Peak and Trough-to-Trough Analyses	86
11	Reference and Specific Cycle Patterns During Two Cycles, Nonagricultural Employment and Unemployment Rate, 1933-38 and 1958-61	103
12	Amplitudes in Programmed Monthly and Quarterly Analyses	116
13	Cycles in Monthly, Quarterly, and Annual Series, Pig Iron Production, 1896-1933	118
14	Recession Analysis, Nonagricultural Employment, Percentage Change From Business Cycle Peaks, 1929-62	154
15	Recovery Analysis, Nonagricultural Employment, Percentage Change From Business Cycle Troughs, 1932-63	158
16	Recession Analysis, Nonagricultural Employment, Percentage Change From Business Cycle Peaks, Simplified Presentation, 1929-62	159
17	Partial Amplitudes vs. Total Amplitudes, Percentage Change and Rank, Nonagricultural Employment, Business Cycle Recessions, 1929-61	162

18	Phase Amplitudes vs. Phase Durations, Nonagricultural Employment, 1929-61	165
19	Recovery Analysis, Nonagricultural Employment, Percentage Change From Preceding Business Cycle Peak, 1932-63	173
20	Recovery Analysis, Unemployment Rate, Percentage Change From Preceding Business Cycle Peak, 1933-63	178
21	Comparative Recession Analysis, Nonagricultural Employment in Texas, Florida, West Virginia, and the United States, Percentage Change During Business Cycles, 1952-62	181
22	Recovery Analysis, Company Sales and Sales of Manufactures, Percentage Change From Trough in Sales of Manufactures, 1949-63	183
23	Recession Analysis, Company Sales and Sales of Manufactures, Percentage Change From Peak in Sales of Manufactures, 1948-61	186
24	Recovery Analysis, New Orders for Durable Goods, Percentage Change From Preceding Reference and Specific Cycle Peak, 1954-64	190
25	Recovery Analysis, Unemployment Rate, Absolute Levels, Arranged Around Business Cycle Troughs, 1949-63	194