

**FARM COST STUDIES
IN THE UNITED STATES**

MERRILL N. BENNETT

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[June 1928]

EUROPEAN SALES AGENTS

GREAT BRITAIN: P. S. King & Son, Ltd., Orchard House, 14, Great Smith Street, Westminster, S.W. 1, London.

MISCELLANEOUS PUBLICATIONS

No. 4

June 1928

FARM COST STUDIES
in THE UNITED STATES

THEIR DEVELOPMENT, APPLICATIONS,
and LIMITATIONS

By

MERRILL K. BENNETT

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FOOD RESEARCH INSTITUTE
STANFORD UNIVERSITY, CALIFORNIA

The Food Research Institute was established at Stanford University in 1921, jointly by the Carnegie Corporation of New York and the Trustees of the Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

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FOREWORD

Broadly stated, the purpose of the present study is to describe and evaluate the work which has been and is being done in the United States in the collection and analysis of statistics of farm costs of production. How such data are collected, who collects them, what purposes they have been intended to serve, how far they are suitable to serve these purposes: all these are topics of some interest and importance. Not long ago agitation was common for the fixation of prices by government on the basis of "cost of production plus a reasonable profit"; today changes in tariff duties involve determination of the difference between costs of production at home and abroad; for many years organized effort has been made to increase farm efficiency through the study of farm costs of production. It is desirable to examine the propriety of employing farm cost data for important purposes like these.

A long-continued study of the literature of farm costs has convinced the present writer that, if the possibilities and limitations of farm cost investigation are to be clearly recognized, more consideration ought to be given to the general theory of cost-and-price relationships in agriculture. Those who have compiled and analyzed the statistics of farm costs have ordinarily approached their problems from the point of view of accountancy. Primarily they have sought accurate methods of expressing costs; and too few attempts have been made to synthesize the existing doctrines of price theory with the statistical material which they have gathered. It is perhaps more proper to say that in many instances the theoretical doctrines have been misinterpreted. A major purpose of the present paper is to point out these misinterpretations.

Consequently a large part of the subsequent discussion is of a theoretical nature.

The study is addressed broadly to farmers and legislators as well as to professional students of economics and farm management. The use of public funds to gather data serviceable for increasing farm efficiency, for price fixing, or for tariff making, is or ought to be a matter of general concern. It has been the intention of the writer to discuss some intricacies of the theory of prices in such a manner that the general reader can follow the reasoning; and the writer hopes that this aim has been achieved. But the study was not designed merely for popular consumption. It is hoped that teachers of economics will find material—historical, statistical, and theoretical—not elsewhere available. It is hoped, in short, that any reader can find herein a sounder and more thorough discussion of the significance of agricultural costs of production than he can discover in any other single source.

The investigation falls naturally into four parts. Chapters i–iii include a generalized description of the forms of statistical data to be found in farm cost studies and of the sources of such data; a historical review of farm cost investigation; and an analysis of the objectives to which investigators have addressed themselves. Chapters iv–vi provide a groundwork for the critical examination of the usefulness of cost study in achieving these objectives—the matter with which we shall be chiefly concerned. In these chapters are considered the methods of collecting cost data, the significance of accounting principles, the nature of variations in farm costs of production, and the causes of the observed variations, with special reference to the question as to how far these variations are subject to control by farmers. Chapters vii–ix deal with cost studies undertaken in furtherance of the general objective of farm management—to increase farm efficiency, or to provide farmers with a basis for making

the best possible choice of enterprises and methods. Chapters x-xii deal with cost studies undertaken in general to influence prices. Here the discussion is more largely theoretical. The relation of agricultural costs to agricultural prices is considered first, and thereafter the theories underlying the use of farm cost data in price fixing and in tariff making.

Conclusions are summarized briefly in chapter xiii. An appendix deals with a technical aspect of farm management cost analysis, the recent proposal to apply the multiple or partial correlation analysis to farm cost data.

Several topics of some importance are not considered in the present study. The first is the subject of account keeping for farmers. Agricultural educational agencies have long been concerned to teach farmers how to keep accounts—either simple financial accounts, by single or double entry, or more involved cost accounts. This subject is excluded not because it is an unimportant type of work involving cost data, but because it has had only an indirect connection with the process of collecting and analyzing statistics from groups of farms.

The second excluded topic, closely allied to the first, is that of the development of sound and usable principles of accounting. Accounting principles are considered only from the point of view of their effect on cost data which are to be used in cost-and-price comparisons. Much discussion about appropriate accounting procedures has raged in the past among farm management investigators, and beyond a doubt changes in accounting procedures have resulted in rendering useless, because incomparable, data gathered chiefly by the route method from the same farms in successive years. But recently farm management cost investigators have practically abandoned attempts either to gather or to compare complete and accurate data on the money costs of producing particular products, so that accounting principles play a far smaller rôle in farm

management investigation than was the case even five years ago. It appears desirable in this study to examine the difficulties to be encountered in currently accepted analytical methods, and hence to ignore methods now abandoned and disputes chiefly of historical interest.

A third topic has not been given the consideration which it perhaps deserves. Farm cost data have more than once been employed in discussions of farm prosperity. But such utilization of data has usually been incidental; cost data have never been collected from specific groups of farms merely to afford comparisons between different farming areas, between different years, and between farming and other pursuits; and one must extend somewhat the meaning of the term "cost data" if one is to include the data on trends in agricultural wages, interest rates, and the like that have been employed in discussions of farm prosperity. The subject of farm prosperity, its measurement and causes, is far too broad a subject to be treated in a study dealing chiefly with data on the costs incurred by specific groups of farmers in producing specific products, especially since these data have not been employed extensively in broad discussions of farm prosperity.

Acknowledgments are due to Dr. Joseph S. Davis, of the Food Research Institute of Stanford University, for invaluable advice and suggestions. The study has been made possible only by the fact that it was conducted and financed as a part of the research program of the Food Research Institute. Through the generosity of the Institute, the author was enabled in the fall of 1924 to visit many organizations which were conducting farm cost studies; and the information secured on this trip, largely through the kindness of workers in the field too numerous to specify, has proved invaluable. For careful reading of the manuscript and many valuable suggestions, the writer is indebted to Professors H. E. Erdman of the University

FOREWORD

ix

of California, Bernard F. Haley of Stanford University, George A. Pond of the University of Minnesota, and to Dr. Carl L. Alsberg, Dr. Alonzo E. Taylor, and Dr. Holbrook Working, of the Food Research Institute. The charts were prepared by Douglas L. King.

M. K. B.

STANFORD UNIVERSITY, CALIFORNIA
June 1, 1928

CONTENTS

| CHAPTER | PAGE |
|---|------|
| I. SOURCES AND TYPES OF FARM COST STATISTICS..... | 1 |
| Scope of the inquiry—Agencies compiling statistics and their publications—Farm costs and farm business expenditures—Reasons for diversity in types of data | |
| II. HISTORICAL DEVELOPMENT OF FARM COST INVESTIGATION | 12 |
| Developments before 1902—Developments after 1902—Influences responsible for growth | |
| III. THE OBJECTIVES IN FARM COST INVESTIGATION..... | 29 |
| Two general types of objectives—Price-controlling objectives—Efficiency-increasing objectives—Current views on the farmer's production problem—Divergent views—Bibliographical note | |
| IV. THE COMPILATION OF FARM COST DATA..... | 41 |
| Collection of data—Accounting principles: the elements of cost—Allocation—Valuation and opportunity cost—Significance of accounting principles in a specific study—Bibliographical note | |
| V. VARIATIONS IN COST..... | 66 |
| Types of variations—Differences in average costs—Differences in individual costs—Changes in average costs—Changes in individual costs | |
| VI. CONTROLLABLE AND UNCONTROLLABLE CAUSES OF VARIATION | 99 |
| The theorist's position—Function of the efficiency expert—A hypothetical problem | |
| VII. FARM COSTS AND FARM EFFICIENCY: SOME GENERAL CONSIDERATIONS | 118 |
| Types of investigation in recent years—Criteria for evaluating farm management investigations—Some fundamental limitations of farm cost inquiry | |

xii *FARM COST STUDIES IN THE UNITED STATES*

| CHAPTER | PAGE |
|--|------|
| VIII. TYPES OF FARM MANAGEMENT INVESTIGATION IN RECENT YEARS | 133 |
| The uses of quantitative cost data: production standards—The application of correlation analysis to quantitative data—Data on unfamiliar machinery and methods—The farm business analysis survey: factors affecting profits—Replanning farms for profit—The co-operative farm management service | |
| IX. A PROGRAM FOR FARM MANAGEMENT INVESTIGATION .. | 168 |
| The nucleus of a program—Undesirable features of the existing program—Desirable supplementary types of investigation—Bibliographical note | |
| ✓X. THE THEORY OF COST-AND-PRICE RELATIONSHIPS.... | 183 |
| The theoretical statement—Common misconceptions of the theory—Bearing of statistical investigation on price theory—Qualifications of the theoretical analysis—Bibliographical note | |
| ✓XI. PRICE FIXING AND FARM COSTS..... | 206 |
| History of American price regulation—Popular and academic theories of price fixing—Accounting principles and variations in costs—Weaknesses of the bulk-line theory—Bibliographical note | |
| XII. TARIFF MAKING BY COST DETERMINATION..... | 232 |
| Employment of farm cost data before 1922—Employment of cost data since 1922—Theoretical criticisms of the cost equalization doctrine—Practical objections—Bibliographical note | |
| XIII. CONCLUSIONS | 260 |
| APPENDIX. CORRELATION ANALYSIS IN FARM MANAGEMENT RESEARCH | 266 |

CHARTS AND TABLES

CHARTS

| CHART | PAGE |
|--|------------------|
| 1. Differences in Costs per Unit of Producing Cotton and Potatoes on Large Numbers of Farms Widely Separated Geographically | 76 |
| 2. Differences in Costs per Bushel of Producing Winter and Spring Wheat on Large Numbers of Farms Widely Separated Geographically..... | 77 |
| 3. Differences in Costs per Unit of Producing Cotton, Spring Wheat, Winter Wheat, and Sugar Beets on Small Numbers of Farms Located within Counties. | 80 |
| 4. Differences in Costs per Unit of Producing Tobacco and Milk on Farms Located within Restricted Areas | 81 |
| 5. Changes in the Cost per Hundredweight of Producing Milk on 108 Farms in New York, 1921 to 1922..... | 88 |
| 6. Changes in Labor Incomes on 108 New York Farms, 1921 to 1922..... | 89 |
| 7. Changes in Rank in Labor Income on 23 Farms in the Gallatin Valley, Montana, 1919 to 1922..... | 94 |
| 8. Changes in Rank in Labor Income on 25 Farms in Washington County, Ohio, 1912 to 1918..... | 95 |
| 9. Changes in Rank in Labor Income on 60 Farms in Dane County, Wisconsin, 1913 to 1917..... | 96 |
| 10. Changes in Rank in Labor Income on 100 Farms in Clinton County, Indiana, 1910, 1913 to 1918.. | <i>facing</i> 96 |

TABLES

| TABLE | PAGE |
|---|------|
| 1. Showing the Percentage of Production above, below, and on a Line with Average Costs and Average Receipts. Data from Twenty Dairies in the Alameda, Contra Costa, and Santa Clara District..... | 56 |
| 2. Differences in Quantitative Costs of Cereal Production in Four Regions of North Dakota, 1921..... | 73 |
| 3. Farm Costs per Acre and per Bushel of Producing Corn and Wheat in the United States by Geographical Divisions, 1922-26..... | 86 |
| 4. Changes in Quantitative Inputs in Feeding Dairy Cows on 21 Farms in Michigan, 1914 to 1915..... | 91 |
| 5. Individual Costs per Acre of Wheat Production on 24 Owned Farms, Grand Forks County, North Dakota, 1919 | 109 |
| 6. Three-Year Average Hours of Labor and Quantities of Materials Used per Acre in the Production of Designated Crops, 1919-21..... | 135 |
| 7. Labor Requirements on 10 Acres of Various Crops in Arkansas, by Months..... | 136 |
| 8. Cultural Practices on 47 Farms in Barron County, Wisconsin—Potatoes, 1919 | 137 |
| 9. Net Relation of Various Feeding Practices to Feed Requirements for Beef Production, and for Pork By-Product | 143 |
| 10. Estimated Grain Input per Pound of Gain for a Steer Weighing 1,000 Pounds at Beginning of Feeding Period, by Rate of Feeding Grain and Length of Period | 144 |
| 11. Probable Daily Gains per Head from Feeding Various Combinations of Corn and Alfalfa Hay to Steers of 847 Pounds Initial Weight for 138 Days..... | 145 |
| 12. Estimated Cost of Producing Beef per 100 Pounds of Gain at Varying Prices of Corn..... | 145 |

CHARTS AND TABLES

xv

| TABLE | PAGE |
|--|-------------|
| 13. Estimated Cost of Beef per 100 Pounds of Gain at Varying Prices of Hay..... | 146 |
| 14. Probable Gain per Day and Total Gains from Feeding Fixed Total Quantity in Periods of Different Lengths to 835-Pound Steers..... | 146 |
| 15. Estimated Cost of Beef per 100 Pounds of Gain, Feeding a Fixed Total Quantity of Feed in Periods of Different Lengths | 147 |
| 16. Tariff Duties on Selected Agricultural Products, 1890-1922 | 237 |

APPENDIX TABLES

| | |
|---|-----|
| 1A. Disposition of Wheat on 5 Farms in Jackson County, Kansas, 1920 | 272 |
| 2A. Variables Employed in Selected Correlation Analyses of Factors Affecting Farm Profits..... | 274 |
| 3A. Net Coefficients of Correlation (Rectilinear) and Their Probable Errors, Obtained in Selected Farm Cost Correlation Analyses..... | 280 |

**FARM COST STUDIES IN THE UNITED STATES:
THEIR DEVELOPMENT, APPLICATIONS, AND
LIMITATIONS**

CHAPTER I

SOURCES AND TYPES OF FARM COST STATISTICS

This study undertakes a historical and critical examination of the literature of farm cost investigation in the United States, with the ultimate purpose of determining how far such investigation has contributed and may contribute to the solution of important economic problems. It is desirable, however, to approach the subject through an analysis of the fundamental statistical material which has been collected in farm cost studies. This material includes something more than data on the costs of producing specific farm products. A convenient term serving to include all of the forms of statistical data which have been collected is "farm business expenditures." Statistics of the business expenditures of farmers have been employed in organized efforts to teach farmers the most profitable methods of organizing and managing their farms, in discussion of the theory of prices, in price fixing, and in the calculation of tariff duties. These are important ends, bearing upon far-reaching problems of public policy in the United States. It is desirable to evaluate the adequacy of statistics of farm business expenditures in providing a basis for the general adoption either of a specific course of action or of a theory. In so far as statistics of farm business expenditures are unreliable, misleading, and subject to general misinterpretation, the theoretical conclusions drawn from them are untrust-

worthy, and the public or private conduct based upon the conclusions is misguided.

Merely to make clear the degree to which statistics of farm business expenditures provide an adequate basis for important generalizations is presumably sufficient justification for the present inquiry. The subject is complex, and clarification is needed. But practical reasons for the inquiry also present themselves. The compilation of statistics of farm business expenditures is costly; it has been pursued almost entirely by agencies supported by public money; and whether or not the money has been well spent is a question open to discussion. Further, there is reason to suspect that some investigational agencies compile and analyze statistics of farm business as a matter of routine; inquiries are in some degree undertaken because they are customary rather than because they are unmistakably significant or useful. A comprehensive critical survey of the investigations has not yet appeared. From still another point of view such a survey seems useful. Statistics of farm business expenditures, and conclusions drawn from them, have emanated chiefly from investigational agencies created and maintained for the purpose of ministering to the welfare of the farming population. Many published studies have shown that large numbers of farmers have incurred costs of production exceeding the prices received for the products. The expansion of farm operations in the face of this fact gives rise to the suspicion either that bias has existed among the compilers of data, or that the data have been misinterpreted. A survey of the literature should make for clearer understanding.

SCOPE OF THE INQUIRY

The present study deals with statistics of business expenditures incurred by groups of farmers. It does not deal with business expenditures incurred by individual

farmers outside of groups, and published as such. It does not deal with business expenditures incurred on experimental farms conducted by public or private agencies. Statements of business expenditures upon single farms, experimental or ordinary, have been exceedingly common. They may be found in the agricultural press even before the Civil War; they have occurred in large numbers as addenda to reports of feeding, fertilizer, and field experiments conducted by agricultural experiment stations. These statements, and the contemporaneous discussion of them, are not without interest, particularly with respect to the tendency of interpreters to regard a statement from one farm as representative of many farms; but they do not constitute statistical investigations. An investigation of farm business expenditures of the sort here considered involves necessarily the collection, and usually the analysis and interpretation, of data from a group of ordinary farms. The group must ordinarily contain at least fifteen farmers, though occasionally significant studies have been based upon data from a smaller number.

We shall deal only with statistics of business expenditures on farms, not with expenditures of farmers for the food, clothing, and recreation which they find desirable; and not with indirect expenditures commonly said to be borne by farmers, such as transportation costs from country points to central markets. The final item in farm business expenditures is ordinarily to be regarded as the hauling of produce from the farm to the local market. Rigid delimitation of the meaning of business expenditures is not, however, feasible or desirable at this point.

We shall further be concerned chiefly with original data and with discussions based upon original data. This restriction removes from consideration a mass of material appearing in the agricultural press. Investigators have frequently published statistics of farm business expendi-

tures and comment upon them in preliminary or popularized form in farm journals. But both the statistics and the conclusions ordinarily appear in more pretentious publications, so that consideration of these news items would constitute mere duplication of effort. Not infrequently, however, articles of importance have appeared in economic journals, and these have been considered.

The present inquiry is confined to statistics of farm business expenditures in the United States. Such statistics have been compiled in Canada and in continental European countries, notably Germany, Switzerland, and Denmark, where the keeping of accounts on farms has long been practiced, and more recently in England. But in the United States, statistics of farm business expenditures have been employed for purposes unfamiliar to foreigners—for tariff making and price fixing, for example. Even in the study of farm management American investigators appear to have taken the lead. A comprehensive discussion of American statistics of farm business expenditures will be, it is hoped, not without significance to European readers concerned primarily with statistics applicable only to European conditions. But the complexity of American statistics alone precludes direct discussion of other data.

American statistics of farm business expenditures were published as early as 1873. Ten or a dozen statistical investigations were conducted before 1900. But systematic collection of statistics did not begin until after 1902; and publications were on the whole scattered and unimportant before 1910. The present inquiry is based upon an examination of statistical material appearing at any time after 1862; but the discussion is largely confined to data appearing after 1910, when statistics of farm expenditures may be said to have begun to attract more than sporadic attention; and illustrations are drawn chiefly from the more important and the more recent publications, particu-

larly those appearing after 1920. Publications appearing before January 1927 have been given attention so far as they could be secured. In general, the present inquiry covers the period January 1902 to January 1927.

AGENCIES COMPILING STATISTICS AND THEIR PUBLICATIONS

Original statistical investigations of farm business expenditures in the United States ordinarily have been conducted by official or semi-official rather than by private agencies. Among these, the Bureau of Agricultural Economics of the United States Department of Agriculture, like each of its predecessors,¹ is pre-eminent. In its collection of statistics of farm business expenditures it sometimes acts independently, sometimes in co-operation with the various state agricultural experiment stations. These stations on occasion conduct numerous inquiries independently; some have also co-operated with the Farm Bureau Federations. State boards of agriculture have occasionally gathered statistics. County agents, farm management demonstrators, extension services and departments of rural economics in the state agricultural colleges, all have undertaken, or at least contributed to, the collection, publication, and interpretation of statistics. The United States Tariff Commission and its predecessor, the Tariff Board, have collected and published data on farm costs of production, as has the Federal Trade Commission. The United States Census Bureau has compiled data respecting several classes of expenditures (labor, fertilizers, and others).

Most of these are official agencies—the Department of Agriculture, the Tariff Commission, the Federal Trade Commission, the Census Bureau, the state boards of agri-

¹ The existing Bureau of Agricultural Economics represents a fusion of the old Office of Farm Management and Farm Economics, the Bureau of Crop Estimates, and the Bureau of Markets.

culture. Others, particularly the agricultural experiment stations, colleges, and extension services, may be regarded as semi-official. These agencies have conducted by far the greater number of the statistical inquiries; very few have been conducted by farmers' organizations, private persons, and agricultural journals.

Publications issued by these agencies provide the great bulk of material upon which the present inquiry is based. The books and journal articles emanating from private investigators and commentators constitute a relatively small proportion. It has been necessary, however, to make selection among the official and semi-official data. Only the more pretentious publications—bulletins and reports—have received serious consideration. Many extension bulletins, reviews of progress in annual reports, press releases, and the like have been ignored, but many of these unimportant documents have been examined with some care before being discarded.

A complete and formal bibliography appears to be unnecessary, in view of readily available lists. Bulletins of the United States Department of Agriculture are easily obtained, and a list of these bulletins, from which those dealing with farm costs may readily be noted by titles, appears in *Publications of the U.S. Department of Agriculture* (Washington, May 1926). Bulletins published by the agricultural experiment stations since their foundation to 1925 are listed in *U.S. Department of Agriculture Bulletin 1199* (May 1924) and in two supplements to this bulletin, appearing in August 1924 and September 1926. Classified lists of publications containing statistics of specific costs of production were issued in 1919, in mimeographed form, by the Bureau of Agricultural Economics of the United States Department of Agriculture. These cover the great majority of important studies. The *Journal of Farm Economics*, with convenient indexes, is an invaluable source for discussions of data. It has seemed

undesirable to reprint an extensive list of publications and articles readily accessible in these lists; moreover, many are not important. Reference to really significant sources appears in footnotes; and certain chapters, to which less well-known documents contributed, are followed by bibliographical notes listing the significant literature.

FARM COSTS AND FARM BUSINESS EXPENDITURES

We have said that the present inquiry deals with statistics of "business expenditures incurred by groups of American farmers"; yet we shall have occasion to speak chiefly of "farm cost studies" or "farm cost investigation." Farm costs and farm expenditures are not strictly synonymous terms. The former has been chosen for its familiarity. It is possible to collect statistics of farm business expenditures which are not strictly statistics of farm costs of production. Thus one may obtain from a group of farmers their gross yearly expenditures in terms of money for feed, fertilizers, wages, seed, machinery upkeep, interest on indebtedness, taxes, and the like. These constitute part of farm business expenditures; and they may be spoken of as part of farm costs of production. But if these expenditures are not allocated to the different products which the farmer produces, or to different productive units like the acre of land or the head of live stock, the application of the term "cost of production" violates customary usage. The essential point is that the term "farm business expenditure" may be taken to include all types of farm cost statistics, while farm cost statistics do not include certain types of farm business expenditures.

It is possible to express statistics of farm business expenditures in a wide variety of forms. The most important single distinction is that between allocated and unallocated expenditures—between statistics of farm costs properly so called, and statistics merely of gross expendi-

tures. Both sorts of statistics may on occasion yield statistics of profits per farm, when brought into juxtaposition with statistics of receipts. A second important distinction is to be observed between types of allocated cost statistics; costs may be expressed in terms of money or in terms of quantities of labor and materials expended in production. Not all of the cost items, of course, are amenable to expression in purely quantitative terms, e.g., taxes, insurance, interest on investment, and depreciation. Further, it is obviously meaningless in most instances to express quantitative costs in terms of costs per unit of product; for farm management purposes, it is more desirable to know the amount of labor expended on an acre than on a bushel of wheat.

Broadly speaking, we have to deal with the following types of statistics of farm business expenditures.

1. *Money costs per unit of product.* These are costs per bushel of wheat, per pound of pork, per quart or hundred-weight of milk. Such data are essential for those who wish to compare costs with prices, prices being customarily expressed per unit of commodity. From accounting records they are computed by dividing total cost on a farm by the number of units of product produced on the farm.

2. *Money costs per productive unit.* These are costs per acre of crops or per head of live stock. They are total costs divided by number of acres or number of live stock.

3. *Money or quantitative costs per operation.* Investigators have occasionally desired to attack specific problems respecting the relative economy of conducting certain farm operations by different methods. Plowing versus listing for corn is an example. Such comparisons can be and have been made on the basis of money costs or of quantitative costs. In such investigations no attempt need be made to obtain either gross expenditures per farm or money costs per unit of product or per acre.

4. *Quantitative costs per productive unit.* Of these the commonest forms are quantitative costs per acre of specific crops and per head of live stock. Such cost data take no account of the prices of the quantitative cost elements or of the cost elements not amenable to expression in quantitative terms.

5. *Unallocated farm business expenditures.* These may be described as costs of farm operation per farm when all expenditures for the farm business are obtained.

6. *Computed costs.* These are money costs per unit of product or per productive unit, obtained not by enumeration or record keeping, but by computation. The basis for such computation is usually quantitative cost per productive unit, obtained by the customary methods. To these quantitative requirements are applied cost rates obtained from different sources, as for instance statistics of wage rates for agricultural labor. The methods employed in reaching computed costs have been highly diverse. Computed costs are always average costs not amenable to expression as arrays of costs incurred by various individual farmers of the group.

All these various types of statistics of farm business expenditures can theoretically be presented either as time series or as frequency series.¹ Very few examples of time series showing farm business expenditures on the same farms for a series of years exist. We possess more examples of average costs per acre applicable to several years, and average money costs per unit and per acre incurred in various geographical areas in a series of years, but even these are few. There exist chiefly statistics of farm business expenditures obtained from groups of farms in single years only. In the majority of publications only averages of farm business expenditures are

¹ That is, one can study the cost of producing wheat on each of a number of farms over a series of years; or one can study the costs incurred on a number of farms in one year only.

presented. Arrays¹ of expenditures incurred by the individual farmers within the group are by no means commonly published; only within recent years has the significance of the array been recognized.

REASONS FOR DIVERSITY IN TYPES OF DATA

The striking diversity of types of statistics of farm business expenditures is due chiefly to the variety of purposes which the statistics have been intended to serve. Certain investigators have sought money costs per unit of product. The money cost per bushel of wheat is required if the price of wheat is to be fixed on the basis of "cost of production plus a reasonable profit"; a similar figure is required if tariff duties are to be established to equal the difference in cost of production at home and abroad. But unallocated expenditures per farm may be thought to suffice if an attempt is being made to ascertain the factors affecting farm profits. Quantitative costs per acre may be thought to suffice in attacking the problem of reorganization of farms. The investigator employs different types of statistics as the problems in hand differ.

In general, the investigators of farm business expenditures fall into two broad classes: those concerned with the use of data in price fixing, tariff making, and discussion of cost-and-price relationships; and those concerned with teaching farmers how to organize and manage their farms most profitably. The interest of the first group lies chiefly in the analysis and interpretation of statistics of money costs per unit of product. The interest of the second group lies not only in this type of statistics, but in the other types as well. To this second group, in fact, the origination of these other types is largely due. Historically, money costs per unit of product first received attention. Money costs per productive unit were next employed.

¹ An array is merely an arrangement of costs incurred on farms in a single year according to the size of the costs—from low to high or high to low.

Statistics of unallocated farm business expenditures were collected still later. The collection of quantitative costs developed later still, in recognition of difficulties involved in placing valuations upon certain items of cost. Computed costs were a relatively late development. Money and quantitative costs per operation have never been common, and cannot be assigned a particular place in the chronological sequence. These developments were closely linked with the development of the new subject of farm management. As new problems in the field appeared, new methods of attacking them were sought; and diversity in the types of statistics of farm business expenditures developed.

In subsequent chapters we shall have to deal at some length with statistics of money costs per unit of product, the type most commonly employed in discussion of cost-and-price relationships. Statistics of quantitative costs and of unallocated expenditures, however, require some attention when we come to consider the procedure of farm management investigators in seeking to increase farm efficiency. With census data we are not concerned, and money costs per productive unit as well as computed costs require little attention. Most of the critical discussion hinges about variations in costs; and the types of statistics in which only averages have appeared or can appear are of secondary importance.

CHAPTER II

HISTORICAL DEVELOPMENT OF FARM COST INVESTIGATION¹

The statistical investigation of farm costs of production is commonly said to have begun in 1902, when the first attempt was made to secure accurate accounting records from a small group of farms in Minnesota. Prior to 1902, however, considerable interest had been shown in farm costs; and some true statistical investigations were made. The development of farm cost investigation does not fall into well-defined historical periods; but for convenience we may consider separately the work done before and after 1902, the commonly accepted date of the beginnings of cost investigation.

DEVELOPMENTS BEFORE 1902

Mere statements of the costs incurred by various individuals in producing numerous sorts of crops and live stock occur even before 1870 in the agricultural press, in reports of the meetings of agricultural societies, and in state and federal reports.² Often these items appear to have been motivated merely by the desire to comment upon the perennially interesting topic of profits; but occasionally the writers sought to show conclusively the desirability of abandoning old practices or products and of undertaking new ones. Not a few cost statements dealt either with entirely new crops like the sugar beet, jute, and hemp, or with crops new to the locality of the com-

¹ Most of the substance of the present chapter has been published in the *Quarterly Journal of Economics*, February 1926, XL, 273-94.

² See, for example, the *Annual Reports* of the U.S. Department of Agriculture from 1862 to 1877, under the heading "Current Facts in Agriculture," sub-heading "Miscellaneous."

plers. These efforts to introduce new crops by the aid of cost data were participated in by the United States Department of Agriculture and the agricultural experiment stations, particularly with regard to sugar beets and sorghum for sugar production.¹

Most of the cost statements appearing before 1902 were incidental to reports of feeding and fertilizer experiments conducted by the agricultural experiment stations. The major purpose of such experiments was to ascertain what rations and fertilizers were most satisfactory from a chemical standpoint, but cost data were frequently added in order to demonstrate the relative profitableness of different rations and fertilizers. Such cost statements were not uncommon even before the granting of federal aid to the agricultural experiment stations in 1888 and the subsequent expansion of agricultural research. Between 1888 and 1902 they increased greatly in number,² and increasing emphasis was placed on the accuracy and completeness of the cost figures.

These cost statements compiled by individual farmers or by investigators in the experiment stations were not, however, statistical in nature. Not only were costs given in incomplete form, but they referred either to single farms or to cultivation under experimental conditions. They serve to show that interest in costs of production existed before 1902, and that the interest was growing. They illustrate the prevalence of the fallacious ideas that costs do not vary greatly from farm to farm and from year to year,³ and that costs obtained from a single farm may be regarded as representative of costs incurred

¹ For fifteen years before the Spanish-American War the Department of Agriculture waged a strenuous campaign to render the United States self-sufficient in sugar production.

² In 1888 and 1889, twelve of the agricultural experiment stations published cost statements attached to reports of feeding experiments; in 1900 and 1901, the number was twenty-eight.

³ See below, chapter v.

throughout a wide region. Otherwise these cost statements are of no significance.

Nevertheless a dozen true statistical investigations of farm costs were conducted before 1902, chiefly by the statistician of the United States Department of Agriculture and by the Kansas State Board of Agriculture. In 1876 the statistician of the United States Department of Agriculture, employing the mail questionnaire and crop correspondents, tabulated the cost of cotton production.¹ In 1887 the New Jersey Agricultural Experiment Station presented the costs of producing sorghum as incurred by six farmers.² In 1890 the Kansas State Board of Agriculture published the average costs of producing wheat, corn, and cattle in Kansas, reports being obtained from correspondents in each county but one.³ In 1893 the Texas Agricultural Experiment Station published the costs incurred by thirteen planters and the station itself in growing cotton.⁴ In 1894 the Department of Agriculture investigated the costs of growing wheat and corn as reported by crop correspondents;⁵ and the Kansas State Board of Agriculture presented figures on the costs of wheat production incidental to a study of the feeding of wheat to animals.⁶ In 1896 the Kansas State Board of Agriculture again investigated through its correspondents the cost of producing corn, chiefly with a view to determining if plowing or listing were the cheaper method.⁷ Throughout 1897 two farm journals, the *American Agriculturist* and the *Orange*

¹ U.S. Department of Agriculture, *Report*, 1876, pp. 114-52.

² *Eighth Annual Report*, 1887, pp. 114-60.

³ *Quarterly Report*, March 31, 1890, pp. 5 ff.

⁴ G. W. Curtis and J. W. Carson, *Cost of Cotton Production and Profit per Acre* (Bulletin 26), March 1893.

⁵ "Expense of Raising Wheat and Corn," *Report of the Statistician*, n.s. No. 113, March 1894.

⁶ F. D. Coburn, "Feeding Wheat to Farm Animals," *Quarterly Report*, September 30, 1894.

⁷ F. D. Coburn, "Corn. Its Planting, Cultivation, Handling, Utilization, Cost, and Values" *Tenth Biennial Report, 1895-96*, pp. 1-119.

Judd Farmer, investigated the cost of corn production by inducing "a large number" of farmers to keep day-to-day records on prepared blank forms.¹ In the same year statistics of the cost per acre of growing the staple crops in each county were published by the Kentucky Bureau of Agriculture, Labor, and Statistics, without comment or explanation.² In 1898 an elaborate report on the costs of production and values of corn, wheat, oats, rye, and barley was issued by the Bureau of Labor of Wisconsin.³ In the same year a bulletin dealing with corn and oats was issued by the Illinois Agricultural Experiment Station.⁴ The last of the statistical cost investigations appearing before 1902 emanated from the Division of Statistics of the United States Department of Agriculture in 1899, and dealt with cotton.⁵ The foregoing list covers the more important examples of statistical cost inquiry before 1902, though a few non-statistical investigations of some interest appeared in addition to the cost statements mentioned on page 13.⁶

These early investigations are noteworthy for the methods employed in gathering data and for the conclusions drawn from them. Two methods were used: the mail questionnaire was exemplified in all of the inquiries of the United States Department of Agriculture, the Kan-

¹ This investigation is reported in *The Book of Corn*, by Myrick and others, in chapter xv, "Cost of Growing Corn," by B. W. Snow.

² *Twelfth Biennial Report, 1897*, pp. 314-17.

³ *Eighth Biennial Report, 1897-98*, pp. 2-196.

⁴ N. A. Weston, *The Cost of Production of Corn and Oats in Illinois in 1896* (Bulletin 50), February 1898.

⁵ J. Hyde and J. L. Watkins, *The Cost of Cotton Production* (U.S. Department of Agriculture, Division of Statistics Bulletin 16), 1899.

⁶ In 1893 the Nebraska Agricultural Experiment Station published a study (Bulletin 29, April 1893) by C. L. Ingersoll and O. L. Perin dealing with the cost of crops on the station farm, of interest for the accompanying discussion of the importance of cost inquiry. Similar studies were published by the Wyoming Agricultural Experiment Station in 1894 and 1895 (Bulletins 17 and 25), the latter of interest chiefly for its comparisons of cost data not properly comparable.

sas State Board of Agriculture, and the Wisconsin Bureau of Labor; the farmer's record plan was exemplified in the New Jersey investigation of sorghum costs and the *Orange Judd Farmer* investigation of corn. The former method involved the collection of the farmers' estimates of cost, the latter of the farmers' records of cost. These two methods were the only ones known before 1902.

For the most part these early studies dealt with the "vexed question" of farm prosperity: what was the margin between farm costs and farm prices, and how could it be widened? There were exceptions: the New Jersey study of 1887 was utilized merely to show that sugar could profitably be produced from sorghum; two of the Kansas investigations and the Texas inquiry dealt with the relative profitableness of different farm practices; the Illinois inquiry of 1898 was addressed to the question of determining costs, not to their interpretation.¹ In the remainder, in all of which cost-and-price comparisons were explicitly or implicitly made, three points of view appeared. The *Orange Judd Farmer* inquiry found the average cost per bushel of corn to be so low that "if sold from the crib at 21.5 cents it would net the producer 6 per cent on his permanently invested capital," the implication being that a sufficiently wide margin between cost and price existed to insure farm prosperity. Similarly the Wisconsin investigation found the relation of costs and prices not to be notably unfavorable to farmers, largely because "the prevailing low price of grain is also largely offset by a reduced cost of production through improved machinery and methods." The Kansas State Board of Agriculture investigation of 1890 showed costs much higher than prices; and here the general tone of the inquiry may be summed up in the complaint of a correspondent, "Something must and will be done for the farmer." The

¹ The Kentucky investigation of 1897 gives no clue to its purposes, since no comment or explanation accompanied the cost statistics.

Department of Agriculture study of corn and wheat production costs in 1894 found average costs exceeding average prices; but rather than assuming prices to be unfairly low, as was done in the Kansas inquiry, it was said that costs were so high that farmers must abandon one-crop farming and turn to rotation of crops in order to save themselves.

Before 1902, it is apparent, the chief cause of the investigation of farm costs lay in the depressed prices of agricultural products during the 1890's. Farm prosperity was threatened, and investigators began to support their analyses and suggestions for remedial measures by determination of costs, prices, and profits. In view of the severity of the depression, it is perhaps surprising that cost data were not more frequently and explicitly brought to bear upon the question of prosperity. The Populist Party, however, apparently made no use of them. The explanation lies in the fact that monetary problems then occupied men's minds, and monetary difficulties were regarded as the source of all evils, the price depression among others.

Yet it is apparent from the large number of incidental cost statements appearing during the 1890's that increasing attention was being paid to problems of farm management, though the term was then practically unknown. The growth of this type of investigation, the essence of which is economical production or low cost, was seemingly inevitable, not only on account of the pressure placed upon farmers by unusually low prices, but on account of the increasing difficulty of escaping the pressure by recourse to cheap and productive new land. With the passing of the period of low prices a part of the pressure remained, and the idea of teaching farmers to produce more economically became an increasingly important influence on the expansion of cost inquiry after 1902.

DEVELOPMENTS AFTER 1902

After 1902, the significant aspects of American farm cost investigation were the origination of two new methods of collecting data and the extensive growth of cost inquiry. The first of these new methods was the route method inaugurated in 1902; the second was the survey method.

In 1902 Professor Willet M. Hays of the University of Minnesota, in co-operation with the Statistician of the United States Department of Agriculture, began systematic cost inquiry of the type later known as the route method. Small groups of farmers (fifteen in number in 1902 and 1903, eight in 1904 and for a time thereafter) in three different localities were induced to co-operate in keeping detailed records with a special paid agent (the "route statistician") who visited each farm daily. This agent summarized each farmer's accounts on specially prepared forms, and the forms were forwarded to Professor Hays for record and analysis.

Inquiry by the route method grew slowly. Before the war it was employed only by the Minnesota and Illinois stations; but after the war it suddenly became popular. This post-war growth was encouraged by a committee of experts summoned by the Secretary of Agriculture to suggest recommendations for the reorganization of the work of the Office of Farm Management, the leading agency concerned with farm cost investigation.¹ The committee, in its report published in March 1919,² laid some emphasis on the accuracy of cost accounting by the route method. By 1920 cost routes were in operation in at least 6 state agricultural experiment stations. In 1924 routes were in

¹ The reorganization was indirectly due to the war-time price-fixing experiences of Congress. A survey to ascertain costs of wheat production was conducted by the Chief of the Office of Farm Management, but was regarded as unsatisfactory by Secretary Houston and certain Congressmen. The Chief resigned and reorganization of the Office followed.

² U.S. Department of Agriculture, *Office of Secretary, Circular 132*.

operation in 14 states; in 1926-27 there were 23 states operating 35 routes.¹

The second new method of collecting cost data, the survey, is best described by reference to the words of its originator, Dr. G. F. Warren of Cornell University.²

The first start in agricultural surveys at Cornell was the work of L. H. Bailey, who made a number of field studies of horticultural conditions in New York. In 1903 Professor John Craig thought it desirable to start an orchard survey, and the work was assigned to the writer, because he had been studying the then new subject of soil-mapping. The intention was to map the soil and study its relationship to apple-growing. It soon became evident that, in the region studied, other factors were more important than the soil. The writer therefore changed from a soil survey to a statistical survey.

In teaching classes in farm management, Professor Hunt required each student to get a financial record of his home farm and calculate the labor income. The writer believed that this method could be extended so as to include all the farms in a region. In 1907 such records were obtained from all the farms in two townships . . . the records were inaccurate. For this reason they were never published . . . Since that time surveys have been made in two other counties.

Believing that the survey method could be used for studying the cost of production of farm products, a study of the cost of producing milk was started in 1912 in Delaware County. In order to check the work the same farms were again visited in 1913. . . . In 1913 the cost of producing potatoes was studied by this method. . . .

The survey method thus involves the collection of farmers' estimates of farm business expenditures by personal interview; exact records are not obtained. It may be regarded as an extension of the mail questionnaire

¹ See W. E. Grimes, *Preliminary Report of a Survey of Economic Research in Agriculture in the United States* (Mimeographed, 1927).

² G. F. Warren, *Agricultural Surveys* (Cornell Agricultural Experiment Station Bulletin 344), April 1914, p. 424. The question of origin is not altogether clear. In 1907 the federal Office of Farm Management had conducted an inquiry into the cost of filling silos on 31 farms. In 1910 the U.S. Tariff Board employed the survey method in its study of the cost of producing wool.

method, whereby a longer list of questions can be asked and certain checks obtained; but both of these methods differ from the route and farmer's record method in that estimates, not records, are secured.

The survey method grew in favor after 1912 and was adopted and continued not only by various state agricultural experiment stations, but also by the federal Office of Farm Management; and it continues to be employed by the United States Tariff Commission. At present the survey method is generally regarded with as much favor as the route method. In 1926-27, 29 states were conducting 57 projects in farm management by the survey method.

The questionnaire method and the farmer's record plan have never been so extensively employed. The former was revived by the Division of Statistics of the United States Department of Agriculture in 1910, and since 1923 it has been employed in yearly cost inquiries by the Bureau of Agricultural Economics; and it is occasionally used in investigations of special problems such as the experience of farmers with new machines. The farmer's record plan was the method of cost investigation first employed (in 1906) by the Office of Farm Management, and a few agricultural experiment stations utilized it. From 1912 to 1918 this method was largely employed; subsequently it was in many instances supplanted by the route and survey methods. It is now used on 17 projects in 9 states.

The general growth of the statistical investigation of farm business expenditures is not amenable to numerical measurement, but a fairly distinct impression can be obtained from the following facts.

In 1902 no organizations except the Division of Statistics in the federal Department of Agriculture and the Division of Agriculture in the University of Minnesota were directly and systematically concerned with farm cost inquiry. The federal Office of Farm Management,

organized in that year, was then conceived merely as an agency for translating the accumulated scientific knowledge of the Department of Agriculture into farm practice, and at first it was an unimportant appendage to the Bureau of Plant Industry. Farm management and agricultural economics were subjects taught in only a few scattered agricultural colleges, and cost investigation as a field for research in these subjects was scarcely thought of.

At present, farm management and agricultural economics are recognized subjects in practically all of the agricultural colleges, and cost investigation is regarded as a field for research in most of the agricultural experiment stations. Among these stations, 82 projects involving farm cost investigations were reported in 1920, 87 in 1921, 96 in 1924-25, and 190 in 1925-26,¹ the recent heavy increase being due largely to increased funds available through the Purnell Act of February 24, 1925. The federal Office of Farm Management is now merged, together with the former Bureau of Markets and Bureau of Statistics (the Bureau of Crop and Live Stock Estimates at the time of the merger), into the influential Bureau of Agricultural Economics. Cost inquiry, largely in co-operation with the state experiment stations, apparently holds co-ordinate rank with the investigation of marketing and with the crop-estimating service of the reorganized bureau. An American Farm Economic Association is flourishing, and many of its members are concerned with cost inquiry. Farm cost investigation has become an important duty of the United States Tariff Commission. If \$10,000 of public money was spent on farm cost inquiry in 1902, \$500,000 is a conservative estimate of what was so spent in the year

¹ These figures were obtained merely by counting the number of projects listed in the mimeographed *Classified List of Projects Carried on by the Agricultural Experiment Stations* (Washington) for each of the years noted, under the captions "Cost of Production and Accounting," "Farm Labor," "Farm Organization and Management," and (for 1925-26 only) "Economics of Production." No attempt has been made to remove duplications between categories.

1925-26. The increase in systematic farm cost investigation has been well over fifty fold in the past twenty-five years, as measured roughly by conservative estimates of public money expended. The expenditure, though small in absolute amount by comparison with other federal expenditures, is large enough to warrant some inquiry regarding the services, actual or potential, rendered by it.

INFLUENCES RESPONSIBLE FOR GROWTH

The influences mainly responsible for this remarkable increase are complex and interrelated. We may, however, list five causes more or less distinct: the general extension of economic studies; the efficiency movement; the country life movement; the "scientific tariff" movement; and cost-and-price disputes. To these may be added the less important influence of state and federal income tax legislation. All of these developments have exerted direct or indirect influence on farm cost investigation.

The growth of interest in economic problems during the present century is unmistakable. Departments of economics in most universities two decades ago were small and unimportant; today they are everywhere large and influential. With steady growth, specialization occurred, and agricultural economics, among other branches, became differentiated from economics proper. Statistical technique borrowed largely from the biological sciences was brought to bear with increasing effectiveness on economic problems of all descriptions. In this differentiation of economic fields agricultural economics and the allied (often indistinguishable) subject of farm management appeared; and farm cost investigation arose as a special application—in the early years almost the sole application—of statistical method to problems of agricultural economics.

What has been called the "efficiency movement" took root first in industry, particularly manufacturing, largely

under the leadership of Frederick W. Taylor in the 1890's. In the first decade of the present century, leaders in agricultural education began to plead for better business methods, better management, more efficiency, on the farm. References to the necessity for regarding farming as a business and for applying business methods to farming became common in the agricultural press. Books on farm management began to appear. Cost accounting was an accepted method of increasing efficiency in business; and the same method came to be regarded by leaders in agriculture as necessary for farming. This type of reasoning was specifically expressed by Professor Hays in the first important document dealing with statistics of farm costs of production:¹

System and efficient management are undoubtedly greater factors in the success of American manufactories and railroads than natural advantages. . . . The success and prosperity of the American farmer are due to the unbounded fertility of the soils, the cheapness of farm lands, and the privilege of utilizing modern inventions in machinery rather than to systematic organization and efficient farm management. . . . System and more efficient management must enter the realm of agriculture if reasonable profits are to be extracted from the soil and its fertility be conserved for the use of future generations.

The first in time of the two most widely employed methods of investigating farm costs, the route method, was thus originated as a part of the efficiency movement as applied to agriculture. This movement has grown in strength. Efficiency on the farm may today be accepted as a major aim, expressed or unexpressed, of most leaders of agricultural thought. In 1900 the idea was new.

The country life movement, of which much was made during President Roosevelt's second administration, had its roots in general alarm at the movement of rural population toward the cities in the early years of the present cen-

¹ *The Cost of Producing Farm Products* (U.S. Department of Agriculture, Bureau of Statistics Bulletin 48), 1906, pp. 9 f.

ture. In 1908 President Roosevelt, seizing upon a growing interest in rural problems, appointed a Country Life Commission to investigate all aspects of rural life in the United States and to make recommendations for the betterment of rural living. Two of the commission's three recommendations, expressed in its *Report* in 1909, had an important bearing on the spread of cost investigation. The first recommendation called for a systematic investigation of rural conditions by agricultural surveys; the second called for extensive development of the extension form of agricultural education, "reaching the people at home and on their farms."

Agricultural surveys, as we have seen, had originated as early as 1903. The commission's report brought such work into prominence, and gave an impetus to its expansion. Educational organizations developed an increasing interest in rural economics; existing departments of farm management and rural economics were enlarged; new ones were formed; all were interested in the agricultural survey, at first to study profits on the farm as a whole, later to investigate the costs of producing particular products. Extension work in agricultural education had been developing even before the investigation of the Country Life Commission. In 1902 the Office of Farm Management, intended as an extension agency, had been founded in the Bureau of Plant Industry of the federal Department of Agriculture. In 1903 the co-ordination of education work already being pursued by farmers' institutes was undertaken by Congress; a small appropriation was granted for a federal farmers' institute specialist. In the same year farm demonstration work was begun in the South for the purpose of teaching farmers a system of farming capable of minimizing the ravages of the boll weevil. Demonstration work increased in popularity in succeeding years, and was adopted by the Office of Farm Management. In 1914 the recommendation of the Country

Life Commission was finally made effective by the passage of the Smith-Lever Act, which provided for county agricultural agents as well as for machinery to supervise their activities in bringing agricultural science to the farmer. These county agents and their superiors often found themselves at a loss to know what sort of teaching was needed to improve farm conditions in their localities, and employed the survey as a method of finding out. Hence the survey method, which dealt principally with questions of farm prosperity—*income, expenditures, receipts, and their causes*—but could be employed also to ascertain costs of production, was given a tremendous impetus. The country life movement thus contributed to an increase in farm cost investigations at least in two ways: by focussing attention directly upon the survey method of research, and by expanding extension work which found the survey method useful.

We need not inquire too closely into the origin and development of the idea that the tariff should be based on differences in costs of production at home and abroad. This basis for tariff making, first explicitly expressed in the Republican campaign platform in 1908,¹ bears more than a family resemblance to the older notion of equalization of labor costs between countries so often mentioned in tariff hearings in the 1890's. One phase of agricultural costs of production, the costs of wool, was investigated in 1910, by the newly formed Tariff Board. The Tariff Commission, succeeding the Board in 1916, investigated the costs of producing sugar in 1917. More recently the costs of producing other agricultural products have been investigated; the "flexible provisions" of the Tariff Act of 1922 have made the Commission's most burdensome duty the investigation of costs of production. The recent agricul-

¹ "In all tariff legislation the true principle of protection is best maintained by the imposition of such duties as will equal the difference between cost of production at home and abroad, together with a reasonable profit to American industries."

tural depression beginning in 1920 raised the question of tariffs on agricultural products far more seriously than was true before. As a consequence, farm costs of production have been increasingly in the public eye.

The final major influence has been the prevalence of cost-and-price disputes. Such disputes during the 1890's gave rise to most of the elaborate cost inquiries conducted before 1900. In the early years of the present century cost-and-price disputes were few; prices seemed satisfactory to most farmers for most commodities, with the possible exception of beef and the certain exception of milk. Constant agitation for clean milk and increasingly severe sanitary requirements by local governmental agencies had been forcing farmers to purchase better dairying equipment and to pursue more careful methods; and in time farmers began to complain that the cost of production of clean milk was higher than the price which consumers were willing to pay. This attitude brought forth official cost investigations in many localities; the fact seemed to require tangible proof, and the resulting cost figures were supposed to quiet the complaints either of consumers when prices were raised or of producers when prices were not raised. Milk cost investigations were of frequent occurrence from 1910 to 1920; but with the advent of the United States into the war in 1917, and subsequent debate about price fixing, the costs of other agricultural products also began to attract attention.

Since 1900 it has been thought by many that costs of production must be used as the basis for price fixing if prices are to be fixed at all, the popular argument being that the farmer must have a price sufficiently high to guarantee him a "fair" profit, but not so high as to make him a profiteer. From 1917 to 1920 cost investigations were common; investigators saw in cost figures a possible if not a certain basis for price fixing, and also an argument to demonstrate that farmers were not getting too

much. Guaranteed wheat prices for the crops of 1917-19 excited much general interest in cost-and-price relationships. After 1920, when prices went down and a severe and long-continued agricultural depression ensued, costs were still regarded as useful to show that farmers were getting too little. Farmers' organizations exerted strong pressure upon the Department of Agriculture and the experimental stations to secure cost data as a basis for governmental action of a price-raising sort.

Income tax legislation has been a minor influence, but only for a brief period in recent years. The first state income tax legislation was passed in Wisconsin in 1911; federal income taxation began in 1913. The interest of those farmers whose incomes have fallen within the reportable range was presumably to some degree aroused in farm cost accounting, but only indirectly. Doubtless also the number of farmers having incomes within the reportable range has always been small, and it grew smaller as the size of the minimum taxable income increased. On the whole, this influence, though not infrequently mentioned in farm cost literature, has probably been slight.

The growth of farm cost investigation is thus fairly clear as to both volume and causes. Whether the growth will continue is, of course, problematical. Several of the influences are still operative. Cost-and-price disputes still occur; and the idea of employing cost data in legislative price fixing, though weakened by the rival notions of "ratio price" and of disposition of surpluses, is apparently still current among the rank and file of farmers. Recent attacks on theory and practice have perhaps diminished the popularity of tariff making by reference to differences in costs of production. Income tax legislation is at most only an indirect influence. But the combined influences of the country life and the farm efficiency movements still continue effective, and the expansion of economic inquiry,

particularly by statistical analysis, continues. Many agricultural leaders are still enthusiastic in regarding cost investigation as valuable in the slow process of increasing farm efficiency. At the present time a considerable expansion of cost inquiry designed to serve this end is contemplated; and with funds available in increasing amounts from the Purnell Act, farm cost investigation in the field of farm management seems more likely to expand than to contract in the next few years. Actual expansion will presumably depend upon the satisfaction or dissatisfaction of farmers with prices, more than upon any other factor; for of late years there has been a tendency to regard research in farm management as a panacea for the troubles of farmers, and demand for the panacea depends largely upon the actual or suspected need for it.

CHAPTER III

THE OBJECTIVES IN FARM COST INVESTIGATION

The objectives in farm cost inquiry are somewhat difficult to formulate. The number of published investigations and discussions of farm costs is very large, and the various agencies compiling data are numerous; but direct discussions of objectives have been few.¹ In a single cost investigation there will often be listed six or more distinguishable objectives toward which the inquiry was directed. The different distinguishable objectives range in their phrasing and meaning from the specific to the general. Not a few investigations have appeared unaccompanied by any statement of objectives whatsoever. And not a few inquiries, ostensibly and explicitly conducted with stated objectives in view, have in fact been conducted in the furtherance of unstated objectives: bulletins addressed to the solution of farm management problems have actually been brought to bear upon the question of "fair" prices.

TWO GENERAL TYPES OF OBJECTIVES

Cost data are of fundamental interest to economists, legislators, and farmers not in themselves, but because they bear upon net income and prosperity. To the individual farmer it seems axiomatic that, prices remaining the same, he can secure a higher income by reducing costs; or conversely, costs remaining the same, his income fluctuates with fluctuations in prices. To speak generally but by no means exactly, there are two ways of increasing net income: by cost reduction or by price lifting.

Cost data appear to be indispensable in either case,

¹ See Bibliographical Note at end of chapter.

but in different ways. The individual farmer knows he can reduce his costs by his own action, once he perceives a "leak" that can be stopped up; and his own accounts may show him the leak. But the price he receives he cannot influence by calculating and acting upon his own costs, unless he combines with other farmers likewise armed with cost data and resorts to political pressure which results in governmental price regulation.¹ If farmers believe, however vaguely, that prices ought to cover costs, either the cost-reduction or the price-lifting processes may receive their endorsement. The same cost data may appear suitable for either purpose.

The objectives in farm cost investigation fall into two broad classes following this cleavage. At one extreme we find cost investigations conducted simply and solely for the purpose of ascertaining costs of production, in order that a price might be fixed on the basis of the ascertained figure. At the other extreme we find investigations which seek to determine whether plowing or listing for corn is the more economical operation in a restricted area. But between the extremes lies the majority of investigations, with objectives not unmistakably of either the price-influencing or the cost-reducing sort, but occupying intermediate ground.

In strictness, some objectives cannot be classified as either price influencing or cost reducing; at least their connection with price influencing or cost reducing is by no means direct and immediately apparent. Examples are the uses of cost data in providing leaders of agriculture with a basis for directing agricultural developments, in determining the fairness of changes in railway rates, and in furnishing prospective farmers with necessary information. But even among these it is clear that the first

¹Of course cost data might conceivably be used in attempts to control acreage or marketing, thus indirectly affecting price. But the bearing of cost data on these devices for regulating prices is remote.

and third bear upon cost reduction more than does the second; and conversely, the bearing of the second is indirectly upon price influencing, but not upon cost reduction.

PRICE-CONTROLLING OBJECTIVES

Among the uses of farm cost statistics broadly in the field of price control the following have been formulated in discussions:

1. To throw light upon the relationships of costs and prices in agriculture;
2. To provide a basis for legislative or administrative price fixing;
3. To provide a basis for scientific determination of tariff duties;
4. To elucidate the matter of agricultural prosperity by comparisons of various profit figures, such as profits per bushel in different years, per farm between different areas, and generally between agriculture and other industries;
5. To aid in determining the fairness of railway rates;
6. To create a better mutual understanding between consumers and producers;
7. To provide producers' co-operative associations with a basis for determining what price to ask;
8. To determine whether or not prices are being enhanced by concerted action of producers.

Certain of these ostensible aims have appeared only as statements of the possible uses of farm cost data. No investigation has ever been directed specifically to the problem of determining whether or not farmers had enhanced prices by concerted action. Similarly no investigation has ever been intended to create a better mutual understanding between producers and consumers except in a special sense: unquestionably some cost studies have

been intended to convince consumers that current prices were not, as they supposed, too high, but were actually too low, because prices were below costs. "To create better mutual understanding" is generally a euphemistic expression for "to prove that higher prices ought to be paid." With these uses of cost data we shall not be concerned hereafter.

Certain other objectives have been little sought. Cost data have but seldom been employed to aid in determining the fairness of the railway rates. They have been employed in testimony before the Interstate Commerce Commission,¹ but their bearing on rate making was only indirect and other data were of greater importance. There has likewise been little use of cost data in providing co-operatives with a basis for deciding what prices to ask. With these unfamiliar and comparatively unimportant objectives we shall not be concerned. The remaining four are of wider significance and have attracted greater attention. But of these we need not consider the use of cost data in discussions of farm prosperity.

In chapters x-xii the endeavor will be made to determine how far existing cost data throw light upon the relationships of cost and price in agriculture. Direct discussions of the problem have been few; but incidental discussions have been numerous. Much argument for price control rests upon a set of assumptions regarding not only the actual relations of cost and price, but also the "fair" or "normal" relationship. As a preliminary to an examination of the use of cost data in price control it is essential to inquire into current doctrine and current misconceptions regarding cost-and-price relations: what people believe these relations are or ought to be, as contrasted with ascertainable facts, must be understood before it is possible to comprehend the popularity of

¹ See, for example, Exhibits Nos. 229, 236, and 239, *I.C.C. Docket 17000, Ex Parte 87*.

price-controlling devices or to indicate their limitations. We shall thereafter be in a position to consider the specific uses of cost data in price fixing and tariff making. Upon these subjects much has been written; and, though no great amount of either price fixing or tariff making has in fact occurred, the notion that cost data provide a "sound" basis for either procedure has extraordinary vitality.

EFFICIENCY-INCREASING OBJECTIVES

Most farm cost investigations have been directed toward the problem of increasing efficiency. But the meaning of "increasing farm efficiency" is not readily apparent. What constitutes efficiency, and at what times and in what regions is increased efficiency needed? To whom shall efficiency be taught—to farmers now operating their farms, or prospective farmers now engaged in other occupations, or sons of farmers now attending high schools or colleges? Ought the same procedures to be used in reaching these various audiences?

A survey of the literature yields the following list of more or less specific objectives in farm management inquiry:

1. To aid farmers in their production problem, by informing them (*a*) what and how much to produce, (*b*) what and how much equipment to employ, (*c*) how to conduct specific operations most economically, and (*d*) how and when to dispose of their products (by feeding or selling) most profitably;
2. To develop sound and practicable methods of farm bookkeeping, and induce farmers to adopt these methods;
3. To provide prospective farmers with useful and necessary information;
4. To develop a coherent set of fundamental principles of farm management, useful not only to teachers and to

leaders of agricultural thought, but to practicing and prospective farmers and the nation as a whole.

We shall be concerned chiefly with the first of these objectives. This is not to say that the development and teaching of practicable methods of farm accounting, the provision of prospective farmers with information, and the development of farm management principles are unimportant or undesirable ends. They are rather subsidiary objectives, and have not, particularly in recent years, been foremost in the minds of investigators. What investigators admittedly seek to do at present is to provide practicing farmers with definite suggestions upon which they may act to achieve higher profits. We must examine the procedures employed in furthering this aim, with a view to determining how far the objective merits attainment and how far it bids fair to be attained. Not all investigators of farm costs distinguish between a principle of farm management, a specific suggestion involving a change of practice among farmers, and a statistical description of farm practice. There appears in all investigations a large amount of statistical description; sometimes a specific suggestion to farmers or a principle of farm management is deduced from this description, sometimes not. With investigations, or parts of investigations, which present descriptions alone we need not trouble; they may be meritorious as descriptions and useful in the sense that census data are useful, but they have only an indirect bearing on the matter of inducing farmers to alter existing practices. The development of fundamental principles of farm management through the use of cost data likewise need not concern us greatly. Exactly what the fundamental principles of farm management are, or what they are thought to be by various writers of textbooks on farm management, is not a relevant problem. We shall not attempt to determine whether or not cost data have contributed to the development of these prin-

ciples. The contribution of cost data to the more specific objective of providing practicing farmers with definite suggestions upon which they may act is in itself a broad subject. The general educational advantages of cost investigation is a question far too broad, because the effect of educational activity can be neither foreseen nor measured.

With some qualifications, we may accept in the present discussion the view on the objectives in cost investigation expressed by Mr. G. A. Pond, who has been for some years in charge of farm cost studies in the Minnesota Agricultural Experiment Station:¹

. . . . I am assuming that the primary purpose of detailed cost studies as well as of all other lines of farm management and organization research is to help individual farmers in the organization and operation of their business I believe that the major emphasis in this type of research should be placed not on the gathering of a large number of general facts in regard to certain groups of farms or concerning farming as an industry, valuable as these may be, but primarily and fundamentally on those specific facts that are most useful to the individual farmer in determining the most profitable or desirable utilization of the resources at his command. It is on these grounds that we can best justify the use of public funds for this type of investigational work and it is by this standard we must measure the success of our projects in this field.

But it is desirable to examine in greater detail the proposals of farm management specialists and agricultural economists² to assist the farmer in his production

¹"The Use of Detailed Cost Studies in Improving Farm Organization in a Community," *Journal of Farm Economics*, January 1924, VI, 69.

²Distinctions between the fields of farm management, farm organization, farm economics, rural economics, agricultural economics, rural life, and rural sociology—names currently applied to organizations pursuing essentially similar work and to investigators within the organizations—are by no means entirely clear. The fields of economics and agricultural economics, agronomy or animal husbandry and farm management, are likewise not entirely separable. For our purpose distinctions are not essential. All cost investigators profess to have regard not only for the welfare of the farmer but also for the welfare of the nation as a whole.

problem. Exactly what is this problem, as investigators envisage it? Precisely what uses of cost data are regarded as most serviceable in solving it?

CURRENT VIEWS ON THE FARMER'S PRODUCTION PROBLEM

We have previously described the problem as fourfold, involving what and how much to produce, what and how much equipment to employ, how to conduct specific operations most economically, and how to dispose of products most economically. In general investigators endorse this fourfold division as theoretically sound, though statements vary considerably. The above statement corresponds closely with Dr. H. C. Taylor's analysis.¹ Dr. J. D. Black prefers to speak of four categories of "maladjustments in production," under the names of "wrong choice or balance of enterprises, wrong combination of cost-factors—the qualitative aspects; wrong methods and practices, and mistakes on the margin—in land-utilization."² But he regards the third and fourth categories as but slightly different aspects of the first and second. Most investigators in fact think of the problem as twofold: the primary matter is the choice and combination of enterprises; the secondary matter is the detailed management of enterprises after they have been chosen. This view is expressed in the majority of cost investigations. The following statements are typical:

Cost-of-production figures give basis for intelligent decisions on what to produce and how to produce it in order to secure maximum net profits.³

The purpose of these cost-of-production studies is to show

¹ "The Objectives in Agricultural Cost Accounting," *Journal of Farm Economics*, April 1923, V, 65-78, *passim*.

² "The Rôle of Public Agencies in the Internal Readjustments of the Farm," *ibid.*, April 1925, VII, 160.

³ F. W. Peck, *Methods of Conducting Cost of Production and Farm Organization Studies* (U.S. Department of Agriculture Bulletin 994), November 1921, p. 3.

how farms may be made more profitable. There are two ways of doing this: (1) by lowering the cost of producing a unit of product, and (2) by selecting the crops and classes of live stock which when combined will give the largest profit from the farm as a whole.¹

The allied problems of choice of equipment—otherwise phrased as size and distribution of investment—and of disposal of products have by no means been altogether ignored. Much has been written regarding optimum size of farms, and most reports of investigations contain sections dealing with distribution of investment. The reason for the prevailing lack of emphasis on these problems in current statements of objectives is, however, fairly clear. If useful suggestions are to be made to farmers, they must be suggestions upon which he is capable of acting; but barns once built cannot be torn down immediately even if they form too large a proportion of total investment, farmers are not able immediately to increase or decrease the area of their farms, and investment in machinery and work stock cannot be expanded or contracted at will. Mistakes in investment, in short, cannot be rectified so readily as mistakes in choice of crops or in choice of methods; the process of pointing out mistakes in investment is therefore not likely to prove as fruitful as indication of mistaken choices of enterprises and methods. Most investigators look, as Mr. Pond has said, toward “determining the most profitable or desirable utilization of the resources at his [the farmer’s] command.” Their primary concern is to suggest feasible readjustments, not to depict ideal circumstances. Hence the preference for the study of choice of enterprises and methods.

DIVERGENT VIEWS

Agricultural economists and farm management specialists are thus in agreement upon several fundamental

¹H. C. M. Case and C. A. Bonnen, *Cost of Producing Farm Products on 14 Farms in Champaign and Piatt Counties in 1924*, Urbana, Illinois, 1925, p. 1.

points. American farming might be more efficiently conducted and made more profitable if farmers could be taught a better choice of products and better methods of operation; and it is within the province of public agencies such as the United States Department of Agriculture and the agricultural experiment stations to discover better choices and induce farmers to accept them. No farm economist supposes that both production problems can be solved for every individual American farmer every year by any means whatever. But disagreement arises with regard to what can and ought to be done. As Dr. Black has pointed out, two schools of thought exist. The theory of the minority school is:

. . . . that each individual farmer should be taught to keep a record of his own business, also how to analyze these records and how to interpret data on prices and production and consumption, and from these data work out an individual program each year for his particular farm The price and production data needed are available to the farmer in newspapers, farm journals, and market reports. But it may be advisable in some cases to assemble such of these data as particularly apply and to arrange them in convenient form and distribute them to the farmers.¹

The theory of the majority school is that

. . . . only a few of the farmers will collect the necessary data or be able to make a proper analysis of it and of the data on prices and production and consumption, and that therefore someone must come along and collect and analyze these data and, on the basis of this analysis, determine what individual farmers should do next year. But since they cannot possibly do it for each individual farmer they must be content with doing it in a general way for all of them, or, better still, for all of them in one region in a county or community.²

We shall be concerned hereafter chiefly with the projects of the majority school. It seems clear that an

¹ "The Rôle of Public Agencies in Internal Readjustments of the Farm," *Journal of Farm Economics*, April 1925, VII, 159-60.

² Influential men in 31 states expressed themselves as substantially in accord with this theory. Cf. *ibid.*, p. 159.

ambitious program of research is contemplated. The agricultural economists are to investigate production problems in selected regions; they are to determine what products ought to be produced and in what proportions, and they are to point out the most satisfactory methods and practices. They are not to attempt to do this for every American farm, but they are to formulate regional production programs stated in a manner "rather specific; but not too positive," and "specific for the region as a whole, [but] not specific for each farm" (again Dr. Black's phrases). They are "to mark off certain important areas within which systems of farming are nearly uniform, to make an analysis . . . for each of these areas, and then to say to the farmers in the area: This is what you need to get ready for in this region. This is the program into which you should begin to fit yourself."¹

The general subject of farm management cost investigation is considered in chapters vii-ix. In these chapters an attempt is made to point out how far the most recently developed types of farm management cost investigation promise to prove successful in informing farmers what to produce and how to produce it. But the subject is better treated by reference to existing programs of farm management inquiry and to outstanding types of investigation than by reference to past or prospective achievements in attaining objectives. Hence we shall be concerned to point out some general limitations on farm management inquiry, to compare one type of investigation with another, and to formulate a general program of work in the field. The objectives sought must of course be kept constantly in mind; but a more satisfactory analysis of farm management investigation is possible if objectives are treated only indirectly.

Certain fundamental questions require attention before detailed consideration is given either to farm man-

¹ *Ibid.*, p. 168.

agement, investigation or to the price-controlling uses of farm cost statistics. It is first desirable to understand how farm cost statistics are collected and calculated, how costs of production vary from farm to farm and area to area in the same year or from year to year on the same farms and in the same areas, and why these variations appear.

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CHAPTER IV

THE COMPILATION OF FARM COST DATA

When statistics of farm costs of production are employed in cost-and-price disputes, in price fixing, or in tariff making, several questions assume immediate importance. Is the sample representative—has a sufficient number of individual costs been secured, and is there bias? Were the accounting principles employed such as to result in a figure neither too high nor too low? Was the form of average chosen an appropriate one? In part these questions may be discussed most satisfactorily in the chapters dealing with variations in costs, the theory of cost-and-price relationships, the use of cost data in price fixing, and the use of costs in tariff making. They are not at present questions of major interest to investigators who employ cost data for farm management purposes. Here we may consider merely the effect of methods of collecting data and of principles of accounting upon conclusions drawn in cost-and-price comparisons, not upon conclusions drawn in farm management investigations.

For the present we may ignore the final step in the calculation, the selection of an appropriate form of average to apply to the array of individual costs certain to appear. Can an array be secured which may be regarded as an array representative, let us say, of costs per bushel of producing wheat in the state of North Dakota, and which displays individual costs with reasonable accuracy?

COLLECTION OF DATA

Current practice endorses the collection of cost data in any of four ways. A prepared blank listing the several

operations in and charges to wheat production might be sent to each of a large group of farmers. An agent, armed with a blank form, might visit each farmer and obtain information by direct questioning. If large numbers of farmers kept records on the same bookkeeping principles, the cost data might be obtained by transcription from their books. Finally, agents co-operating with farmers might supervise the keeping of detailed records throughout the year.

Under actual circumstances it would of course be impossible to employ precisely the same methods of accounting in each of these methods of collecting data. Very few farmers keep books showing the details of the cost of producing wheat. It is therefore impossible to secure data of the same completeness from the questionnaire method as can be secured by the route or the farmer's record plans, partly because farmers receiving questionnaires cannot fill out a long schedule, partly because experience has shown that the longer the schedule, the fewer are the farmers who will fill it out. Whether or not data of the same degree of completeness can be obtained from the survey and the route methods is a question which has received much attention. It is contended, and on the whole has been satisfactorily demonstrated, that the estimates of farmers given under the survey method, when averaged, yield the same figure as precisely recorded data otherwise obtained.¹ This is not to say, however, that if it were feasible to obtain cost data from the same farms for the same year under both methods, each farmer would give the same cost figure in each case: differences there would be, but these differences would be of a compensatory nature, so that the same average cost would appear under each method. The route and farmer's record plans are inherently more accurate, if only because

¹ On this point see W. J. Spillman, *Validity of the Survey Method of Research* (U. S. Department of Agriculture Bulletin 529), April 1917.

day-to-day records are inherently more trustworthy than memory, however checked under cross-examination by an intelligent investigator. There seems good reason to believe that, under given accounting principles, the survey method yields fairly satisfactory arrays as well as accurate averages; but in so far as the farmer's memory must be trusted, the cost figures must be accepted with some reserve. Data obtained by the questionnaire method are inherently much less trustworthy. All this, of course, assumes that satisfactory accounting principles are followed under whatever method.

An array representative of North Dakota costs must contain data obtained from farms located in all areas of the state where natural conditions differ sufficiently to cause differences in costs. The Red River Valley has not the same climate and soil as the semi-arid region of western North Dakota, and costs from a group of farmers in either region could not be regarded as representative of costs incurred throughout the state. Some violation of this principle occurred in the earlier farm management investigations,¹ and there is still a tendency to assume that costs incurred in a given county are representative of costs throughout most or all of a state; but on the whole the principle is observed. It is more common to encounter cost investigations in which the number of farms furnishing data is so small as to throw doubt upon the representative quality of the array for any area whatever. There is scarcely more reason to endorse the representative quality of data gathered from ten farms than from one farm. Conclusions drawn from such investigations have nevertheless frequently been phrased not as if they applied to the ten farms only, but as if they applied to a county, a type-of-farming area, or even a state.

¹ Cost data collected in Minnesota from three routes of eight farmers each were said to be "capable of wide use, especially in the upper Mississippi Valley." *U.S. Department of Agriculture, Bureau of Statistics Bulletin 48, 1906, p. 85.*

Investigators generally recognize at present, however, that a goodly number of farms well scattered throughout the area to which conclusions are to apply must be included in an investigation. The survey method is regarded as capable of fulfilling these primary requirements. The route method is said to have merits of its own, particularly in obtaining reliable data on quantitative costs and the distribution of labor throughout the year; and it continues to be used in farm management investigations. But it is too expensive and too slow to be practicable in an inquiry regarding costs of production per unit applicable to a large area—a figure needed in a tariff-making investigation. The questionnaire method is too inaccurate, the farmer's record plan too slow and incapable of yielding a proper number of records. Consequently statistics of costs per unit intended to be applicable to large areas have been gathered in the most instances by the survey method. Sometimes the data may be regarded as representative, sometimes not. And it is desirable to recall that a certain amount of inaccuracy is inherent in the survey method, though how much cannot be said.

The possibility of bias appears with respect to many investigations, though not to all. Its existence, though it may often be suspected, is difficult to prove. A cost investigation conducted in a time of prosperity might not yield the same results as an investigation conducted in the midst of an agricultural depression, even if we assume that the costs incurred were precisely the same. One may suspect that in times of depression a general tendency to pad costs would prevail, not only among farmers, but among investigators whose sympathies lay with the farmers. This possibility is worth bearing in mind when one scrutinizes the data gathered in recent years.

It is clear, then, that farm cost statistics must be accepted with some reserve merely because practicable methods of collecting data are inherently imperfect. One

is likely to encounter general statements obviously based upon unrepresentative data; and in inquiries where adequate samples have been secured, the data themselves inevitably contain a margin of error due to the fact that costs cannot be measured precisely through the methods necessarily employed. Under identical accounting procedures, the route and farmer's record plans would yield the more accurate data, but the less adequate sample; the questionnaire and survey methods would yield the less accurate data but the more adequate sample.

ACCOUNTING PRINCIPLES: THE ELEMENTS OF COST

The absolute figures in an array of costs per bushel of producing wheat on a number of farms cannot be obtained by mere enumeration. The problem is obviously not so simple as that of census taking, wherein farmers may be asked how many acres they have in corn or how many horses they keep, and may be expected to furnish accurate answers. Costs must be calculated; and a large degree of estimation is necessarily involved.

The first question to be asked has reference to the elements of cost—what they are. The second problem is to determine how to reach figures expressed in money accurately representing each of the elements of cost; here the difficulties are to evaluate non-cash cost items and to allocate certain "overhead" costs.

Cost investigations frequently list the following items as elements in the cost of producing wheat: labor of men and animals; depreciation and repairs to machinery and buildings; interest on investment in land, buildings, machinery, work stock, and growing crops; wages of management; seed, twine, and fertilizers; crop insurance, association dues, telephone, and taxes.

The chief dispute arises with regard to the inclusion of rent of land and interest on investment as cost items. Some industrial accountants insist that neither interest on

invested capital nor rent of land ought to be regarded as a cost; others include interest but exclude rent; still others include both. The farm cost accountants customarily follow the last procedure. Early practice involved the calculation of a composite interest and rent charge by ascribing values to land, buildings, machinery, and work stock, multiplying these values by some arbitrary rate, and allocating the resulting charge to the different products. Later the practice was introduced of charging rent of land by ascertaining the cash rental current in the community of (say) wheat land, interest on machinery and work stock being figured as before. Much discussion of these matters has appeared, but we need not examine the fine distinctions which have been made. It is clear that, if farm cost statistics are to be brought to bear upon the problem of cost-and-price relationships, interest on capital not sunk in the land ought to be included as a cost, while interest on capital sunk in the land (in permanent improvements such as roads, drainage, buildings, and fences) and rent of land itself ought not to be included.¹ Briefly, the reason is that costs compiled for use in cost-and-price discussions should be the sort of costs which affect price, not the sort of costs which are affected by price; and rent of land, which shades imperceptibly into interest on permanent improvements, is not a cause of price but a result of it. We shall have more to say of these matters in another place. Here it is merely necessary to observe that there is no practicable accounting method of drawing hard-and-fast distinctions between interest and rent, and that so many variations in practice have appeared that one can seldom be certain exactly how charges for interest and rent were figured in different investigations. Frequently one cannot ascertain whether or not

¹ If, however, the cost data are to be employed for purely farm management purposes, there is no fallacy in including land rent as a cost; but it seems probable that inclusion of this item, which is evaluated only with great difficulty on owned farms, serves to obscure rather than clarify the analysis.

interest on machinery and live stock was included; usually investigators abandon attempts to calculate a charge for interest on growing crops.

Largely as a result of the inevitable difficulties of calculating interest charges on various sorts of investment, one encounters cost investigations dealing with the same product which are far from comparable. Furthermore, some investigations include a charge for wages of management as distinct from wages of labor, though most do not; and the reason is that no objective criteria for calculating the charge appear. Many cost investigations contain an item of appreciable size called "miscellaneous," and one does not know what it means. For all of these practices simple expediency is largely responsible, though in part investigators have failed to reason soundly on the inclusion of rent of land. For our purposes detailed discussion of accounting principles is not pertinent. We are concerned only to show that in farm cost investigation definite agreement has never existed upon the elements which ought theoretically to be included in cost. In view of the divergent practices which have been followed, as well as the practical impossibility of demarcating interest from rent with precision, it is obvious that an array of cost statistics needs to be scrutinized carefully for the list of elements included in cost before it can be accepted; and it is equally clear that no array can represent precisely the costs which affect price. But the use of different methods to calculate charges for the same items is perhaps of even greater importance.

ALLOCATION

It is clearly possible to account for the amount of labor directly employed in the production of a given crop. One can determine how many hours were spent on how many acres. The labor hired for any operation in wheat growing can be recorded precisely. One can also ascer-

tain the amount of seed sown. But practically all other costs must be allocated. Machinery and horses are employed more or less throughout the year for other tasks than wheat growing. How shall it be said that a definite amount of the yearly interest on these items, or of the yearly depreciation and repairs, ought to be charged to wheat? If it is possible to determine total hours of use during the year and hours of use in wheat culture, a reasonable ground for allocation appears. This procedure may be followed accurately under the route and farmer's record plans, but not so accurately by the survey method.

Under any method it is difficult to say what proportion of farm expense for fence and road and building repairs, of telephone and automobile expense, of interest on investment in land and buildings, of fertilizer, ought to be charged to wheat. Should one decide that if one-third of the farm area is in wheat, one-third of the calculated interest on investment in land and buildings is chargeable to wheat? What if the acres in wheat are admittedly worth only half as much as the acres in corn? How does one determine what proportion of fencing expense the wheat crop ought to bear? If fertilizer influences not only this year's crop but next year's as well, and in different degrees, how may one determine what proportion of the expense of application ought to be charged to this year's crop? It is unnecessary to state that working methods have been developed. But for present purposes it is merely necessary to emphasize that the methods are not uniform, and that any method, from the very nature of the problem, must be a rule-of-thumb method, designed to yield not absolutely accurate results but merely rough approximations.

We have specifically referred only to problems of allocation arising in accounting for the cost of producing wheat. The problems are more acute in accounting for the costs of producing certain other products. How allo-

cate the costs of production of mutton and wool; cotton and cottonseed; beef, veal, milk, butter, and cheese; or poultry and eggs? These products do not become differentiated until a late stage in the productive process, and their costs have to be accounted for jointly in most instances. Wheat and wheat straw grow together; in some areas each has value; but to separate the costs of one from the costs of the other necessarily involves some arbitrary principle of allocation. The common practice is to subtract the value of (say) straw calculated at market prices from the cost of producing wheat and straw together. Obviously this is a rough-and-ready method. It could not be followed in cases where the value of the by-product equaled or nearly equaled the cost of the main product and the by-product; for this would result in little or no cost for the main product. Such a problem arises in some areas with respect to mutton and wool. It is present in greater or less degree for most products. Usable and often valuable green feed grows with root crops, straw with small grains, fodder with corn, and so on. Sometimes, usually in cases where by-products are of minor importance, one encounters the principle of allocation of which we have spoken. When by-products assume larger importance, one finds costs allocated by the use of another principle. Receipts from the sale of both products are ascertained, and if the one product has yielded 75 per cent of the total receipts, it is concluded that this product should bear 75 per cent of the joint cost. The arbitrary nature of this principle is self-evident. Either method of allocation is simply a practicable, not a logical, method: it is a device enabling one to accomplish in a rough manner something that otherwise could not be accomplished at all. Hence, from several points of view, the difficulties of allocating costs enforce the necessity for accepting with reserve any figures showing the costs of producing specific agricultural products.

VALUATION AND OPPORTUNITY COST

The fact that many of the elements in the cost of producing wheat do not involve the expenditure of money gives rise to the problem of valuation. Relatively few of the items of the cost of producing wheat can be ascertained directly. If seed and other materials are purchased, if taxes, interest on borrowed money, or rent are paid in cash, and if labor is hired, most of the charges to wheat can be determined by reference to records, and few estimates are involved. But under actual circumstances the farm is frequently owned or perhaps rented on shares, machinery and work stock are not hired, the greater part of the labor is performed by the farmer and his family, and seed is raised on the farm. It becomes necessary to calculate, on some principle or other, the charges for interest, depreciation, labor both managerial and manual, and materials.

The general principle adopted in farm cost investigation has been called that of "opportunity cost." If in plowing a man could obtain \$5 a day, then it is said \$5 should be taken as the rate at which a day of unpaid labor performed on his own farm should be charged. If he can obtain 6 per cent on his investment by using it for other purposes than farming, then 6 per cent is the appropriate rate of interest to be used in calculating his costs. If he can sell a bushel of wheat for \$1, then \$1 per bushel is the appropriate rate to charge for wheat grown on his own farm and used for seed. A corollary of this principle is that if the price of wheat does not cover his cost so calculated, self-interest dictates that he should withdraw wholly or partly from wheat production.

Apart from their unwillingness to include rent of land as a cost of production, economists endorse the fundamental idea of the opportunity cost principle. They define the cost which determines price as a cost calculated on current rates for labor, capital, and management. But

when these current rates are actually sought, a rather sharp division of opinion appears. Economists mean by current rates, rates which all farmers of a group may receive. They would not agree that if one farmer was so expert at stacking wheat that his neighbors would be willing to pay him \$20 a day, then the labor of all farmers in the group ought to be charged at \$20 a day. Economists conceive that current community rates are ordinarily well defined, and are the rates which farmers have in mind in such calculations as they make. For the purposes contemplated in economic theory, which deals with explanations of broad tendencies and general relationships, this conception is satisfactory. But it is not a precise conception: the economists do not say that the appropriate interest rate to be used in cost calculations should be the rate current in a given year on chattel mortgages or on a few municipal bonds or on any other particular type of security. And so with wages of labor and of management. The rates economists have in mind are rates accessible to all over periods of time—rates long established and little subject to fluctuation.

It is as yet impossible to determine with precision what sort of rates farmers actually do employ in the calculations leading them to expand production of this product and contract production of that, or to withdraw from and enter into farming. Unquestionably different men employ different calculations at any time, and the same men may employ different calculations at different times. Economists for the most part recognize these facts, and frame their theory to comprehend them. Of necessity the statement is highly generalized; only broad statements can be made of forces acting upon social movements over long periods of time. As a part of such a statement the economist's vague definition of cost is the only acceptable one yet available.

When a cost investigation covering a large group of

farms is undertaken, it is frequently brought to bear upon the theory of cost-and-price relationships, and the cost sought is frequently the cost which determines price. But if costs are to be compiled at all, some definition of cost has to be reached, some practicable accounting methods must be developed. It is easy to misinterpret the general theory of cost-and-price relationships; and, in the search for usable rates in calculating costs, to fix upon rates not contemplated in theoretical discussions. What has often resulted in practice is the use of rates which economists contend are too high, even if they cannot say how much too high or suggest better ones.

The labor of the farmer and his family has been calculated by at least three different methods. The farmer has sometimes been asked to state how much he thinks his labor or his son's is worth per year, and the figure has been accepted without question. Sometimes the investigator and the farmer discuss the appropriate rate and reach an agreement. Sometimes current rates in the community for similar labor are employed. From the economist's point of view the last method obviously appears most satisfactory; it approximates the "current" rate he has in mind. But from a practical point of view such a rate is not always desirable, simply because it cannot be obtained to cover all cases. In some communities there is no single established current rate: men may be hired at anything from, say, \$30 to \$60 a month. There is further no definite gradation of rates permitting definite determination of proper charges for the labor of industrious and "handy" as against clumsy and lazy farmers; or of ten-year-old sons as against seventeen-year-old daughters. No matter what the basis of calculating the costs of labor may be, a large element of estimate is involved. The same is true in greater degree of the costs of superintendence.

Selection of an appropriate interest rate, of appropriate valuations of the land and capital upon which interest

is to be calculated, of an appropriate rate of depreciation, of appropriate valuations of the items to be depreciated, of appropriate valuations of unmarketed home-grown produce, constitutes the same sort of a problem. The principles employed, if the data are to be used in discussion of cost-and-price relationships, ought to embody an attempt to utilize the rates which farmers normally have in mind when considering the desirability of expanding or contracting production. But such rates are difficult, if not impossible, to ascertain by reference to tangible facts. In many instances it would appear that farm cost investigators have employed improperly high rates. This matter we may illustrate more specifically in the following section. For the present it is sufficient to observe that valuation of non-cash cost items in farming is by no means a mechanically accurate procedure. Because of the existence of the valuation problem, rough estimates are necessary even in the calculation of the cost of wheat production on a single farm; and no cost figure is to be accepted without reference to the principles of valuation employed in reaching it.

The validity of an array of original cost data is thus affected by the method followed in collecting data, the number of cost elements included, the processes employed in allocating costs, and the methods of valuation used. Therefore farm cost statistics, and the conclusions drawn from them, cannot be accepted without careful scrutiny of the data with respect to these points. Such scrutiny is difficult, because explanations covering all points occur but infrequently. On account of the diversity of practice comparable data can seldom be secured from investigations conducted by different agencies or by different persons in the same agencies,¹ though comparisons of trends

¹ For an attempt to render comparable several investigations of wheat production costs in Canada and the United States in pre-war and post-war years, see *WHEAT STUDIES OF THE FOOD RESEARCH INSTITUTE*, May 1925, I, No. 6, and a mimeographed supplement to that study.

in costs over considerable periods of time would be valuable as historical evidence of shifts in types of farming and in methods of cultivation. Currently accepted principles of farm cost accounting have resulted in a widespread conviction that the costs shown are commonly inflated. Hence they create an untrue picture of farm prosperity and contribute to a mistaken theory of cost-and-price relationships, which in turn lends support to unsound proposals for tariff making and price fixing.

SIGNIFICANCE OF ACCOUNTING PRINCIPLES IN A SPECIFIC STUDY

To illustrate the necessity for examining with care conclusions drawn from farm cost statistics, and hence the structure of the statistics themselves, we may briefly consider portions of an agricultural experiment station bulletin dealing at length with the cost of producing milk and butterfat in California for the year March 1922-February 1923.¹ This bulletin need not be regarded as a typical enterprise cost survey. It differs from others of its general class in several points of procedure and principle. Neither is it the type of farm management investigation in greatest vogue at the present time. But in common with many enterprise cost studies published during the period of acute agricultural depression, it leads up to two important types of conclusions—suggestions for the improvement of farm practice, and statements respecting the relationships of costs and prices. It may at least be regarded as one of the more pretentious cost investigations. It consists of 164 pages, cost some \$17,000 in direct appropriations, and was circulated to some 9,000 farmers.

For present purposes the conclusions pertaining to possible improvements in farm practice may be ignored;²

¹ R. L. Adams, *The Cost of Producing Market Milk and Butterfat on 246 California Dairies* (California Agricultural Experiment Station Bulletin 372), November 1923.

² Precisely how far the conclusions of this bulletin actually arose from the cost investigation, and how far they comprise mere reiteration of generally

only those conclusions of wider import need be examined. The following quotations and tables summarize the pertinent portions of the cost-and-price discussion:

. . . . in all of the districts studied [12] there are a number of dairies selling their output at a price below the cost of producing

The manner of presentation, as herein set forth, is of value in showing the point which prices should reach to insure a satisfactory supply of any given commodity within the limits of current costs.

Table 30 [Table 1, p. 56] indicates the situation with respect to dairymen whose costs were studied in Alameda, Contra Costa, and Santa Clara counties. Of the 20 dairies only 30 per cent of the total production was secured for costs of whole milk at or below the price received by them of \$2.50 per 100 pounds. This means that 70 per cent of the supply from this group was produced at a loss.

From tables made up for all the dairies in other districts where costs of producing whole milk and butterfat were studied, similar deductions were made.¹

There were 246 dairies included in the inquiry. The investigation showed that 168 dairies produced milk or butterfat at a loss, or that about 60 per cent of the production of these 246 dairies was produced at a loss.²

Now it may be assumed that what was intended in the investigation was to create a representative picture of the dairy industry in California. So far as the geographical distribution of particular dairies and the number of dairies included are concerned, we need not question the picture: without attempting fine distinctions, we may

known facts and principles, would constitute a nice question. In many farm management investigations it is difficult to distinguish the contributions ascribed to the investigations but actually reached by other means. The question may often be raised whether or not a particular investigation contributed anything at all.

¹ Adams, *op. cit.*, 146-49.

² These total figures were not calculated in the bulletin, wherein figures were given for each of the 12 districts. They have been obtained by the present writer merely by listing and averaging the figures for districts appearing on pp. 147-50 of the bulletin.

assume that the sample is satisfactory. But are there other grounds for questioning the validity of the conclusions drawn?

TABLE 1.—SHOWING THE PERCENTAGE OF PRODUCTION ABOVE, BELOW, AND ON A LINE WITH AVERAGE COSTS AND AVERAGE RECEIPTS. DATA FROM TWENTY DAIRIES IN THE ALAMEDA, CONTRA COSTA, AND SANTA CLARA DISTRICT*

| Number of dairy | Cost of production per 100 pounds of whole milk | Proportion of output | Cumulative output | Point of average costs and receipts |
|-----------------|---|----------------------|-------------------|-------------------------------------|
| 9..... | \$2.13 | .8 | .8 | ..... |
| 14..... | 2.19 | 6.4 | 7.2 | ..... |
| 7..... | 2.44 | .6 | 7.8 | ..... |
| 230..... | 2.45 | 10.2 | 18.0 | Average price received \$2.50 |
| 6..... | 2.51 | 12.0 | 30.0 | |
| 2..... | 2.55 | 6.1 | 36.1 | |
| 226A..... | 2.63 | 7.5 | 43.6 | ..... |
| 228..... | 2.69 | 6.2 | 49.8 | ..... |
| 227..... | 2.72 | 1.2 | 51.0 | ..... |
| 13..... | 2.76 | 2.6 | 53.6 | Average cost \$2.83 |
| 4..... | 2.79 | 2.0 | 55.6 | |
| 3..... | 2.86 | 10.2 | 65.8 | |
| 21..... | 2.88 | 4.1 | 69.9 | ..... |
| 23..... | 3.24 | 10.0 | 79.9 | ..... |
| 229..... | 3.26 | 5.4 | 85.3 | ..... |
| 16..... | 3.33 | 6.6 | 91.9 | ..... |
| 10..... | 3.43 | 2.8 | 94.7 | ..... |
| 12..... | 3.44 | 1.9 | 96.6 | ..... |
| 17..... | 3.54 | 1.9 | 98.5 | ..... |
| 18..... | 4.34 | 1.5 | 100.0 | ..... |

* Table 30 in R. L. Adams, *The Cost of Producing Market Milk and Butterfat on 246 California Dairies* (California Agricultural Experiment Station Bulletin 372), November 1923, p. 148.

It is perhaps desirable in the first place to emphasize the significance of the quotations given above. These

statements and the figures accompanying them were unquestionably intended to convey the impression that, with 7 out of 10 dairymen producing at a loss and 60 per cent of the product being sold below cost of production, higher prices must be paid by consumers either immediately or eventually. For if higher prices should not prevail at once, dairymen would be forced to withdraw from business, supply would be greatly reduced, and prices would necessarily rise, assuming that consumers desired as much milk or butterfat as before. These conclusions are not stated in the bulletin in so many words, but as appears from the quotations given above, precisely such conclusions were in fact implied.

The critical reader may immediately raise several questions. Was the relationship of cost and price in the year March 1922-February 1923 an especially unfavorable relationship such as farmers must and do expect to occur at uncertain intervals; was this year in dairying the sort of a year which North Dakota wheat growers, or wheat growers in any fairly restricted area, expect to occur when the yield of wheat and prices are both low? This question is not answered in the bulletin and cannot be answered here. But it is a question which ought to receive attention in any similar investigation; for if farmers necessarily anticipate the occurrence of such years, they are not likely to reduce their output appreciably when such a year occurs. Further, is it proper to assume that the unfavorable cost-and-price relationship experienced by 168 of the 246 dairymen in this particular year must be experienced in succeeding years; do individual farmers retain the same relative rank in the cost array from year to year? In the succeeding chapter¹ evidence is produced to show that they do not; consequently there is no reason to suppose that anything like 168 out of 246 dairymen were on the verge of withdrawing from production. But

¹ Pp. 87-98.

aside from these matters, how do we know that the whole array of cost figures represents price-determining costs with accuracy? Is it certain that the costs presented in the bulletin are reasonable approximations to the costs upon which farmers either do or ought to calculate in determining whether or not to curtail production; or are they too high or too low? This is the significant question for consideration in the present chapter. The assumptions underlying the theory of cost-and-price relationships embodied in this bulletin—the bulk-line theory—may be considered subsequently,¹ and the kind of a price figure used in the comparison may be ignored.

The following figures show both the cost elements and amounts of each for the Alameda-Contra Costa-Santa Clara district:

| | Debits | Credits |
|---------------------------|---------------------|---------------------|
| Horse labor | \$ 5,331.73 | |
| Truck and auto..... | 7,390.70 | |
| Hauling milk | 41,604.55 | |
| Supplies | 12,860.49 | |
| Upkeep | 5,366.29 | |
| Taxes | 3,974.74 | |
| Insurance | 2,254.10 | |
| Mortality | 11,130.62 | |
| Feed | 267,628.99 | |
| Depreciation | 32,000.98 | |
| Use of land..... | 3,209.00 | |
| Interest | 37,074.88 | |
| Man labor | 131,208.60 | |
| Management | 27,906.00 | |
| Total debits | <u>\$588,941.67</u> | |
| Calves | | \$ 10,896.85 |
| Manure | | 11,857.65 |
| Total credits | | <u>\$ 22,754.50</u> |
| Total net cost..... | | \$566,187.17 |
| Milk produced (lbs.)..... | | 19,973,201 |
| Average cost per cwt..... | | \$2.83 |

¹ See below, pp. 224-28.

It is unnecessary to inquire into the accounting principles employed in the calculation of all of these items. Many of the items are of minor importance in the total cost or were computed merely by recording sums actually paid out in cash: such items were the first eight listed. For the district to which the figures above apply, these items amounted to about \$90,000, some 16 per cent of the total cost. The remaining items are largely, though not entirely, non-cash costs, and comprise 84 per cent of total costs; and it is with respect to these that accounting methods assume major significance.

In this study rent of land, or rather interest on investment in land, was not calculated in full as a cost. It was argued that a charge computed by multiplying current land values by an assumed interest rate of 6 per cent would have resulted in unreasonably high costs. But neither was rent of land specifically excluded. It was argued that the charging of home-grown feed at market prices less cost of delivery to markets automatically accounted for the contribution of crop land, but a charge for land not in crops was calculated on the basis of cash rentals current in the community. Economists would maintain that no trace of a charge for rent of land ought to enter into the cost statistics; but we need not trouble to discuss so small a charge as appears in the bulletin under consideration. Depreciation of buildings and equipment was calculated by reference to first cost and the dairyman's estimate of probable length of life; of dairy herds by subtracting the closing inventory valuation, as fixed by the dairyman, from the initial inventory similarly fixed. Interest was computed at a rate of 6 per cent, somewhat uncertainly chosen,¹ on investments in live stock, buildings, equipment, and improvements. Presumably the

¹"All things considered a rate of 6 per cent was deemed fair. However, if exception be taken to the use of this particular rate, it may be pointed out that sufficient detail in the tables will permit reworking with any other rate."
—Adams, p. 12.

valuations of investments to which the interest rate was applied were in part original costs, in part dairymen's valuations; but this is not made clear. Manual labor was calculated at rates actually paid if the labor was hired (though board and perquisites were assigned a value if wages were paid in the usual manner—so much plus board and lodging) and at going rates in the community if the labor was not hired. Management charges were computed by multiplying the amount of time spent by operators in purely managerial work by the going rate of salary for dairy managers, unless a salary was actually paid to the operator. From the published data it is impossible to determine how far they represent actual expenditures of cash; but that computed charges predominated may be assumed.

The question necessarily arising in the minds of critical readers is whether or not these methods resulted in costs clearly too high or too low; was the supply of milk likely to be curtailed by producers who received prices below costs so computed, or was it not? The only possible answer is a compromise. The cost-and-price situation was unquestionably an unfavorable one; for if it had not been the complaints current at the time would not have been voiced. On the other hand, the situation seems not to have been so bad as the picture given by the cost investigation. From the figures given, one might infer that 7 out of 10 producers were likely to withdraw 60 per cent of the supply; certainly nothing is said to warn readers that withdrawal would probably not go so far. One may concede that presumably some percentage of output as well as an indefinite number of producers was likely to disappear. How large a reduction in supply was likely simply cannot be determined; but there is every reason for supposing that it could not have been so large a reduction as the unqualified figures suggest.

The grounds for questioning the accounting principles

THE COMPILATION OF DATA

of this bulletin, the cost statistics erected by use of the principles, and the conclusions drawn from the statistics are necessarily general in nature. One cannot determine precisely what wage or what interest rate farmers must receive in order to be induced to maintain their output. But one may reasonably suspect that in the long run they need not receive as wages what they would like to receive at any particular time; they will accept less, though perhaps not without complaint. Nor is it certain that farmers growing crops and feeding them to cows must receive in receipts from milk exactly what they would receive from selling the crops. The calculation must be less direct and more involved: sale in full of home-grown feeds is not a precisely alternate opportunity to feeding home-grown crops. Any intelligent farmer must give some thought to the prices he would be likely to receive for these crops and for the animals which he had to sell when he changed his farm organization. His choice cannot reasonably be determined merely upon present cost-and-price relationships, but upon relationships likely to prevail over long periods. Farmers further find dairying a method of disposing profitably of roughage otherwise not marketable at all, and they would miscalculate if they refused to continue production when prices failed to cover home-grown feeds charged at market prices. With interest rates also, no sensible man would assume that merely because he knew he could sell his dairy herd at top prices and invest the receipts in 6 per cent municipal bonds, then it is necessarily wise for him to sell. He needs rather to consider the nature of the bonds, whether they are safe, whether they are callable, whether or not in the long run they promise to pay him a higher return than will his dairy herd. Farmers usually know the risks of their own pursuit better than the risks of others; consequently there is reason to suspect that something like a riskless interest rate is the rate which farmers in general view as their

alternative, as the rate which must be obtained by them if they are to continue to produce.

To an undeterminable extent the accounting principles employed in the bulletin under discussion permit farmers to evaluate their own labor and wages of management; they permit board of laborers to be calculated at the values farmers please to put upon it; they permit feed costs to be figured in a way which would not be followed by farmers in the long run; they permit inflated charges for interest to be included. One cannot say definitely that California dairymen in general would maintain production if 4, not 6, per cent was to be secured on invested capital, and if somewhat less than they would like to receive as wages was to be obtained. The truth of the matter obviously could not be determined by asking farmers in the midst of a depression. But on a priori reasoning it seems likely that such costs as were calculated in the bulletin under consideration were too high, certainly for cost-and-price comparisons.

It is futile to attempt to ascertain how much too high these cost figures were in fact. If, however, the costs incurred in the Alameda-Contra Costa-Santa Clara district be scaled down 10 per cent,¹ one reaches an average cost not of \$2.83 per hundredweight for the district, but of \$2.55; and, even adopting the bulk-line principle, one would have to say not that 15, but 10 of the 20 dairymen produced at a cost above the average price of \$2.50, while 45 per cent of the output, not 70 per cent, was produced at a cost higher than the price received. This procedure by no means creates a picture of cost-and-price relationship favorable to the dairymen of the district, but it is a picture less dark than that conveyed to readers by the published figures. In general it is a more acceptable pic-

¹ Such a percentage figure is employed merely in illustration. It appears to the writer as a conservative guess at the amount of inflation involved in the bulletin under consideration; but it is merely a guess, useful to show how inflated cost figures may lead to questionable conclusions.

ture, but no one knows how accurate. It is of interest to observe, however, that in the district in question prices of milk have not risen but have fallen since 1923; but so far as can be ascertained there has been no exceptional reduction in output and no withdrawal of dairymen from business.¹

Such an analysis as the foregoing, incomplete as it is, indicates clearly that not only the absolute size of the cost data published in many farm cost investigations, but also the reasoning underlying the principles of accounting which result in such cost figures, require careful analysis before conclusions can be accepted. In general it may be said that such data as have commonly appeared ought never to be used in cost-and-price discussions. The only sort of cost that affects price is a vaguely defined cost employed by farmers in deciding for themselves whether to curtail or expand production. In such cost calculations a reasonable being must look both backward and forward and must anticipate vicissitudes; and it is absurd to base conclusions on cost-and-price comparisons of a single year. For the costs in single years are not the costs which farmers use in their calculations; and the costs they do employ are so vaguely defined as not to be ascertainable by statistical means. If adequate samples of costs of production similarly defined, though however imperfectly, could be obtained for long periods of years, something might be made of cost-and-price comparisons. We should then be able at least to ascertain with fair precision when and how far the cost-and-price relation (cost being defined not in the economist's sense, but merely as postu-

¹ Professor E. C. Voorhies of the University of California has furnished the following yearly average prices of milk in cents per gallon f.o.b. Oakland, which lies in the district to which the cost data apply:

| | | | |
|-----------|-------|-----------|-------|
| 1920..... | 36.30 | 1924..... | 26.66 |
| 1921..... | 27.74 | 1925..... | 23.05 |
| 1922..... | 24.00 | 1926..... | 24.51 |
| 1923..... | 27.14 | | |

lated in the inquiry) was favorable or unfavorable. But no such investigations have been made, and the labor—in view of the meager results to be anticipated—may be regarded as prohibitive.

In the present chapter we have seen that any and all farm cost statistics of money cost per unit of product (or per productive unit) must be accepted with reserve. The samples are often not adequate; as a practical matter it is seldom possible to secure complete data. But sampling difficulties are less important than difficulties in allocating joint costs. Joint costs prevail in agriculture, but any principle of allocation must be arbitrary. The prevailing principles of evaluating non-cash cost items, which constitute the larger proportion of total costs in agriculture, rest on unsound assumptions. In general farm cost statistics are likely to be inflated. This circumstance is of serious consequence when the data are used in cost-and-price discussion. In subsequent chapters we shall have occasion to consider the significance of currently accepted accounting principles from other points of view, and the drift of the present chapter will become increasingly clear when the general theory of cost-and-price relationship is analyzed. But it is first desirable to study the nature and causes of variations in costs, and the reliability of averages.

BIBLIOGRAPHICAL NOTE

Remarks on accounting principles will be found in practically every investigation wherein money cost figures appear. But such investigations are so numerous, and the comments so inconclusive, that little is to be gained by a comprehensive list. The most influential general systems of farm accounting have probably been those set forth in G. F. Warren, *Farm Management* (New York, Macmillan, 1913), chapters 16 and 17, and in H. T. Scovill, *Farm Accounting* (New York, Appleton, 1918). Some problems of valuation are discussed in G. F. Warren *et al.*, *Cost Accounts for Six Years on Some Successful New York Farms* (Cornell Agricultural Experiment Station Bulletin 414), February

1923, pp. 12-26. This bulletin discusses the propriety of charging home-grown feeds at market prices; on the same problem see H. J. Davenport, "Farm Products and Cost Accounting," *Journal of Political Economy*, May 1919, XXVII, 354-61, and C. S. Duncan, "Mercantile and Agricultural Economics," *ibid.*, October 1918, XXVI, 769-806. Discussions from the farm management investigator's point of view of the question of handling charges for rent and interest may be found in W. E. Grimes, "Interest and Rent in Cost Determination," *Journal of Farm Economics*, January 1923, V, 79-85, and in A. Leitch, "Interpretation to the Farmer of Cost of Production Data," *ibid.*, January 1924, VI, 61-68. A useful compendium of quotations from economists and accountants on the same problem is *Are Interest and Rent Fair Charges against Cost of Production?* a mimeographed document prepared by a committee of the American Farm Economic Association late in 1922 or early in 1923.

CHAPTER V

VARIATIONS IN COST

Whether or not the avowed objectives in cost inquiry can be achieved obviously depends largely upon the nature of the basic data and the validity of the analytical processes applied to them. We have already observed that farm cost data are largely estimates; but these estimates are not necessarily so inaccurate that averages computed from them are entirely untrustworthy. The averages, and the conclusions based upon them, are sometimes to be regarded as valid and sometimes not, so far as conclusions are conditioned by the accuracy of primary data. In the present chapter we turn to the question of the representative quality of averages.

A long-accepted doctrine of statistical theory is that the representative quality of an average of a series depends upon the dispersion of the members of the series. If, for example, we average the figures 500, 501, and 502, the result is 501; but we obtain an identical result by averaging the figures 1000, 500, and 3. Clearly 501 is a more representative average of the first series than of the second, because all members of the first series fall close to the average, while only one-third of the members of the second series do so. In statistical texts the proposition is illustrated by frequency curves similar to those shown in Figure 1. The average is identical for both series; but it is more representative for the humped than for the flattened series, because the dispersion of the former is much the greater of the two.

Not much attention has been given to the problem of dispersion of farm costs, or, as we shall term it, variation. Dispersion is a statistical concept certainly not grasped

by the rank and file of farmers today; it is perhaps not too well grasped by many farm cost investigators. That variation in farm costs requires attention even at the present time is evidenced not only by the widespread acceptance of difference in costs between countries as a basis for

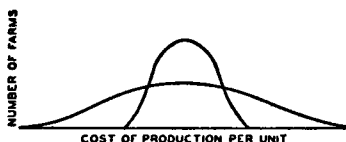


FIG. 1

tariff making, but also by various cost computations which involve the assumption that quantitative "inputs" do not vary to any appreciable degree from year to year, though cost rates may vary widely.¹ It is true that farm management investigators no longer urge farmers to adopt methods and practices which are shown to be profitable merely on a single experimental farm; yet this was the common practice twenty years ago. Probably not even a farmers' organization would accept today the validity of an argument that, because it cost (as expert accountants showed) a certain sum to produce wheat on a given farm in the Red River Valley, the price of wheat ought to be fixed in the neighborhood of that cost. Yet such an argument was advanced by the American Society of Equity in 1909. A vague notion that uniformity or near uniformity in farm costs prevails apparently persists in the minds of many, and constitutes a tacit assumption or unconscious presupposition, difficult to illustrate by concrete examples, upon which no small amount of the current belief in the usefulness of cost data depends. Whether or not costs vary and how and why they vary,

¹ See, for example, the cost computations endorsed by the Corn Belt Committee in 1926.

² "Paper . . . Showing the Cost of Raising Wheat in Red River Valley," 60th Congress, 2nd Session, *Senate Document No. 699*.

are questions upon which some light still remains to be thrown.

TYPES OF VARIATIONS

We have previously observed that there are several types of farm cost statistics. Several types of variations may be observed in any of these types of statistics. Suppose, for example, that costs per bushel of producing wheat were obtained from 10,000 individual farms scattered over the United States for each of five years, and that data were obtained from the same farms in each year. We might calculate as a final average the average five-year cost of producing wheat in the United States. We might secure five final figures showing average costs in the United States for each of the five years. We might split the 10,000 farms into five or some other number of groups on a geographical basis, and compare one-year costs in the several groups or five-year costs in the several groups; or we might compare the five annual cost figures applicable to a particular group. Similarly we might compare frequency distributions of individual costs for different areas in the same year or the same area in different years; and the same comparisons might be made for particular farms.

The fundamental types of variation are two: between areas or individuals in the same year, and between years for the same area or individual. The first sort of variation we shall, for convenience, term "differences" in costs; the second we shall term "changes" in costs.

The available data on both differences and changes in costs are by no means so extensive as might be desired for illustrative purposes. Data on changes in costs are notably scarce. No publication has ever appeared containing costs of any sort incurred by as many as 500 identical farmers for a single agricultural product over a period of ten years. We have average costs per unit for

geographical areas and for several products over four years; we have costs per unit of producing milk on the same farms for two years. But on the whole the data on changes in costs, as between both areas and individuals, are not often encountered. Such data have sometimes been collected, notably by the route method, but seldom published.

Much more comprehensive data are available on differences in costs, largely because the survey method, the most convenient to use, lends itself well to investigation covering one year only; but partly because the notion has prevailed that statistics applicable to one year are, within fairly narrow limits, applicable to other years as well. This notion is of considerable importance from several points of view, as will presently appear; and it is desirable in the present chapter to examine its validity rather closely.

DIFFERENCES IN AVERAGE COSTS

We may examine first the existence and extent of differences in cost per bushel of producing wheat and corn in different geographical divisions of the United States for the single year 1923.¹

The average cost per bushel of producing wheat in the United States as a whole in 1923 was \$1.24. But, as the following figures show, the average costs in each of six

AVERAGE COST PER BUSHEL OF WHEAT IN SIX GEOGRAPHICAL DIVISIONS OF THE UNITED STATES IN 1923

| | |
|-------------------------|--------|
| Western | \$1.09 |
| East North Central..... | 1.11 |
| North Atlantic | 1.24 |
| West North Central..... | 1.24 |
| South Central | 1.32 |
| South Atlantic | 1.60 |

¹ The data cited in this section, except as otherwise noted, are from M. R. Cooper and C. R. Hawley, *Cost of Producing Field Crops, 1923* (U.S. Department of Agriculture Circular 340), May 1925.

geographical divisions showed a considerable range, from \$1.09 in the Western division to \$1.60 in the South Atlantic division. These are rather large geographical divisions, each including a number of states. Further variations are shown in the state average costs, for example between states of the Western division, where the average cost for the division was \$1.09.

| | |
|------------------|--------|
| Washington | \$.97 |
| New Mexico | .97 |
| Wyoming | .98 |
| Idaho | 1.04 |
| Colorado | 1.07 |
| Montana | 1.09 |
| California | 1.09 |
| Oregon | 1.12 |
| Utah | 1.19 |

Among all states (35 in number) going to make up the average United States cost of \$1.24, the range in cost per bushel was from \$0.96 to \$1.92. Georgia produced wheat at a cost (\$1.92) 100 per cent greater than the cost in Illinois (\$0.96); North Carolina incurred costs (\$1.79) nearly 100 per cent greater than costs in Washington (\$0.97); North Dakota incurred costs (\$1.41) nearly 30 per cent higher than those in the neighboring state of Montana (\$1.09). If, now, it were possible to secure costs applicable to all counties within any state, we should unquestionably find similar variations; and so also between costs incurred by individuals in each county. It is perfectly possible that the range between individual costs going to make up the United States average may have been at least as great as from \$0.50 to \$25.00 per bushel in 1923.¹

Variation is similarly apparent in cost per bushel of

¹ See Chart 2, p. 77, for examples of differences in individual costs of wheat production per bushel.

producing corn. The average cost for the United States in 1923 was \$0.68; the range in average costs applicable to geographical divisions was from \$0.54 in the West North Central region to \$0.88 in the South Central region; the range in state average costs was from \$0.42 in North Dakota to \$1.33 in Connecticut. If data were available we should unquestionably find wider variations as between average county costs, and yet wider as between individual costs. Data on oats and potatoes exhibit the same characteristic variations. It may be said that average costs per unit of product for all agricultural products differ widely as between different geographical areas, and that differences are larger between many small geographical areas than between a few large ones.

Costs per acre are sometimes regarded as more "stable," less variable, than costs per bushel. Yet in 1923, when the United States average cost per acre of producing wheat was \$21.92, the average cost in the West North Central area was \$16.17, while that in the North Atlantic area was \$28.43; and the extreme range in state average costs was from \$12.66 in North Dakota to \$38.10 in Utah. For the same year the cost per acre of producing corn was \$23.75 for the United States; \$18.81 in the West North Central area as against \$40.73 in the North Atlantic region; and \$13.40 in North Dakota as against \$78.33 in Connecticut. Costs per acre therefore also differ widely as between geographical areas.

These differences arise from many causes. Thus the average yield of wheat in 1923 ranged from 9 bushels per acre in North Dakota to 32 bushels per acre in Utah; and yield per acre of corn ranged from 16 bushels in Oklahoma to 59 bushels in Connecticut. Charges for land rent per acre on wheat varied from \$2.49 in North Dakota to \$13.05 in Utah. Charges for manure varied from \$0.13 in Texas to \$4.18 in New York; for seed, from \$1.06 in New Mexico to \$2.63 in New York; for commercial fertilizer,

from nothing in South Dakota, Texas, and Wyoming to \$5.02 in New Jersey; for preparation of soil and planting, from \$2.50 in South Dakota to \$6.90 in New York; for marketing, from \$0.68 in North Dakota to \$2.14 in Wyoming. Different prices of materials and labor, differences in nearness to markets, different cultural methods, and different quantitative expenditures prevail in different regions. All these influence the absolute size of money cost figures, whether per bushel or per acre. Moreover, the number of influences taken in conjunction with the fact that no single area appears to incur highest or lowest costs for all of the factors influencing costs, makes explanation of differences in total costs extremely complex.

Not only do costs per bushel and per acre expressed in terms of money vary widely between geographical areas, but quantitative costs vary also. Thus 6.4 hours of man labor were employed in threshing an acre of wheat in Hancock County, Illinois, in 1919; but in Franklin County 3.9 hours were required.¹ In New York in 1920, 511 pounds of commercial fertilizer was applied per acre of tomatoes in Orleans County, 538 in Niagara County, 777 in Chautauqua County; and (from 1917 to 1920) 1.9 tons of manure were used in Chautauqua County, 3.8 in Orleans, 4.1 in Niagara.² The figures in Table 2 show differences in average quantitative costs per acre of producing wheat, oats, and barley in four regions of North Dakota in 1921. Clearly quantitative costs are not the same between different areas in the same year; the variations are in fact larger than merely notable.

Total man or horse hours per acre we should, of course, expect to vary as yields vary: more labor must be employed in harvesting a 30-bushel than a 5-bushel crop. But variations are notable in pre-harvest operations as

¹ *Illinois Agricultural Experiment Station Bulletin 267*, May 1925, p. 381.

² *Cornell Agricultural Experiment Station Bulletin 412*, December 1922, pp. 48 f.

well. In the Red River Valley 40 per cent more seed was used than in the northwestern and southwestern regions of North Dakota. Further evidence of wide variation in

TABLE 2.—DIFFERENCES IN QUANTITATIVE COSTS OF CEREAL PRODUCTION IN FOUR REGIONS OF NORTH DAKOTA, 1921*

| Crop and Area | Man hours | Horse hours | Tractor hours | Bushels of seed | Pounds of twine |
|-----------------------|-----------|-------------|---------------|-----------------|-----------------|
| <i>Wheat</i> | | | | | |
| Red River Valley..... | 5.1 | 15.4 | .4 | 1.4 | 2.0 |
| Central | 4.4 | 14.8 | .2 | 1.3 | 1.9 |
| Northwest | 5.3 | 15.9 | .1 | 1.0 | 1.8 |
| Southwest | 4.6 | 14.6 | .2 | 1.0 | .3 |
| <i>Oats</i> | | | | | |
| Red River Valley..... | 5.1 | 15.8 | .3 | 2.3 | 2.0 |
| Central | 4.2 | 13.9 | .3 | 2.0 | 2.0 |
| Northwest | 5.4 | 20.3 | .1 | 1.7 | 1.8 |
| Southwest | 5.1 | 16.2 | ... | 1.6 | .7 |
| <i>Barley</i> | | | | | |
| Red River Valley..... | 5.3 | 16.5 | .2 | 1.8 | 1.8 |
| Central | 4.4 | 15.0 | .3 | 1.6 | 1.8 |
| Northwest | 5.0 | 19.5 | ... | 1.3 | 1.5 |
| Southwest | 4.8 | 15.3 | .1 | 1.4 | .4 |

* Data from North Dakota Agricultural Experiment Station Bulletin 165, December 1922, p. 72.

pre-harvest quantitative costs is given by the following figures for man and horse hours employed in 1919 in preparation and seeding wheat in 9 counties, located in Kansas, Missouri, and Nebraska:¹

| Area | Man hours per acre | Horse hours per acre |
|-------------------------|--------------------|----------------------|
| <i>Kansas</i> | | |
| Ford County | 2.8 | 12.0 |
| Pawnee County | 2.6 | 11.7 |
| McPherson County | 4.5 | 18.8 |
| <i>Missouri</i> | | |
| Saline County | 5.1 | 18.5 |
| Jasper County | 8.1 | 26.8 |
| St. Charles County..... | 8.2 | 25.1 |

¹ U.S. Department of Agriculture Bulletin 943, April 1921, p. 26.

| Area | Man hours per acre | Horse hours per acre |
|---------------------|-----------------------|-------------------------|
| <i>Nebraska</i> | | |
| Phelps County | 3.7 | 13.0 |
| Saline County | 6.7 | 24.7 |
| Keith County | 2.7 | 9.3 |

These figures are for operations done by horse power alone; farms employing tractors are excluded. Over 200 per cent more hours of man labor were used in St. Charles County than were used in Pawnee County, and nearly 200 per cent more hours of horse labor were used in Jasper County than in Keith County. These cannot be regarded as small or negligible variations.

Similar data are available for hours of man and horse labor employed in plowing and cultivating an acre of sugar beets in four separate districts in the states of Utah and Idaho.¹

| Area | Plowing | | Cultivation | | Total | |
|--|--------------|----------------|--------------|----------------|--------------|----------------|
| | Man hours | Horse hours | Man hours | Horse hours | Man hours | Horse hours |
| Lehi, Utah | 6.6 | 20.1 | 9.5 | 10.2 | 16.1 | 30.3 |
| Garland and Tremonton, Utah Idaho Falls and Blackfoot, Idaho | 5.5 | 18.3 | 5.1 | 9.8 | 10.6 | 28.1 |
| Twin Falls, Idaho..... | 4.9 | 15.2 | 5.7 | 10.7 | 10.6 | 25.9 |
| | 5.2 | 17.0 | 6.9 | 12.3 | 12.1 | 29.3 |

Over 50 per cent more hours of man labor and some 20 per cent more hours of horse labor were used in the Lehi area than in the Idaho Falls area.

Many other examples of differences between areas in both money and quantitative costs, and in costs not correlated with yield, might be presented. But further evidence is not necessary to demonstrate the existence of wide differences between areas; such differences might for the most part be expected on account of long recog-

¹ U.S. Department of Agriculture Bulletin 963, September 1921, pp. 26 f.

nized differences in soil, climate, and intensity of cultivation as between widely separated geographical areas. The existence and extent of differences in costs on individual farms located within comparatively small areas is of still greater importance.

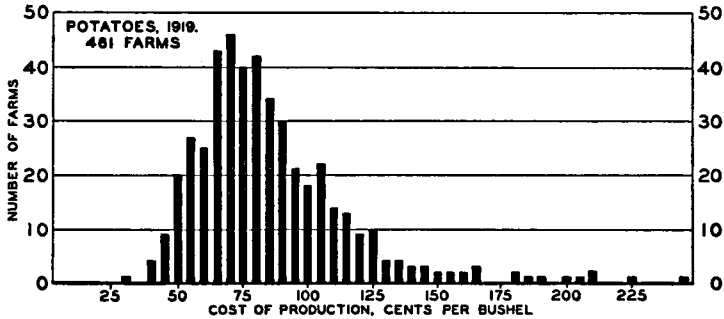
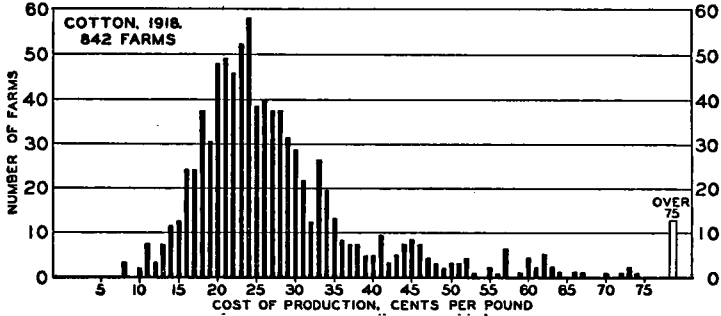
DIFFERENCES IN INDIVIDUAL COSTS

Chart 1 (p. 76) and Chart 2 (p. 77) display variations in money costs per unit of producing cotton, potatoes, and wheat (winter and spring) on individual farms scattered over wide areas. The data on cotton were secured from farms in South Carolina, Georgia, Mississippi, and Texas; potato costs were obtained in Maine, New York, Michigan, Wisconsin, and Minnesota; spring-wheat costs from Minnesota, North Dakota, and South Dakota; winter-wheat costs (1919 and 1920) from Kansas, Missouri, Nebraska, and (1920) Oklahoma.

The range in costs, as one would expect when farms are scattered over areas so different in soil and climate, is wide. The difficulty of computing a representative average from a series with such wide dispersion is so apparent as to require little comment. In the case of cotton, only 58 out of 842 individuals, less than one-tenth of the total number, incurred costs of 24 cents per pound (and this was the modal or most common figure); whereas 37 had costs of 18 cents—25 per cent lower, 26 had costs of 33 cents, and on 51 farms the costs ran above 50 cents per pound. The coefficients of variation¹ calculated from the frequency distributions of Charts 1 and 2 ran as follows: for cotton, 46 per cent; for potatoes, 35 per cent; for winter wheat (1919), 34 per cent; for winter wheat (1920), 50

¹ The coefficient of variation is the standard deviation of a series divided by the mean. Coefficients of variation, being measures of dispersion expressed in percentage form, permit comparisons of frequency series made up of different data, e.g., dollars as against inches or pounds. Standard deviations, being expressed in the units of the frequency series from which they are derived, do not lend themselves to comparison when these units differ.

CHART 1.—DIFFERENCES IN COSTS PER UNIT OF PRODUCING COTTON AND POTATOES ON LARGE NUMBERS OF FARMS WIDELY SEPARATED GEOGRAPHICALLY*

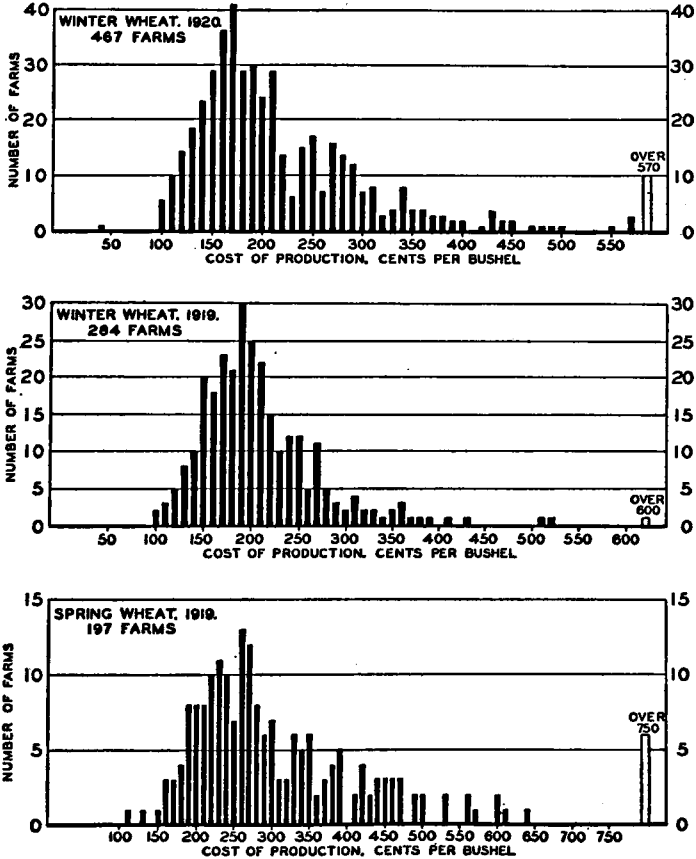


* Data from U.S. Department of Agriculture Bulletins 896, November 1920, p. 47; 1188, April 1924, p. 15.

per cent; for spring wheat, 53 per cent. These figures contrast sharply with the coefficient of variation for heights of men, 3.7 per cent.¹ People commonly look upon the "average man's" measurements as unrepresentative in the sense that a great many men do in fact differ in height,

¹ Calculated from data on the heights of 8,585 male adults in the British Isles, as given in G. Udny Yule's *Introduction to the Theory of Statistics* (London, Griffin, 1911), pp. 112, 141.

CHART 2.—DIFFERENCES IN COSTS PER BUSHEL OF PRODUCING WINTER AND SPRING WHEAT ON LARGE NUMBERS OF FARMS WIDELY SEPARATED GEOGRAPHICALLY*



* Data from U.S. Department of Agriculture Bulletins 1198, April 1924, p 27; 943, April 1921, pp. 47 f.

weight, and so on from the "average man." Yet it would appear that those who view with suspicion such an aver-

age as height of men are willing to accept an average cost figure as representative, despite the fact that dispersion about the average cost is far larger than dispersion about the average height.

More than one sort of an average might, of course, be computed from any of the frequency series of Charts 1 and 2. Unweighted averages would be arithmetic, harmonic, and geometric means, the median, and the mode; and given the volume of production on each farm, the first three means might be weighted. Different results might be obtained by using different averages. The arithmetic averages for frequency distributions negatively skewed, as are those in Charts 1 and 2, would yield a higher figure than the mode; the median would ordinarily yield a higher figure than the arithmetic average. If price fixing on the basis of cost data were to be practiced, not a little difference of opinion might therefore arise regarding the proper form of average of costs to employ. The statistical criteria for the choice of an average are not rigid.

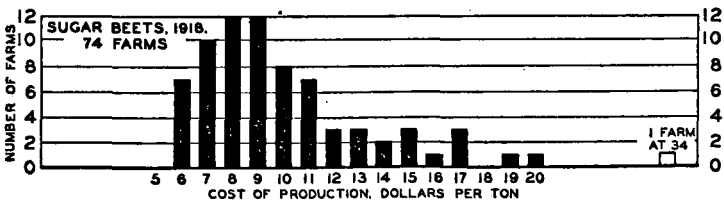
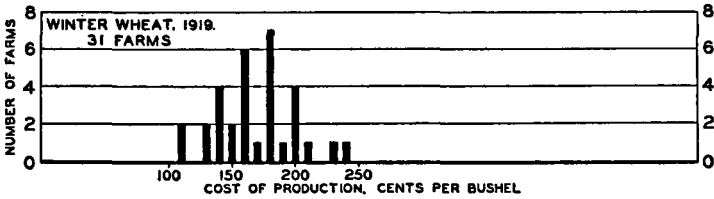
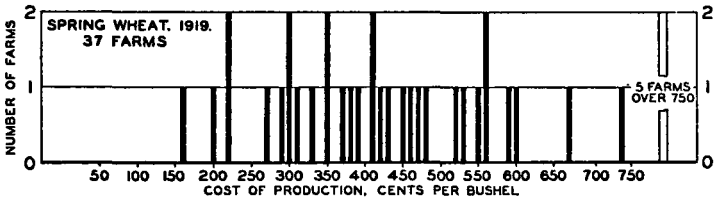
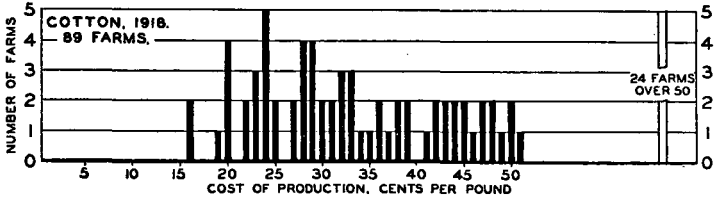
Charts 1 and 2 show variations in the costs per unit of producing only three agricultural products. Some may regard these charts, taken alone, as doubtful evidence that money cost per unit varies widely from farm to farm in the same year, whatever product is considered. They display, in fact, some evidence that variation is much greater for some products than for others: the curves for winter wheat (1919) and potatoes show considerably less dispersion than those for cotton, spring wheat, and winter wheat (1920). But it is to be observed that the variations in costs are wide in all instances, and that the average for any of the five series could be questioned for its representative quality. Available evidence is not sufficient to permit the conclusion that in any given year the costs of certain crops (for example, cotton) vary much less as between individual farms than the costs of certain other crops (for

example, milk). But Charts 1 and 2, taken in conjunction with data subsequently to be presented, indicate that the costs per unit of product incurred by individuals vary widely for any crop in any year.

It might be objected that wide variations ought to be expected when one considers the costs incurred on farms separated by hundreds or even thousands of miles, but that no such variations ought to appear within smaller areas much more homogeneous in soil and climate. In fact, however, differences in costs incurred on farms located within the same county are notable. This is shown in Chart 3 (p. 80) and Chart 4 (p. 81), which display variations in money costs per unit of producing cotton, spring wheat, winter wheat, sugar beets, tobacco, and milk. In every instance the range between the high and the low cost figure is very wide. In only a single instance (sugar beets, Chart 3) is there any evident tendency for costs to cluster about a central representative figure. The dispersion of each of the series is so large as to render any form of average unrepresentative.

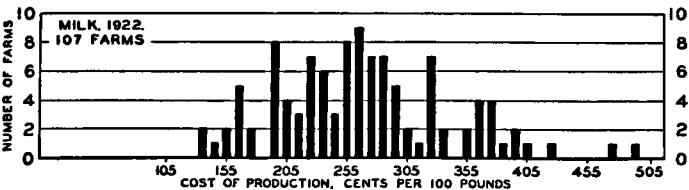
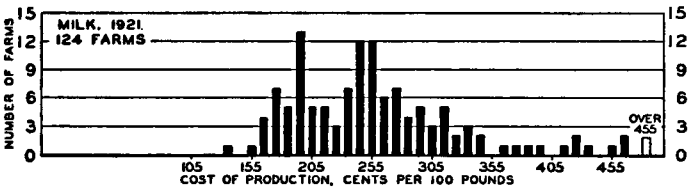
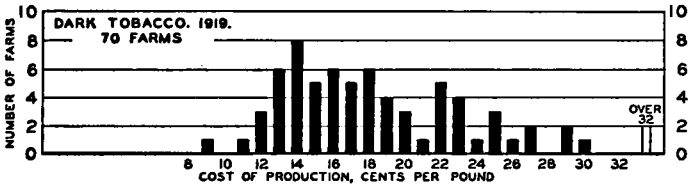
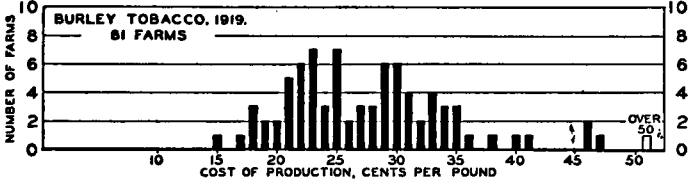
The prevalence of wide dispersion in the series shown in Charts 3 and 4 may in part be due to the comparatively small number of individual cost figures which go to make up the frequency distributions; more data might have yielded smoother curves with better defined modes. It is impossible, however, adequately to test this theory on the basis of available data. The probability is that costs would vary widely within any given county even if large numbers of records were obtained. For yield, one of the most important influences on cost per unit, may vary widely on farms within the same neighborhood. On the spring-wheat farms whose costs per bushel are plotted in Chart 3, yield per acre varied from 1.0 to 9.6 bushels per acre. Other examples might be given. Moreover, quantitative costs vary from farm to farm more widely than one might suppose.

CHART 3.—DIFFERENCES IN COSTS PER UNIT OF PRODUCING COTTON, SPRING WHEAT, WINTER WHEAT, AND SUGAR BEETS ON SMALL NUMBERS OF FARMS LOCATED WITHIN COUNTIES*



* Data from U.S. Department of Agriculture Bulletins 896, November 1920, p. 53; 943, April 1921, pp. 54 f., 58; 963, September 1921, p. 20.

CHART 4.—DIFFERENCES IN COSTS PER UNIT OF PRODUCING TOBACCO AND MILK ON FARMS LOCATED WITHIN RESTRICTED AREAS*



*Data from *Cornell Agricultural Experiment Station Bulletin 438*, March 1925, pp. 97-100; *Kentucky Agricultural Experiment Station Bulletin 229*, October 1920, pp. 147, 150.

Little evidence is available on farm-to-farm variations in quantitative costs. Some variation would be expected in view of differences in yield; and variations appear in total hours of man or horse labor employed per acre on various crops. Thus, among 81 Burley tobacco growers in Kentucky in 1919, the range in hours of man labor per acre was from 188.4 to 555.8, in hours of horse labor from 50.8 to 211.7; among 70 producers of dark tobacco, man hours per acre ranged from 156.4 to 649.6, horse hours from 54.0 to 179.0.¹ Among 48 Wisconsin dairy farms in 1920, the range in hours of man labor per cow per year was from 116 to 368.² In Pike County, Missouri, in 1920, variations in hours of man labor per acre of winter wheat were as follows:³

| Hours of man labor | Number of farms |
|-----------------------|--------------------|
| 8 to 10..... | 3 |
| 10 to 12..... | 7 |
| 12 to 14..... | 10 |
| 14 to 16..... | 6 |
| 16 to 18..... | 8 |
| 18 to 20..... | 4 |
| 20 and above..... | 3 |

In Champaign and Piatt counties, Illinois, among 14 farms producing corn, the range in hours of man labor per acre was from 9.73 to 17.24; in hours of horse labor, 21.15 to 43.10.⁴

These few examples (others could be adduced) are perhaps sufficient to demonstrate that, within small areas, different farmers apply different quantities of labor per

¹ *Kentucky Agricultural Experiment Station Bulletin 229*, October 1920, p. 190.

² *U.S. Department of Agriculture Bulletin 1144*, March 1923, p. 10.

³ *U.S. Department of Agriculture Bulletin 1198*, April 1924, p. 7.

⁴ Case and Bonnen, *Cost of Producing Farm Products on 14 Farms, in Illinois, 1925*, p. 4.

acre.¹ But in these illustrations, which deal with total hours per acre, yield must have been influential in causing variation. Is uniformity usual in the application of labor and materials when yield exerts no influence? From the available evidence, it appears not. On 25 farms in Michigan in 1914, succulent roughage fed per cow per year to dairy cows ranged from .4 ton to 7.41 tons; in dry roughage and bedding used, from .178 ton to 4.02 tons; in concentrates, from .22 ton to 6.43 tons; and in total feed and bedding, from 4.04 tons to 16.37 tons.² Variations in hours of labor per acre employed in the operations of plowing, listing, disking, and harrowing for winter wheat on 16 farms in McPherson County, Kansas, in 1922 were as follows:³

| Farm No. | Hours of man labor | Hours of horse labor | Hours of tractor labor |
|------------|--------------------|----------------------|------------------------|
| 13..... | 1.72 | 7.94 | .... |
| 1..... | 2.11 | 10.77 | .... |
| 5..... | 2.32 | 8.17 | 0.70 |
| 12..... | 2.37 | 4.65 | .36 |
| 4..... | 2.40 | 10.53 | .... |
| 14..... | 2.50 | 11.67 | .... |
| 6..... | 2.55 | 5.38 | 1.18 |
| 2..... | 2.66 | 6.16 | 1.08 |
| 7..... | 2.79 | 16.81 | .... |
| 3..... | 2.75 | 4.50 | 1.38 |
| 17..... | 3.00 | 7.86 | .96 |
| 15..... | 3.09 | 13.94 | .... |
| 10..... | 3.20 | 15.66 | .... |
| 18..... | 3.37 | 15.84 | .... |
| 8..... | 3.44 | 14.05 | .... |
| 11..... | 3.92 | 16.82 | .... |
| Range..... | 1.72-3.92 | 4.65-16.82 | .... |

¹ Of course one must not suppose that an hour of labor is a perfect unit of measuring energy expended. For all that is known, one hour of one farmer's labor may involve the expenditure of as much energy, and equal in effectiveness two hours of his neighbor's.

² *Michigan Agricultural Experiment Station Bulletin 277*, December 1916, p. 18. For details, see Table 6, p. 91.

³ *U.S. Department of Agriculture Bulletin 1296*, January 1925, pp. 13 f.

Seed-bed preparation for oats on 15 of the same farms required from 1.64 to 5.10 hours of man labor per acre, and from 5.01 to 23.30 hours of horse labor; seed-bed preparation for corn on 17 farms required from 3.10 to 8.54 man hours, 10.71 to 35.66 horse hours. In southwestern Minnesota in 1921, plowing, among 19 farms, required from 1.81 to 4.34 man hours and from 8.60 to 15.73 horse hours per acre; among 21 farms, disking required from .145 to .84 man hours and from 1.80 to 2.97 horse hours; and among 22 farms, harrowing required from .19 to .46 man hours and from .76 to 1.84 horse hours.¹

Variations in the bushels of seed planted per acre of potatoes in Steuben and Monroe counties, New York, in 1912 and 1913 were as follows:²

| STEBUEN COUNTY, 1912 | | MONROE COUNTY, 1913 | |
|----------------------|--------------------|---------------------|--------------------|
| Bushels per acre | Number of farms | Bushels per acre | Number of farms |
| 6 to 8..... | 19 | Less than 10..... | 38 |
| 8 to 10..... | 138 | 10 to 12..... | 62 |
| 10 to 12..... | 126 | 12 to 14..... | 111 |
| 12 to 14..... | 57 | 14 to 16..... | 69 |
| 14 to 18..... | 20 | 16 and more..... | 20 |

The evidence, incomplete as it is, indicates that farmers within restricted areas differ in their practices to a notable extent. This appears to be true of quantities of materials and labor applied during pre-harvesting operations, before the accident of yield has introduced variations. It is true for many, probably all, agricultural products, in any given year.

CHANGES IN AVERAGE COSTS

That agricultural costs of several types vary from area to area and from farm to farm in the same year is certain. Whether or not costs change from year to year in the same

¹ *Minnesota Agricultural Experiment Station Bulletin 205*, November 1923, p. 25.

² *Cornell Agricultural Experiment Station Memoir 57*, June 1922, pp. 1227, 1229.

area or on the same farm is a question less well understood. Here changes in costs from year to year on the same group of farms are of paramount importance. Are there consistently low-cost or consistently high-cost producers; do individual farmers tend to retain, from year to year, the same position on the cost curve? If so, the process of drawing conclusions from data gathered in a single year is sound. But if not, much of the customary reasoning about tariff making, price fixing, cost-and-price relationships, and improvement of farm efficiency, is of doubtful validity. A good deal depends upon the extent of year-to-year variations in cost, if these exist; for the greater the variations may be, the more difficult it becomes to select an average cost which may properly be regarded as representative. Although the data are meager, we shall find that changes in costs on identical farms seem not only to be general, but also large.

Of changes in average costs, either money costs per bushel or per acre, or quantitative costs, there are few examples. Table 3 (p. 86) shows changes in money costs per acre and per bushel of wheat and corn over the years 1922-26, for the United States as a whole and six geographical divisions.

The maximum change in cost per bushel of corn is 27 cents between costs in 1923 and 1926 in the Western division—a 30 per cent increase. For wheat the maximum change is 51 cents between 1925 and 1926, in the South Central region—a decrease of more than 30 per cent. Per acre costs changed considerably less in terms of percentages. Changes in average costs applicable to large areas appear to be small by comparison with differences in average costs applicable to large areas. If, however, it were possible to determine changes in state average costs (state averages have been published only for 1923), as between all five years, we should probably observe more striking changes; and county average costs would probably appear

still more striking. Figures for the cost per bushel of producing wheat in North Dakota for the years 1919 to 1922 show a range of more than 100 per cent—from \$2.47 in 1919 to \$1.03 in 1922; and costs per acre ranged from \$20.37 in 1920 to \$13.84 in 1922.¹ These figures, however,

TABLE 3.—FARM COSTS PER ACRE AND PER BUSHEL OF PRODUCING CORN AND WHEAT IN THE UNITED STATES BY GEOGRAPHICAL DIVISIONS, 1922-26*

| Geographical division | Net cost per acre | | | | | Net cost per bushel | | | | |
|------------------------|-------------------|-------|-------|-------|-------|---------------------|------|------|------|------|
| | 1922 | 1923 | 1924 | 1925 | 1926 | 1922 | 1923 | 1924 | 1925 | 1926 |
| CORN | | | | | | | | | | |
| North Atlantic | 43.09 | 40.73 | 41.99 | 44.23 | 42.70 | .83 | .87 | 1.02 | .87 | .91 |
| South Atlantic | 25.01 | 25.57 | 27.07 | 27.71 | 26.13 | .83 | .85 | .97 | .96 | .84 |
| East North Central | 25.83 | 26.77 | 25.60 | 27.35 | 26.06 | .56 | .61 | .75 | .56 | .61 |
| West North Central | 17.89 | 18.81 | 18.96 | 19.98 | 18.28 | .53 | .54 | .70 | .59 | .68 |
| South Central | 19.38 | 21.18 | 21.18 | 21.87 | 20.72 | .75 | .88 | .88 | .99 | .74 |
| Western | 20.14 | 19.02 | 18.58 | 20.77 | 19.59 | .67 | .66 | .88 | .83 | .93 |
| United States | 23.01 | 23.75 | 23.77 | 24.97 | 23.10 | .66 | .68 | .82 | .69 | .70 |
| WHEAT | | | | | | | | | | |
| North Atlantic | 28.42 | 28.43 | 28.46 | 30.43 | 29.41 | 1.35 | 1.24 | 1.42 | 1.32 | 1.28 |
| South Atlantic | 22.45 | 22.42 | 23.92 | 25.49 | 24.24 | 1.60 | 1.60 | 1.60 | 1.50 | 1.21 |
| East North Central | 21.08 | 22.12 | 23.05 | 23.29 | 23.37 | 1.17 | 1.11 | 1.15 | 1.29 | 1.02 |
| West North Central | 15.42 | 16.17 | 17.38 | 17.16 | 16.31 | 1.03 | 1.24 | .97 | 1.23 | 1.16 |
| South Central | 17.23 | 17.16 | 17.74 | 17.89 | 18.61 | 1.44 | 1.32 | 1.18 | 1.49 | .98 |
| Western | 22.90 | 23.95 | 24.05 | 26.20 | 23.93 | 1.09 | 1.09 | 1.20 | 1.19 | 1.20 |
| United States | 19.68 | 21.02 | 21.88 | 22.41 | 21.33 | 1.23 | 1.24 | 1.22 | 1.32 | 1.12 |

* Compiled from *Crops and Markets*, June 1927, IV, 203.

would be expected to show greater changes than similar figures applicable, as in the first illustration, to the years 1922 to 1926, when prices of materials and labor rates were more stable.

Available information on changes in money costs as

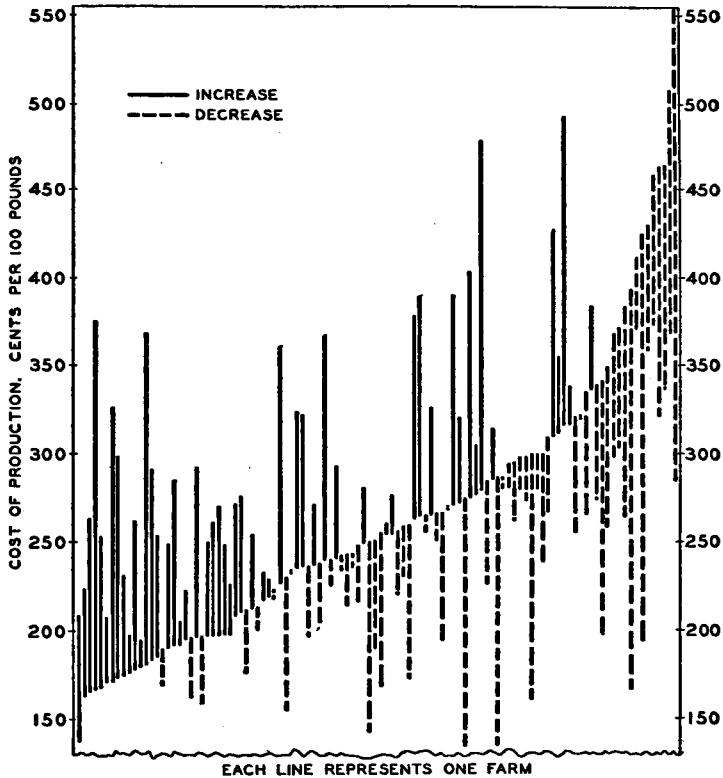
¹North Dakota Agricultural Experiment Station Bulletin 165, December 1922, p. 83.

between areas and sub-areas over a series of years is too insufficient to warrant definite conclusions. More change is to be expected for small areas than for large—for costs in a single county as against costs in the United States as a whole—because in the large areas more stability of yield is likely. Similarly more change is to be expected in years when the general price level changes radically than in years of comparative price stability. Very little change is to be expected in average quantitative costs for pre-harvesting operations, at least when the averages apply to very large areas; more would be expected in smaller areas. On the subject of changes in average quantitative costs the information is too meager to warrant the use of illustration, especially in view of more extensive and more significant data on changes in quantitative costs on the same farms in different years.

CHANGES IN INDIVIDUAL COSTS

Chart 5 (p. 88) shows both the direction and the extent of changes in costs per hundredweight of producing milk on 108 farms in New York between 1921 and 1922. In this chart costs incurred in 1921 are arranged in a curve running from the lowest to the highest; and 1922 costs are indicated by the ends of the bars distant from the central curve. A solid bar represents the fact that cost on a particular farm increased between 1921 and 1922; a broken bar indicates that cost on a particular farm decreased. On 53 of these farms 1922 costs were increased over 1921 costs; on 55 farms 1922 costs were lower than 1921 costs: about half of the farmers incurred higher costs in the second year than in the first, while the other half incurred lower costs in the second year than in the first. Further, a tendency appears for high-cost producers in one year to reduce their costs in the next year; and conversely, for low-cost producers to increase their costs in the next year. Of the 25 farms where costs were highest in 1921, 20 re-

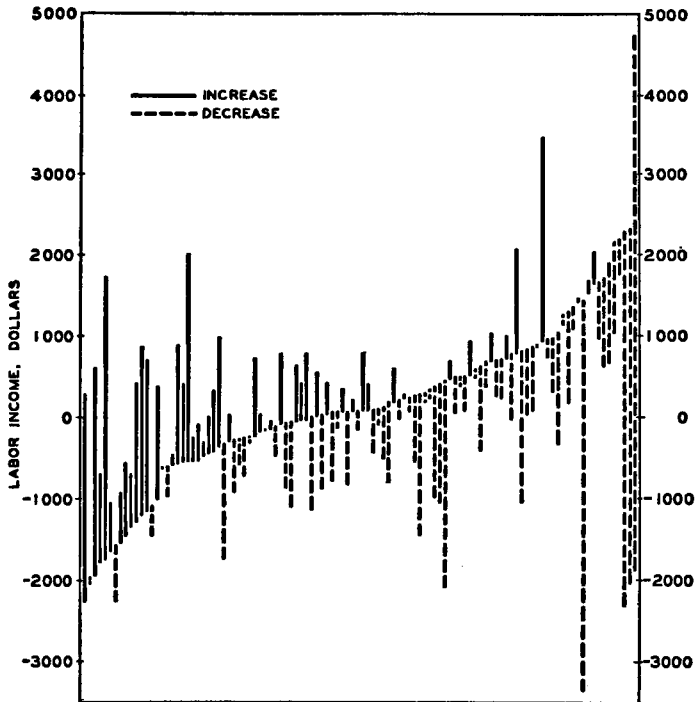
CHART 5.—CHANGES IN THE COST PER HUNDREDWEIGHT OF PRODUCING MILK ON 108 FARMS IN NEW YORK, 1921 TO 1922*



* Data from *Cornell Agricultural Experiment Station Bulletin 438*, March 1925, pp. 97-100.

duced their costs in 1922; of the 25 low-cost farms in 1921, 22 incurred increased costs in 1922. It is clear that extreme changes, alternation from a high-cost to a low-cost position between two years, were by no means uncommon on this group of farms. Consistently high-cost or low-cost producers were, at least in this instance, uncommon.

CHART 6.—CHANGES IN LABOR INCOMES ON 108 NEW YORK FARMS, 1921 TO 1922*



* Data from *Cornell Agricultural Experiment Station Bulletin 438*, March 1925, pp. 97-100

Much the same conclusions may be drawn from Chart 6, which shows changes in labor incomes¹ on the same farms. The notion that a high-cost producer in one year is a high-cost producer the next—that, generally, producers closely maintain the same position on the cost curve from

¹ Labor income is calculated by subtracting from farm receipts all farm expenses except the operator's labor, and also an allowance for interest on farm capital (including land), ordinarily at about 5 per cent.

year to year—appears on the basis of these data to be unfounded. What appears, at least in Charts 5 and 6, is a general tendency toward erratic changes, and a special tendency for exceptionally low- or high-cost producers in one year to lose these exceptional positions in the year following. Of course common observation suggests that there are in fact exceptional men who consistently maintain positions as low-cost producers; but these charts indicate that such men are not always easy to discover, and in fact may not appear in some—perhaps many—localities.

Evidence respecting changes in quantitative costs is practically non-existent. Table 4, however, summarizes changes in quantities of food supplied per cow per year, and quantities of labor employed per cow per year, on 21 Michigan farms, 1914 and 1915. Increases in quantities fed and labor employed between the two years ordinarily occurred on farms where input was low in the first year; decreases ordinarily occurred on farms where input was high in the first year; and changes were erratic in the middle ranges. These data bear out, though by no means conclusively because of the small number of farms, the conclusion that, as between two years, erratic changes in cost occur, together with a tendency toward increases on farms of low costs in one year and decreases on farms of high costs.

Unfortunately we do not possess data on money costs per unit or per acre, or quantitative costs, gathered by identical methods under identical principles, for a reasonably large number of identical farms over a series of as much as ten years. The foregoing data comprise all the material available to the present writer on changes in money or quantitative costs; and these are not sufficient to provide a conclusive answer to the general problem of the nature and extent of changes in costs from year to year. They establish the presumption that the same farms

do not maintain the same relative positions on the cost curve in different years; but whether or not such a tendency would appear over a longer period of years is not clear.

TABLE 4.—CHANGES IN QUANTITATIVE INPUTS IN FEEDING DAIRY COWS ON 21 FARMS IN MICHIGAN, 1914 TO 1915*

(Tons or hours per cow per year)

| Farm No. | Tons of succulent roughage | | Farm No. | Tons of dry roughage and bedding | | Farm No. | Tons of concentrates | | Farm No. | Hours of man labor | |
|----------|----------------------------|------|----------|----------------------------------|------|----------|----------------------|------|----------|--------------------|-------|
| | 1914 | 1915 | | 1914 | 1915 | | 1914 | 1915 | | 1914 | 1915 |
| 14 | .42 | .18 | 21 | .78 | 1.24 | 24 | .22 | .68 | 5 | 108.3 | 124.5 |
| 4 | 2.16 | 3.36 | 8 | .85 | 1.27 | 5 | .38 | .38 | 24 | 129.5 | 176.0 |
| 8 | 2.47 | 2.53 | 9 | 1.10 | 1.68 | 21 | .54 | .95 | 21 | 138.9 | 154.3 |
| 5 | 2.49 | 2.12 | 5 | 1.17 | 1.99 | 6 | .60 | .77 | 18 | 140.0 | 147.8 |
| 11 | 2.77 | 5.41 | 19 | 1.19 | 1.46 | 18 | .77 | 1.05 | 8 | 154.7 | 139.7 |
| 17 | 2.78 | 4.08 | 6 | 1.28 | 2.05 | 4 | .79 | .81 | 14 | 165.8 | 143.1 |
| 10 | 3.08 | 3.63 | 22 | 1.30 | 1.49 | 2 | .79 | 1.37 | 10 | 168.1 | 159.2 |
| 25 | 3.34 | 3.73 | 20 | 1.40 | 1.29 | 8 | .86 | .81 | 11 | 172.9 | 194.3 |
| 24 | 3.40 | 4.33 | 10 | 1.50 | 1.25 | 20 | .89 | .58 | 22 | 173.3 | 154.0 |
| 18 | 3.58 | 4.38 | 12 | 1.53 | 1.38 | 3 | .92 | .65 | 19 | 177.8 | 162.5 |
| 3 | 3.93 | 4.38 | 18 | 1.60 | 2.50 | 10 | 1.00 | .92 | 4 | 178.0 | 185.9 |
| 6 | 3.98 | 5.09 | 2 | 1.64 | 3.24 | 11 | 1.06 | .49 | 25 | 179.4 | 169.1 |
| 22 | 3.99 | 4.89 | 24 | 1.64 | 2.18 | 9 | 1.09 | .26 | 6 | 181.7 | 191.6 |
| 20 | 4.30 | 3.52 | 17 | 1.70 | 2.37 | 12 | 1.14 | 1.11 | 2 | 188.3 | 170.3 |
| 19 | 4.45 | 4.61 | 4 | 1.76 | 2.61 | 25 | 1.20 | .81 | 17 | 200.5 | 274.9 |
| 13 | 4.57 | 4.83 | 13 | 1.85 | 1.58 | 14 | 1.26 | 1.37 | 9 | 205.7 | 214.9 |
| 2 | 4.58 | 3.97 | 11 | 2.26 | 2.06 | 22 | 1.27 | .88 | 3 | 206.2 | 216.2 |
| 12 | 5.28 | 5.51 | 3 | 2.39 | 2.54 | 17 | 1.32 | 1.62 | 15 | 218.0 | 196.0 |
| 9 | 5.73 | 5.69 | 25 | 2.53 | 2.43 | 13 | 1.43 | 1.43 | 20 | 223.5 | 206.0 |
| 15 | 5.92 | 2.96 | 14 | 2.71 | 3.41 | 19 | 1.45 | 1.19 | 13 | 229.0 | 230.2 |
| 21 | 7.41 | 6.38 | 15 | 4.02 | 1.22 | 15 | 6.43 | 6.66 | 12 | 255.8 | 212.8 |

* Compiled from A. C. Anderson and F. T. Riddell, *Studies in the Cost of Market Milk Production* (Michigan Agricultural Experiment Station Bulletin 277), December 1916, pp. 18, 21.

Statistics of labor incomes on the same farms over a period of years, however, provide a reasonably close analogy to the desirable but unavailable cost statistics.

Labor incomes are affected by all the factors that affect costs, though by other factors as well. Yields, prices of the production factors, quantitative inputs—all these affect both figures. It is customary to speak (though inaccurately) of good and bad farmers, high-profit and low-profit farmers, and low-cost and high-cost farmers as essentially the same. We might indeed suppose that, generally speaking, and assuming that farms much alike in size and type of farming furnished the data, men who produced all products lowest would be the highest-profit farmers in a given year. The actual difficulty in identifying low costs and high profits of course lies in the fact that farms of different sizes and types of farming are customarily included in the group; and that apparently individual farmers in a single year produce some products more cheaply than others. Nevertheless, partly because labor income figures as criteria of efficiency are of interest in themselves, and partly because changes in labor income from year to year on the same farms indicate broadly what might be expected in changes in cost, we shall find the data on labor incomes of value.

Charts 7, 8, 9, and 10 (pp. 94 ff.) show changes in labor incomes on identical farms over periods varying from four to seven years in length. The construction of the charts requires some explanation. Farms are numbered according to their rank in labor income over the period as a whole: that is, Farm No. 1 in each chart was the farm which had the highest average labor income over the period, which would be the seven years 1912-18 in Chart 8. Letters (A, B, C, etc.) are ascribed to figures applicable to particular years. Rank in labor income in particular years is shown along the sides of the chart. Every farm occupied some definite rank in labor income in every year. If in each year of the seven, Farm No. 1 had ranked first in labor income, the upper left-hand cell in Chart 8 would have contained seven letters:

FARM No. 1

| | | | |
|--------|---|---|---|
| Rank 1 | A | B | C |
| | D | E | F |
| | G | | |

So with Farm No. 2. For five farms, in five years, a chart showing a perfect tendency for farms to maintain the same relative ranks in labor income would appear as follows:

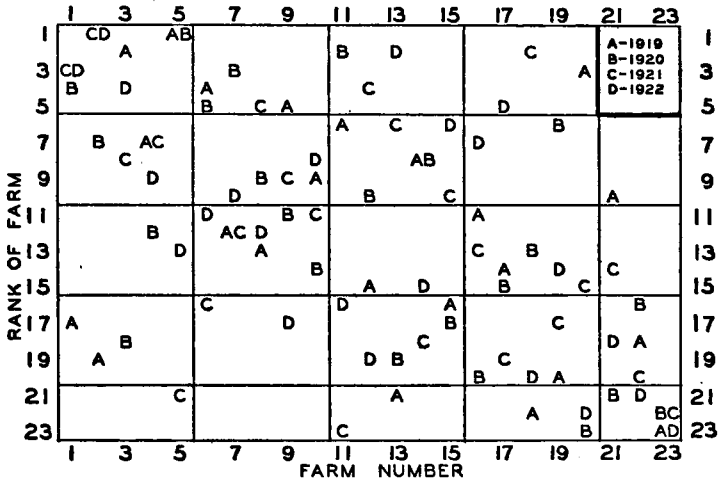
| | | FARM NUMBER | | | | | |
|------|---|--------------|--------------|--------------|--------------|--------------|--|
| | | 1 | 2 | 3 | 4 | 5 | |
| Rank | 1 | A B C D E | | | | | A = 1910 B = 1911 C = 1912 D = 1913 E = 1914 |
| | 2 | | A B C D E | | | | |
| | 3 | | | A B C D E | | | |
| | 4 | | | | A B C D E | | |
| | 5 | | | | | A B C D E | |

If, on the other hand, no tendency whatever were observable for farms to maintain their relative positions, the chart would appear as follows:

- A B C D E
- B C D E A
- C D E A B
- D E A B C
- E A B C D

In this example, of course, it would have been impossible to secure an average five-year ranking as a basis for ascribing numbers to the various farms; but this is for our purposes unimportant. A different appearance could have been given to each of the charts by choosing rank in

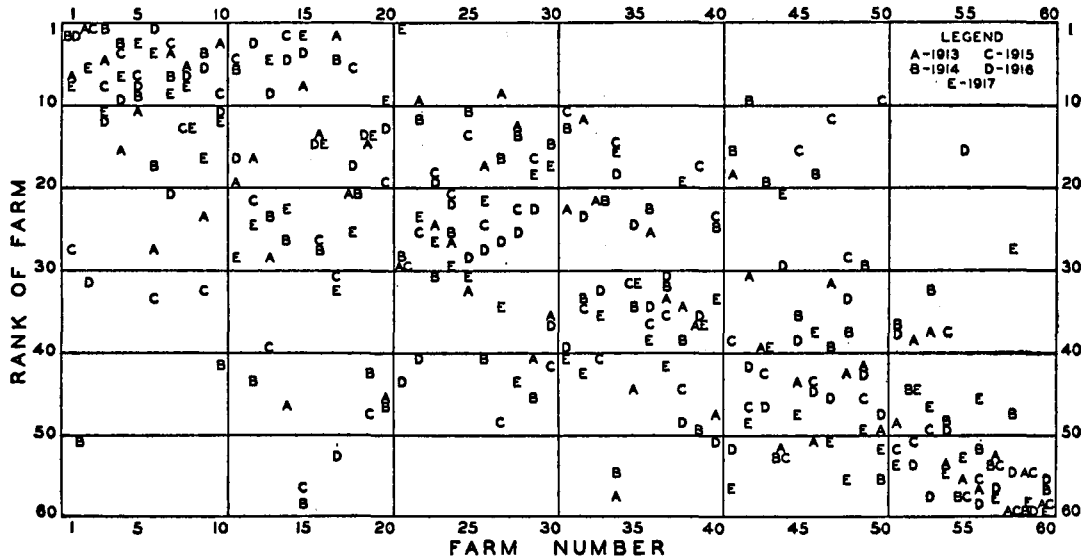
CHART 7.—CHANGES IN RANK IN LABOR INCOME ON 23 FARMS IN THE GALLATIN VALLEY, MONTANA, 1919 TO 1922*



* Data from Montana Agricultural Experiment Station Bulletin 175, February 1925, p. 10.

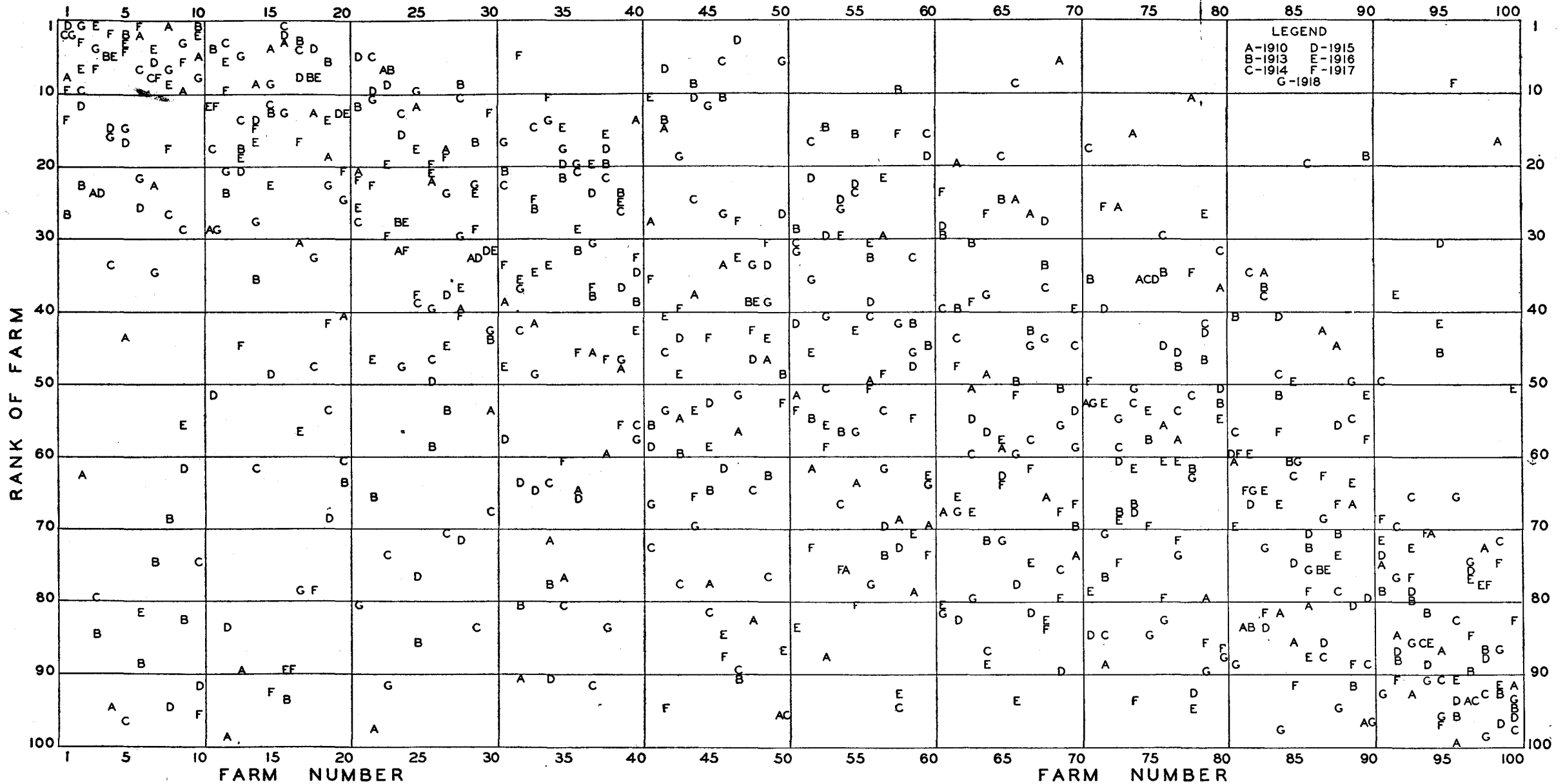
the first (or any other) year of the period as a basis for ascribing numbers to farms. Here the combinations are many and the construction of charts is correspondingly laborious. But this method, so far as it was tested, gave essentially similar results, and the use of the average rank gives the greatest possible concentration. In no case did a marked diagonal belt appear, running from the upper left to the lower right of the chart. In short, no distinct and unmistakable tendency appeared for farms to maintain their same ranks in labor income from year to year.

CHART 9.—CHANGES IN RANK IN LABOR INCOME ON 60 FARMS IN DANE COUNTY, WISCONSIN, 1913 TO 1917*



* Data from U.S. Department of Agriculture Bulletin 920, December 1920, p. 50.

CHART 10.—CHANGES IN RANK IN LABOR INCOME ON 100 FARMS IN CLINTON COUNTY, INDIANA, 1910, 1913 TO 1918*



* Data from U.S. Department of Agriculture Bulletin 920. December 1920, pp. 34 f.

1912-18; in this instance, certainly, "normal" years exceeded abnormal. And here it is clear that consistency in maintaining rank is more notable than in Chart 7. It is on the question of how far Chart 8 furnishes proof of consistency, how far proof of inconsistency, that the principal ground for difference of opinion exists. Those who expect extreme inconsistency can discover inconsistency in a qualified form; those who expect notable consistency can discover consistency in a qualified form. Its significance for our purposes is to indicate that, though unquestionably a tendency does exist for farms to maintain their relative ranks from year to year, the tendency is assuredly not well marked or in any way striking.

Chart 9 is compiled from data obtained from 60 farms in Dane County, Wisconsin, 1913-17. Here also a central tendency is more evident than in Chart 7, though perhaps not so clear as in Chart 8. The data cover more farms than the data for preceding charts, but for fewer years than Chart 8; and Chart 9 yields a conclusion midway between the conclusions deducible from Chart 7 on the one hand and Chart 8 on the other. But in Chart 10, covering 100 farms in Clinton County, Indiana, for 1910 and 1913-18, the period is as long as in any other chart (though not consecutive) and the number of farms largest. Here the tendency toward consistent maintenance of rank is weaker than in any chart except Chart 7. Whether or not the exclusion of the war year 1918, and the inclusion of the pre-war years 1911 and 1912, would have made for greater consistency cannot be said.

Now it is possible that, had we data for a large group of farms in a long-settled area covering a distinctly pre-war period like 1903-12, a great deal more of consistent maintenance of rank might be observed than, let us say, in data covering a Great Plains area for the years 1915-21. It is further possible that, given a very long (say 15-year) period, an era of stable price level, and a long-settled

area, we should find a notable consistency. Perhaps the degree of consistency depends upon size of the group, character of the area, and general economic conditions.

But of these possibilities we know practically nothing; data are not available. It is clear from what data we have that farmers, far from maintaining themselves consistently in favorable, unfavorable, or intermediate positions with respect to size of labor income, on the whole, over periods as long as seven or even nine years, shift from position to position in a fashion certainly not consistent. So far as labor income constitutes a criterion of "good farming," it appears that the selection of a "good farmer," who is good because his practices are economically sound, is a difficult matter. One cannot, apparently, conclude that the man with the highest labor income in 1927 will achieve the highest labor income in 1928.

In so far as it is possible to argue that changes in costs of production would be of the same nature as changes in labor income, it appears that the notion of consistently high-cost and consistently low-cost producers, with regard to periods of years, is erroneous. The data on costs per unit indicate a negative sort of consistency—a year-to-year reversal of position—quite as well as they indicate a tendency toward consistency. The data on labor income, by analogy, indicate inconsistency in maintenance of position quite as well as they indicate consistency.

Apparently unconscious presuppositions that agricultural costs differ little from farm to farm in the same year, even within homogeneous areas, are unfounded. Differences are in fact large; dispersion is great; averages are consequently untrustworthy. Changes in costs from year to year on the same farms are also noteworthy; the concept of uniformity or consistency is apparently invalid. The existence and extent of these differences and changes in costs necessarily give rise to difficulties in the interpretation and employment of farm cost data.

CHAPTER VI

CONTROLLABLE AND UNCONTROLLABLE CAUSES OF VARIATION

The causes of variations—both differences and changes—in farm costs of production are obviously numerous. In a given year, some farmers in a group produce at relatively high costs in part because they have encountered relatively unfavorable natural conditions such as deficient precipitation or damage from pests or disease; in part, perhaps, because they have experienced breakdowns of machinery or personal illness; and in part because they have not chosen to combat the forces of nature by the best available means—by seed selection, approved methods of plowing, planting, or cultivation, and the like. In short, both differences and changes in costs of production are due not only to causes which farmers are able to control, but also to causes over which control is to varying degrees impossible.

Distinctions between controllable and uncontrollable causes of variations in costs are exceedingly difficult to draw. If hail or frost visits some farms in a group, other things being equal the costs per unit of production on those farms are likely to be relatively high; and they are high largely in spite of the judgment and skill of the farmers. But judgment can be exercised to minimize even such visitations; to some degree farmers can employ frost-resistant crops on low-lying lands, or guard against hail by insurance. It is in fact a most difficult process to set forth the reasons why, out of a group of say 20 farmers, some produced at high costs per unit and some at low—and further to suggest means by which the high-cost producers can hope to become low-cost producers.

The problem of first ascertaining the causes of variations in costs, and thereafter of separating controllable from uncontrollable causes of variation, is nevertheless of importance. Here we cannot pretend to contribute to a solution of the problem. But something is perhaps to be gained by indicating that such a problem exists, and that some divergence of ideas, or at least of emphasis, prevails between economic theorists and farm management specialists. The theory of value currently accepted as applicable to agricultural products rests in part upon the proposition that in agriculture, at least in the long run, differences in costs are more largely inevitable than avoidable. Farm management cost investigation, on the other hand, has apparently been built up largely on the assumption that farmers can control their costs in large part if they will—that the methods and practices implicit in management, and not natural conditions, are the dominant influences on costs.

THE THEORIST'S POSITION

The economic theorist has little to say directly regarding differences in money costs per unit among farms located in restricted areas in a given year; indirectly, however, in the course of discussion of costs per unit of the potential supply of any agricultural product, he says a good deal. The theorist argues that in agriculture, viewed as a whole, lands are different in quality. Some soils are deeper, better in topography, superior in chemical composition, nearer to markets, than others; some lands are more favored by rainfall, temperature, and sunshine than others. With the same outlay of labor and capital, the better land will yield a larger physical output than the poorer land. Expenditures per unit of product (excluding any calculation of land rent) must therefore be larger on the poorer lands; a general tendency must exist for such costs per unit to range by small gradations from low to

high at any given time. But farmers will be willing to pay for the better lands amounts of rent equal to the difference between costs excluding rent and prices of the product, so that costs per unit of production including land rent tend to be equalized, though the equalization is never perfect.

A part of the general theory of value thus includes the proposition that, as Professor Taussig says, "permanent causes underlie the varying costs [excluding land rent] of the several producers." These permanent causes spring primarily from geographic or climatic conditions, which man can affect comparatively little. Permanent causes of differences in costs may therefore be regarded as uncontrollable causes. Most economic theorists would probably agree that, if statistics of costs per unit show wide differences among farms in a given year, these differences might be expected to spring predominantly from varying natural conditions. To be sure, it would be admitted that some of the variation in costs could properly be ascribed to management—the more as the area from which the cost data were obtained was homogeneous with respect to soil and climate. If data were secured showing costs per bushel of wheat on 10,000 farms widely scattered geographically for the average of 15 or 20 years, theorists would expect costs excluding land rent to differ almost entirely from uncontrollable causes, while costs including land rent would differ but little among the various farms; and they would say that management must be a distinctly subordinate factor in causing differences in such average costs per unit excluding land rent.

In manufacturing, on the other hand, theorists regard the factors giving rise to differences in costs per unit between establishments as less permanent, and more largely subject to control. This does not imply that only temporary causes of differences in costs are effective in manufacturing, while only permanent causes operate in agricul-

ture. The generalization extends no further than the statement that in agriculture, but not in manufacturing, permanent causes predominate. It would be admitted that some branches of agriculture, like dairying or feeding, approach manufacturing, while some branches of manufacturing approach agriculture. And in a broad view, the conditions of supply are clearly different between agriculture and manufacturing; differences in cost of production are in the long run more characteristic of the extractive than of the manufacturing industries; in agriculture nature imposes differences in cost to a greater degree than in manufacturing; in agriculture costs are less subject to control than in manufacturing. So much may be said without reference to statistics of either farming or manufacturing costs. That farm costs of production in general are not altogether subject to control either in a short or a long period constitutes an essential part of the theory of prices as applied to agriculture.

FUNCTION OF THE EFFICIENCY EXPERT

Whether or not costs of production in agriculture are subject to human control is a matter of some importance to farm cost investigators; but it is a subject which has been passed over rather lightly in the literature dealing with farm cost investigation. The farm cost investigator, unlike the theorist, is not concerned with the erection of a long-run theory of value. As we saw in a preceding chapter, the major objective in farm management cost inquiry is to increase farm efficiency; more specifically, to evolve, through the study of cost statistics, suggestions respecting more profitable choices of enterprises and methods—suggestions at once feasible and desirable for farmers to adopt. Pioneers in farm cost investigation plainly regarded themselves as bringing to agriculture the services of the efficiency expert in manufacturing; and there can be no question that at present farm cost in-

investigators look upon their profession as closely akin to efficiency engineering.

Efficiency experts in both agriculture and manufacturing have always looked to cost analysis as a vital part of their procedure. The procedure, of course, has never been precisely the same in the two fields: in manufacturing, the efficiency expert has largely confined his analysis to costs incurred in a particular establishment, whereas the farm cost investigator has dealt with costs incurred on groups of farms. But all efficiency experts deal with costs somewhat different from the long-run costs of major interest to the theoretical economists. Their concern is with costs incurred at particular times; and their fundamental purpose is to point out "leaks" that can be stopped up. In so far as they proceed on direct cost comparisons (the efficiency expert in manufacturing draws upon a fund of information respecting "performance records" of men and machines, rather than upon plant-to-plant comparisons), their function is essentially to hasten the spread of new and efficient methods by informing high-cost producers how the low-cost producers operate.

A question may well be raised regarding the probable extent of the field for efficiency engineering in agriculture as compared with manufacturing. Economic theorists are fairly in agreement upon the doctrine that any given time, the costs of producing homogeneous products must differ both between farms and between manufacturing establishments, but that in the long run variable costs tend to prevail in agriculture much more markedly than in manufacturing. If so, the task of the efficiency expert in agriculture would appear more difficult, and his contribution to general efficiency in the industry perhaps less significant, than would be true of the task and contribution of the efficiency expert in manufacturing. For one is to expect that in agriculture costs applicable to a given year will differ largely because permanent and

uncontrollable causes of difference are present, while in manufacturing the differences will be due largely to temporary and controllable causes, then it would seem that less would result from attempts to teach efficiency to farmers than to manufacturers. Nowhere in economic theory is the doctrine specifically laid down that differences in costs between farms in a given year are entirely due to uncontrollable causes; but enough is said to establish the presumption that the efficiency expert in manufacturing will discover fewer uncontrollable causes of differences in costs than will the efficiency expert in agriculture.

Yet it is common in the literature of farm costs to encounter such statements as the following:

The wide range in labor income . . . gives evidence that the man of skill, industry, and judgment can hope to earn a handsome income by operating a farm.¹

While the average profits in each area were rather low, and while many farmers made very low profits, yet the well-managed farms gave much larger returns. . . .²

The wide variation in the costs of producing . . . crops indicates the possibility of increasing the efficiency of a large number of the farms studied.³

Cost figures are used in commercial work for the purposes of making adjustments that will greatly enhance the business; they can be applied equally well in the field of agriculture.⁴

A study of production costs on several farms will provide many suggestions with respect to practices that are more economical than the customary methods on the majority of farms in the community.⁵

These quotations indicate clearly enough that farm cost investigators have been inclined to draw a close anal-

¹ *Wisconsin Agricultural Experiment Station Bulletin 300*, March 1919, p. 14.

² *U.S. Department of Agriculture Bulletin 920*, December 1920, p. 55.

³ *Idaho Agricultural Experiment Station Research Bulletin 2*, March 1922, p. 2.

⁴ *U.S. Department of Agriculture Bulletin 896*, November 1920, p. 3.

⁵ *U.S. Department of Agriculture Bulletin 943*, April 1921, p. 3.

ogy between farming and manufacturing or merchandising, between efficiency engineering or cost analysis in agriculture and in manufacturing; and they demonstrate that the appropriate procedure in farm cost analysis has been thought to involve study of the methods of low-cost or high-profit producers in order to teach efficiency to high-cost or low-profit producers. They are further notable as evidence that variations in costs or profits have been widely regarded as subject to control.

It is of interest to observe that the orthodox theory of value is in general endorsed by farm cost investigators: they, like the theorist, speak of the marginal producer and varying costs, and not a few have endorsed the "bulk-line" theory as an adaptation or orthodox economic theory. But by implication they deny the notion upon which the orthodox theory of value is in part based—that agricultural costs are variable in the long run for causes beyond control, and largely so at any given time. In part this inconsistency perhaps springs from a disposition to interpret the orthodox theory as an explanation of short-time rather than long-time phenomena, though in part it is apparently a result of failure to consider the problem.

As a matter of fact, the whole question of controllable versus uncontrollable causes of variation has been slighted in the literature of farm cost. When one comes to inquire into the detailed reasons why farms designated in particular investigations as both profitable and well managed were in fact profitable, the explanation most commonly encountered is that these farms achieved exceptionally good yields. But when one seeks the causes of good yields, one often finds no explanation whatever; how far yields were the result of "good farming," how far of "good luck," is a question commonly not considered. Of course this is not true of all investigations; but the situation unfortunately occurs very frequently. Yet it is obvious that yield cannot be said to depend wholly upon good manage-

ment; natural conditions must play an important part, perhaps a more important part than management.

This possibility, readily enough apparent, would seem to be of sufficient importance to have attracted more attention in farm cost inquiry than in fact it has. It is common knowledge that soils differ in chemical composition and texture not only between widely separated geographical areas, but also between farms located in a single county or different fields on the same farm; and it is likewise well known that precipitation in a given year is not the same in amount or distribution even on farms a few miles apart, and that temperature varies considerably within restricted areas especially where the topography is uneven.¹ Why farm cost investigators have so often failed to consider the effects upon costs of these differences in natural conditions is difficult to explain. That investigators have been unaware of such differences is highly improbable; it is possible that a long-standing assumption that farming is as much a business as any other occupation has often led to underemphasis of such factors. But it is also possible that the great difficulty merely of recording the differences in costs or profits has diverted attention from the nature of the causes of differences in costs or profits.

It is illuminating to consider a hypothetical illustration of the manner in which the question of controllable versus uncontrollable causes of variation obtrudes itself in any attempt to evolve from farm cost statistics feasible suggestions for the improvement of farm practice. The procedure of the agricultural efficiency expert, once data in any of the customary forms are collected, is in the first place to explain the variations which always appear, and

¹ One would expect natural conditions to be of greater influence in causing variations in costs when the costs are secured from farms widely separated geographically than when the costs are secured from adjacent farms. The points of view of the theoretical economist and the farm management investigator perhaps differ largely because the former thinks of farms in a large area, while the latter often deals with farms in a restricted area.

in the second place to evolve the suggestions. In the second step in analysis consideration must be given to the possibility of controlling variations; for the purpose of the efficiency expert is obviously not served merely by informing farmers that they might have done better if they had loam instead of clay soil, or 60 inches of rain instead of 20. An efficiency expert, if he is to fulfill the task he sets for himself, must suggest modifications in farm practice upon which farmers are at least able to act. Otherwise he fails as an efficiency expert, though he may succeed in contributing to human knowledge, by pointing out that certain relationships exist between profits and this or that factor.

A HYPOTHETICAL PROBLEM

Most farm cost investigators fix upon profits per farm in one form or another as the significant final figure in cost analysis, on the ground that what farmers seek is the highest possible net return from the farm as a whole rather than from distinct enterprises or operations contributing to farm income. Clearly such a figure must be affected by a great number of influences—prices received, yields secured, costs incurred, each of these being susceptible of detailed subdivision. Much attention has been paid both to the choice of an appropriate summary figure and to analysis of the causes affecting such a figure. But discussion of these matters, and of the more recently developed procedures in farm management cost inquiry, can best be reserved for a subsequent chapter. At this point we may advantageously consider the difficulties involved in an attempt merely to ascertain the causes of variation in the costs (of several sorts) of producing a single product on a group of farms in a given year, and to separate controllable from uncontrollable causes of variation.¹

¹ We may ignore the causes of changes in costs, partly because little is known of the very existence of changes, but partly because most of the litera-

Suppose, then, we have in hand an array of costs per bushel of wheat incurred on a group of farms in a restricted area. We wish to inform farmers of this group why their costs varied, and how far they could have achieved lower costs if they had followed methods different from the methods they did follow, but not beyond their power to alter. For convenience we may employ data collected by the survey method from 24 owned farms in Grand Forks County, North Dakota, applicable to the wheat crop of 1919. The data appear in Table 5.

The significant figure is cost per bushel; for, assuming that each farmer would receive the same price per bushel, any farmer would have been better off if he could have produced the same number of bushels at a lower cost per unit. Costs per bushel ranged from \$1.25 to \$6.12. So far as appears from the table, a fairly close relationship existed between cost per bushel and yield per acre: low-cost producers had high yields, high-cost producers had low yields. This general relationship has often been pointed out in farm cost investigations. But it is clearly of no great significance for the efficiency expert. Little would be gained by informing the high-cost producers that they ought to have secured higher yields; what is needed is to inform high-cost producers *how* they could have obtained higher yields. Solution of this problem would inevitably involve the collection of a vast amount of data. One would require information from every farm on at least the following number of topics: prevalence and incidence of plant diseases and weeds, texture and composition of soil, daily temperature records, amount and distribution of rainfall, quantity and quality of seed, date and depth of plowing, time and method and amount of disking and

ture of farm costs has dealt with cost data applicable to but a single year. If costs change widely from year to year, doubt is thrown upon the propriety of the whole notion of suggesting changes in methods from study of one year's data. But the significance of changes in costs to farm management cost investigation is considered in chapter vii, below.

TABLE 5.—INDIVIDUAL COSTS PER ACRE OF WHEAT PRODUCTION ON 24 OWNED FARMS, GRAND FORKS COUNTY, NORTH DAKOTA, 1919*

| Record number | Acres harvested | Factors of cost, per acre | | | | | | Total net cost, with rent | | | | |
|---------------|-----------------|---------------------------|-------------|-------------|---------------|-------------------------------|--------|-----------------------------|-------------------------------|----------|------------|----------------|
| | | Labor | Material | Threshing | Miscellaneous | Total gross cost without rent | Credit | Total net cost without rent | Rent (Interest on investment) | Per acre | Per bushel | Yield per acre |
| 1..... | 375 | \$6.25 | \$3.59 | \$2.72 | \$3.22 | \$15.78 | .... | \$15.78 | \$3.60 | \$19.38 | \$1.26 | 15.4 |
| 2..... | 280 | 7.43 | 4.63 | 3.21 | 5.12 | 20.39 | \$0.36 | 20.03 | 5.40 | 25.43 | 1.52 | 16.7 |
| 3..... | 260 | <u>3.63</u> | 3.60 | 2.88 | 3.92 | 14.03 | .50 | 13.53 | 6.00 | 19.53 | 1.63 | <u>12.0</u> |
| 4..... | 173 | <u>6.59</u> | <u>4.67</u> | 3.58 | 3.95 | 18.79 | .... | 18.79 | 3.60 | 22.39 | 1.64 | 13.7 |
| 5..... | 200 | 5.42 | <u>3.47</u> | 3.67 | 3.29 | 15.85 | .... | 15.85 | 2.40 | 18.25 | 1.66 | 11.0 |
| 6..... | 180 | 8.88 | 4.66 | 3.19 | 4.66 | 21.39 | .... | 21.39 | 4.50 | 25.89 | 1.71 | 11.9 |
| 7..... | 65 | 4.84 | 3.94 | 2.12 | <u>3.08</u> | <u>13.98</u> | .46 | 13.52 | 5.40 | 18.92 | 1.72 | 11.0 |
| 8..... | 63 | <u>9.37</u> | 3.94 | 4.00 | 4.86 | <u>22.17</u> | .63 | 21.54 | 4.50 | 26.04 | 1.75 | 14.9 |
| 9..... | 553 | 7.02 | 4.27 | 2.25 | 3.50 | 17.04 | .09 | 16.95 | 4.20 | 21.15 | 1.76 | 12.0 |
| 10..... | 475 | 5.66 | 3.80 | 3.18 | 3.40 | 16.04 | .... | 16.04 | 6.00 | 22.04 | 1.87 | 11.8 |
| 11..... | 236 | 8.07 | 4.26 | 3.18 | 4.76 | 20.27 | .21 | 20.06 | 4.50 | 24.56 | 1.88 | 13.1 |
| 12..... | 110 | 6.53 | 3.99 | 2.24 | 3.35 | 16.11 | .... | 16.11 | 5.40 | 21.51 | 1.89 | 11.4 |
| 13..... | 65 | 7.54 | 4.10 | 2.07 | 4.46 | 18.17 | .77 | 17.40 | 4.20 | 21.60 | 1.92 | 11.3 |
| 14..... | 200 | 5.58 | 4.15 | 3.92 | 5.22 | 18.87 | .17 | 18.70 | 3.30 | 22.00 | 1.95 | 11.3 |
| 15..... | 80 | 5.83 | 3.19 | <u>1.75</u> | 3.34 | 14.11 | .... | 14.11 | 5.40 | 19.51 | 2.08 | 9.4 |
| 16..... | 410 | 5.55 | <u>2.81</u> | <u>3.66</u> | 4.40 | 16.42 | .... | 16.42 | 5.40 | 21.82 | 2.14 | 10.2 |
| 17..... | 90 | 6.30 | 3.28 | 2.78 | 3.97 | 16.33 | .... | 16.33 | 5.40 | 21.73 | 2.24 | 9.7 |
| 18..... | 300 | 8.06 | 4.01 | <u>4.77</u> | 5.20 | 22.04 | .17 | 21.87 | 5.10 | 26.97 | 2.34 | 11.5 |
| 19..... | 295 | 5.37 | 4.47 | <u>1.87</u> | 3.44 | 15.15 | .30 | 14.85 | 5.10 | 19.95 | 2.67 | 7.5 |
| 20..... | 160 | 6.61 | 3.76 | 2.25 | 3.73 | 16.35 | .... | 16.35 | 7.50 | 23.85 | 2.98 | 8.0 |
| 21..... | 300 | 6.25 | 4.22 | 2.50 | 4.44 | 17.41 | .20 | 17.21 | 3.00 | 20.21 | 3.37 | 6.0 |
| 22..... | 15 | 6.63 | 4.19 | 3.82 | 3.53 | 18.17 | 2.33 | 15.84 | 3.60 | 19.44 | 3.89 | 5.0 |
| 23..... | 155 | 7.69 | 4.63 | 2.58 | 5.40 | 20.30 | .32 | 19.98 | 3.60 | 23.58 | 4.57 | 5.2 |
| 24..... | 450 | 5.46 | 4.57 | 2.22 | <u>10.18</u> | <u>22.43</u> | .89 | 21.54 | 6.00 | 27.54 | 6.12 | <u>4.5</u> |

* Data from U. S. Department of Agriculture Bulletin 943, April 1921, p. 54.

harrowing, date and method of cutting, harvesting, and threshing. Differences in any of these factors, and in others also, might conceivably have affected yield.

Such information would be required for a thoroughgoing solution of the problem. Much of it could be obtained by detailed record keeping, though some of it, like soil analyses and precipitation records, would require a prohibitive amount of scientific apparatus and analysis. But even if all these factors could be kept account of, it would be a matter of extreme difficulty to ascertain with precision which factor or factors exerted the dominant influence. Heavy rainfall in the autumn may have prevented plowing on clay soils or in low-lying fields, but not on sandy soils or high-lying fields. Mild temperature in the spring may have encouraged weed growth on fields not plowed in the autumn; weed growth may have necessitated three diskings instead of two in the spring. The yield achieved by some farmers might appear to have been reduced because late seeding necessitated late harvest and hail at harvest reduced the yield; but the date of seeding might have been determined quite as much by soil condition as by the judgment of the farmer. It is unnecessary further to particularize. The various factors affecting yield clearly may affect each other: rainfall affects soil texture, soil texture affects the date and method of cultivation, and so on.

Under such circumstances it is easy to formulate unwarranted conclusions. It might be found, for example, that yield per acre was in general higher on those farms where selected seed was sown. Hence one might conclude that farmers who did not use selected seed would have had better yields if they had done so; and this would constitute a suggestion upon which any farmer might act. But one would first need to show that high yield had not resulted from some other cause than selected seed, and many causes might appear. Even the simplest conclusion

might be regarded as untenable unless a long and difficult process of analysis was undertaken. The form of analysis required in order to achieve reasonable precision is the partial correlation analysis. This procedure has been recently developed, and will be considered in a subsequent chapter.

For present purposes it is desirable to observe that no formal analytical procedure of itself solves the problem of distinguishing controllable from uncontrollable causes of variations in costs, or profits, or yields. A partial correlation analysis serves to measure with some precision the degree of association between the dependent variable (profits or costs or yields) and the several independent variables. But such an analysis can be conducted entirely without reference to controllable and uncontrollable causes. If, for example, a high correlation was found between date of seeding and yield, we should not be able to conclude that farmers would have been able to change the date of seeding. Date of seeding happens to be a factor in part controllable and in part not so; amount and distribution of rainfall are clearly factors not under control; quantity of seed sown per acre is largely controllable; and so on. There can be no question that correlation analysis is the most effective device for measuring the extent to which profits are affected by different factors; if executed with care, it would certainly prevent one from placing too much emphasis upon a single observed relationship to the exclusion of others. But if the partial correlation analysis is to be of service in informing farmers of desirable and feasible changes in practice, care must be taken so far as possible to define the independent variables as variables either entirely controllable or entirely uncontrollable. From the point of view of the efficiency expert, little is gained by proving that date of seeding and rainfall both affect yield because farmers can control the one only in part, the other not at all.

It is to be hoped that the correlation analysis will be directed toward the problem of ascertaining how far differences in yields (similarly profits and costs) are subject to control and how far they are not. If high correlations should always appear between yield and entirely uncontrollable factors like rainfall, temperature, and soil, while low correlations always appeared between yield and quantities of seed, depth of plowing, and the like, one might feel assured that the efficiency expert could hope to accomplish little. This sort of analysis has not in fact been undertaken; but it constitutes one of the most promising fields of inquiry and would be of great service.

It is the present writer's conviction that, generally speaking, differences in yields, costs, and profits are due more largely to uncontrollable than to controllable factors.¹ Evidence supporting this view appears in the general reasoning applied by all economists in explaining the differences in crop yields in a given year between several countries. But much might still be done to demonstrate that farm-to-farm differences in yields, costs, and profits in the same year may result largely from uncontrollable causes. As a matter of fact, farm cost investigators have wavered between their assumption that differences must be due to management and concrete evidence that differences were in fact due to nature. It is common to read in the introductions to cost investigations that study of the data would show better methods of management, and in the same studies to find high costs explained by wet or dry soil, or plant diseases, or pests—or not explained at all.

We have thus far spoken chiefly of the influence of yield on variations in cost per bushel, and of the various factors affecting yield. Farm cost investigators seldom attempt to analyze the causes of variation in money costs

¹ This statement is intended to apply especially to field crops, and is, of course, the more valid as farms are widely scattered geographically.

per bushel, partly, no doubt, because yield exerts so strong an influence that other factors are submerged. It has been thought that costs per acre provided better figures to work with; factors affecting costs can be expressed more easily on a per acre than on a per bushel basis. Profit per acre is of course the more appropriate final figure; but, if one assumes that yield and price would not be affected by changes in costs per acre, it would seem proper to search out ways and means whereby high costs per acre might be reduced.

Thus the highest expense per acre for labor, \$9.37, was incurred by Farmer No. 8 of Table 5. This farmer incurred the third highest cost per acre, \$26.04; the third highest yield per acre, 14.9 bushels; and the eighth lowest cost per bushel. It would therefore appear that this farmer might have profited by reducing his unusually high labor cost. If he could have reduced it by about \$3.00—about to the average labor cost incurred by the other farmers—his total cost per acre would have been lower, and his cost per bushel would have fallen from \$1.75 to \$1.55. This would place him as the third in the rank of low-cost producers instead of eighth.

But no efficiency expert could venture to suggest this reduction in labor cost without further examination of the causes lying behind it. He would need to know in the first place whether Farmer No. 8 incurred the highest labor cost of the group because he employed an exceptional amount of labor at exceptionally high rates. In this particular instance rates were the same for all farmers; hence it was the amount of labor which was exceptional. But the efficiency expert would need to ask why so much labor was used. No explanation is given in the investigation, and one is reduced to speculation. Perhaps the farmer was naturally slow to move about; perhaps he cultivated more frequently than other farmers; perhaps he had exceptionally hard soil to work. The explanation would be

hard to find, but presumably it could be found. Even so, if one could not be certain that the farmer could have reduced the amount of labor without affecting yield adversely, one would not be justified in ascribing his comparatively unfavorable position in the cost array to unintelligent management of his labor.

Essentially the same difficulty appears if one chooses to compare quantities of labor expended per acre, without reference to money costs per acre. It is never proper to assume, without detailed analysis of causes, that farmers who employed much labor could have employed less if they had chosen. It is quite as necessary to consider the controllable nature of the causes of variations in expenditure of hours of labor as it is to consider the controllability of the factors affecting yields or money costs or profits. Otherwise suggestions involving changes in labor utilization cannot reasonably be made, and the efficiency expert's expressed purpose is not furthered.

Money costs of production may vary not only because natural conditions impose variations and because different farmers pursue different methods from choice rather than from necessity, but also because accounting procedures may introduce differences. Thus, as appears in Table 5, Farmer No. 20 incurred the highest rent charge per acre of all farmers in the group, \$7.50 per acre. Farmer No. 5 incurred a charge of only \$2.40 per acre. Now if Farmer No. 20 had incurred only the average rent charge, some \$4.70, he would have reduced his cost per bushel from \$2.98 to \$2.64; and if Farmer No. 5 had incurred the average charge for rent, his cost per bushel would have risen from \$1.66 to \$1.87. If we examine the accounting principles upon which rent charges were computed, we find that each farmer (all 24 farmers owned their land) was asked to state the value of his wheat land per acre, and the land charge was calculated by multiplying this figure by the current community rate of interest

on first mortgages. There is no way of ascertaining whether or not Farmer No. 8 ascribed too high a value to his land, or Farmer No. 5 too low a value. All farmers in the group might conceivably have ascribed precisely the proper value to their land; on the other hand, they might all have erred, some in one direction and some in the other. It is generally known that land values for particular farms are poorly defined; consequently there must have been at least an opportunity for erroneous valuations. If so, the rank of various individuals might be considerably altered. In so far as erroneous valuations of land may have made particular farmers appear as low-cost producers, while other valuations would have altered their position, it is clearly a questionable procedure to designate these low-cost producers as efficient. Their efficiency would rest not on skill in management, but on mere cost calculations; and no efficiency expert would be justified in supposing that their methods were worthy of emulation.

The difficulties of cost analysis arising from accounting principles might be further examined, notably with respect to the not uncommon practice of allowing farmers to set the valuation of their own labor. But the futility of analyzing money costs in detail has long been recognized, and has led farm cost investigators to stress the greater value of quantitative data. We shall have occasion, in another chapter, to examine more in detail the uses to which quantitative data have been put. But from the preceding discussion it appears that even quantitative data do not solve the whole problem of the efficiency expert in agriculture. Quantitative costs vary from farm to farm in the same year. To assume that the farmer among a group who expends the least labor and materials in growing an acre of wheat is the most efficient wheat producer is quite as erroneous as to assume that he who produces at the lowest cost per bushel or per acre is the most efficient

producer. One cannot conclude that his methods ought to be emulated by other farmers until one is able to ascertain that the results he achieved were due to his managerial ability as expressed in his practices, not to natural conditions which permitted these practices to be used.

In conclusion, the necessity is apparent for farm cost investigators, when they purpose to increase farm efficiency, to separate controllable from uncontrollable causes of variation in costs. Their expressed objective is to suggest feasible modifications in farm practice, not merely to designate and measure the causes of variations in costs. Yet all forms of cost data that have been extensively employed, and all methods of analysis, do not serve to show how far costs are subject to control and how far they are not. The question is not faced squarely in the literature of farm management. On a priori grounds there is reason to believe that uncontrollable factors predominate in causing variations in costs, profits, or yields. If this presumption is correct, the field of the efficiency expert in agriculture must be a more restricted field than has usually been supposed; and the prospects of obtaining valuable hints for farmers from farm cost investigation are considerably less bright than they have commonly been pictured.¹ The expenditures of public funds neces-

¹ The present writer does not intend to imply that important instances cannot be found wherein methods of farm management unquestionably exerted a more profound influence on costs, profits, or yield than natural facilities. Professor Pond of the University of Minnesota in a letter to the writer has cited an instance in which one of two adjacent fields of corn operated under different crop rotations and cultural practices yielded 25 bushels of nubbins per acre, whereas the other yielded 75 bushels of good corn; here natural advantages were the same, so far as could be ascertained, and the difference lay in management. It is the conviction of the present writer that such instances, where differences in yields and costs are *unmistakably* due to management alone, are exceptional. In the literature of farm management, at least, similar instances to that cited by Professor Pond are distinctly scarce, while differences in costs explained by reference to natural advantages are relatively common. One would expect, of course, to find differences due entirely to management on adjacent rather than distant farms.

CONTROLLABLE AND UNCONTROLLABLE CAUSES 117

sary in order to obtain data sufficiently detailed to provide investigators with reasonable assurance that their conclusions are sound, and to permit a process of analysis necessarily laborious, are very heavy. If meager results are likely to result from farm cost investigations designed to evolve profitable and usable suggestions for farmers, while heavy expenditures of public funds are necessary in order to conduct the investigations properly, the propriety of expending the money may well be questioned.

CHAPTER VII

FARM COSTS AND FARM EFFICIENCY: SOME GENERAL CONSIDERATIONS

In the present and two succeeding chapters we shall consider various ways in which farm cost data have been utilized, or are thought to be useful, in solving the general problem of increasing farm efficiency. We shall deal in these chapters with what may be called farm management inquiry, as distinguished from the study of cost-and-price relationships in agriculture. This latter subject will be treated in chapters x to xii. Our immediate problem is to determine broadly wherein farm management cost investigation has succeeded, or failed, or bids fair to succeed or fail, in contributing to increased efficiency among American farmers.

So large a question cannot be answered in limited space. A thoroughgoing review of the literature is in itself an almost impossible task merely in view of the very number of publications. Farm management investigation is no longer in its infancy. Its development, however, has involved not only the production of a mass of literature, but also continuous changes in the details of objectives, types of data secured, and analytical methods. Merely to describe these changes is a task of no small magnitude, and a task which need not be attempted for the purposes of the present inquiry.

We shall attempt to examine the procedures and results of farm management investigation in such a way that suggestions can be devised for a program of work in the field somewhat different from the program now apparently in vogue. This procedure is desirable because of the close interrelationship between the United States De-

partment of Agriculture and the state agricultural experiment stations—an interrelationship of such a nature that a particular type of research, once approved by leaders in the field, tends to be adopted quickly by investigators all over the country, and hence becomes part of a general program of research. Under such circumstances particular methods of inquiry and analysis tend to become standardized—often, perhaps, before they have been thoroughly tested or their possibilities clearly perceived. If, then, we are eventually to formulate suggestions for a program of research in farm management, it is desirable to focus attention upon the types of inquiry which have been most favored in the past few years and are regarded with favor at the present time. We shall accordingly consider primarily the literature appearing after 1920. Particular attention will be given to publications emanating from the United States Department of Agriculture, since it holds a position of leadership as well as some power (as exerted by the Office of Experiment Stations) to approve or disapprove the use of federal funds by the experiment stations in pursuing particular types of research. In the present chapter we may attempt a rough classification of the various inquiries of recent years into types, establish the criteria for adjudging the value of various types, and point out some general limitations necessarily applicable to all types. In the following two chapters we shall deal more specifically with the merits and defects of the various important types of investigation, and conclude by suggesting a program for work in the field of farm management and that part of the field of agricultural economics which bears most closely on farm management.

One important aspect of the investigation of recent years is best reserved for special consideration. This is the application of multiple and partial correlation to farm cost data. In effect it has been proposed to abandon the

older and simpler methods of analysis in favor of this more accurate analytical device. But since the correlation analysis can be discussed only in technical language, such consideration of it as is required for the purposes of the present paper is best reserved for a special appendix, and little need be said of it in the ensuing chapters.

TYPES OF INVESTIGATION IN RECENT YEARS

Classification of the numerous farm management cost investigations appearing in recent years into well-defined types is not easy. Many investigations ostensibly conducted as farm management inquiries have in fact centered about the quite different problem of cost-and-price relationships in agriculture. The farm management investigations differ one from the other with respect to objectives, methods of collecting data, forms of data collected, and methods of analysis and presentation. Any one of these four aspects of farm cost studies might reasonably be regarded as an appropriate basis of classification; and all of them ought to be considered. But, as it happens, few studies are found to which all four criteria of classification are common. Studies with the same objectives differ with respect to methods of analysis and presentation; and so on. There has been no rigid standardization.

In so far as there may be said to exist at present a definite program for farm management investigation in the agricultural experiment stations, that program apparently involves the erection of production standards through study of quantitative cost data, occasional investigations of unfamiliar machinery and methods, analyses of the factors affecting past profits, and the replanning of farms for profit. We shall need to consider each part of this program in relation to the other parts; and it will be convenient in certain instances to focus attention upon particular bulletins which may be regarded as approxi-

mately representative. But there are further procedures, some of them not yet a recognized part of what may be called the existing program, which also require attention.

In particular it will be necessary to consider a co-operative scheme of investigation practiced in Illinois. Here the general objectives of farm management investigation are held in mind. But farmers keep their own records with little assistance and pay a fairly large proportion of the expense of compilation and supervision; and the supervisors compile data in a form different from that customarily followed elsewhere. This scheme is especially important as an alternative to the replanning of farms for profit as exemplified in recent studies by the route and survey methods, and also as an alternative to the usual procedure in erecting production standards; hence, though it is not as yet in general use, it deserves somewhat detailed description and comment.

CRITERIA FOR EVALUATING FARM MANAGEMENT INVESTIGATIONS

It would be desirable, if possible, to set up perfectly definite criteria for determining the merits and the defects of each type of farm management cost investigation, so that a sound basis could be reached for deciding which types ought to receive particular emphasis in a general program of investigation in the field. For a variety of reasons, however, perfectly definite criteria cannot be established.

It is impossible, for example, to evaluate with precision a contribution to human knowledge, however small it may be taken alone. No one can say with certainty that a bit of economic history, or a statistical description of farming practice within even a small area, is either of no value or of great value. Little is to be gained by attempts to ascertain the relative value of investigations in history, economics, biology, chemistry, physics, and mathematics.

Farm cost investigation has not been directed solely toward the matter of arriving at tangible suggestions for the improvement of existing farm practice. In part it has aimed merely to describe and explain existing practice. Investigators have regarded themselves not only as efficiency experts aiming to formulate practicable suggestions for farmers to follow, but also as historians and scientists, concerned with description and with the formulation of theoretical statements of many sorts. It is one thing to lay down the generalization that size of farm bears an important relationship to profits, but quite another thing to suggest that Farmer A both could and ought to cultivate an additional twenty acres of land. The fact that farm cost investigations usually contain statements of fact in the form of statistical descriptions makes the evaluation of different types of investigation in a sense impossible, because one cannot adjudge, either in general or in particular, the value of these facts.

Another difficulty lies in the matter of determining precisely to whom farm cost investigations are supposed to be useful. Prospective farmers might reasonably be supposed to be interested in data and conclusions which are of no particular importance to practicing farmers. Students of agricultural economics might be interested in comparisons of farm practice between different areas, and in the history of changes in farm practice; but the concern of either prospective or practicing farmers with these matters may be of many degrees of remoteness. Different conclusions respecting the value of the various types of inquiry might obviously be made as one adopted the point of view of the student,¹ the prospective farmer, or the practicing farmer.

¹ Investigators have frequently stated that farm cost investigations provided data invaluable to teachers of farm management. Without arguing the point, the present writer believes that much of this "invaluable" knowledge could have been obtained, and probably has been obtained, in a less expensive fashion, by direct observation of a non-statistical sort. At least it seems prob-

Nevertheless, particularly in recent years, farm management investigators have addressed themselves rather definitely to the problem of evolving suggestions and compiling data useful to practicing farmers. We shall be justified, therefore, in adjudging the relative merits of the various types of investigations from the point of view of the practicing farmer. One may imagine himself a farmer and ask whether or not he could use the data and conclusions presented in farm management cost investigations, if he so chose.

A procedure apparently more satisfactory must be discarded as impracticable, and also somewhat unfair. It might seem desirable to ascertain how far cost investigation had in fact proved useful to farmers—how far they had actually utilized the data and conclusions furnished by the investigations. But the facts simply cannot be ascertained. And if they could, it would be unfair to say that certain studies were useless because no tangible evidence existed to show that farmers had adopted the conclusions suggested. The studies themselves might have been meritorious, but they might have been ineffective either because the publicity given to them through the extension agencies was deficient, or because farmers were too stupid or too conservative to change their customary methods.

Yet to adjudge the merits of different types of investigation by asking if intelligent and discriminating farmers could possibly have found them useful is not altogether a satisfactory procedure. The purely scientific aspect of cost inquiry ought not to be overlooked, though it deserves less emphasis than the practical aspect since inves-

able that less elaborate and expensive investigations could have been employed satisfactorily. But on this point the present writer is of course not so well fitted to judge as are experienced teachers of farm management; he has had available for study only the published reports of investigations, and much material has never been published.

tigators have chosen to emphasize the practical aspect. Furthermore, something needs to be said of the relative expense of different forms of investigation. Farm management inquiry involves the expenditure of public funds.¹ One cannot say conclusively whether or not farm cost investigation in general, or a particular type of investigation, has been worth what it cost. To prove the point it would be necessary to demonstrate conclusively that the funds could and would have been spent to better advantage in other uses; and no such demonstration is possible. But one may at least conclude that, if much the same results are to be expected from inexpensive as from expensive types of investigation, the less expensive ought to be preferred.

One aspect of expense deserves special emphasis. In so far as farm management cost inquiry resolves itself into an efficiency service, it is difficult to see why individual farmers should not be called upon to share at least a part of the expense. Private forecasters of business conditions, cost analysis in manufacturing, efficiency engineers—these people, whose function does not differ greatly from that of the farm management investigators, are not dependent upon public funds. There is necessarily some question about the propriety of employing public funds directly for the advantage of individuals. No one will quarrel with the use of public monies in collecting and presenting information in a generalized form, such as *The Agricultural Situation*, *The Survey of Current Business*, or the *Tariff Information Series*. But to keep elaborate cost records on 25 farms and to employ the

¹ In the past investigations have been financed either by federal appropriations to the United States Department of Agriculture and to the agricultural experiment stations, or by state appropriations to the experiment stations. The federal funds are in large part supposed to be employed in furthering purely scientific research rather than in financing an efficiency service for farmers; and it is partly because of this situation that the purely scientific aspects of farm cost inquiry ought not to be overlooked.

data chiefly for suggesting changes in organization and methods on these 25 farms is a somewhat different matter, and one less easy to justify. Partly in view of the fairly close analogy between the efficiency expert in agriculture and in manufacturing, farm cost investigation would appear to be a field not unsuited for support by private subscription rather than by public levies.

Private support would further appear desirable as providing a much-needed realistic test of the value of the work. If farmers who supported it failed to profit from it, it might reasonably be allowed to lapse. If they really found it useful, it might well be expected to spread. And the direct interest in it likely to be taken by men who were paying for a service might also be expected to result in more precise knowledge of the most useful data to collect and the most satisfactory methods of analysis and presentation. Enough preliminary inquiry in the field has been made, the general procedure has been sufficiently outlined, and the general problem far enough analyzed, so that the fostering support of government, though perhaps necessary in setting a new development on its feet, ought now to be removed, at least in part. Efficiency engineering in agriculture is, after all, not quite the same thing as agricultural education or purely scientific research in agriculture; and *prima facie* it constitutes a somewhat less appropriate use of public funds. On these grounds such forms of investigation as involve financial support directly from farmers are to be regarded favorably.¹

SOME FUNDAMENTAL LIMITATIONS OF FARM COST INQUIRY

Before considering particular types of farm cost investigation appearing in recent years, we may summarize certain limitations common to all types of inquiry. We must bear in mind the fact that farm cost investigators

¹ See also below, pp. 167, 170 ff.

have conceived their function as an advisory one: they do not wish merely to point out to farmers in homogeneous type-of-farming areas what mistakes they made last year, but to indicate what ought to be done next year or perhaps in a period of future years.

In chapter iv we saw that available data indicate not only that costs of several types vary widely from farm to farm in the same year, but also that they change widely from year to year on the same farms. If such variations are to be encountered even within as restricted an area as a single county, the difficulties involved in employing cost data of any form are necessarily numerous. The importance of differences and changes in costs and profits lies in the fact that they throw doubt upon the utility of averages, of any sort, to practicing farmers. A farmer wants to be able to predict his own net income for the coming year under alternative schemes of operation; he is not concerned with the average net income in his community unless his own lies close to the average and is influenced by the same factors as the average. Available evidence indicates that wide divergences from what may be termed average methods and practices exist within restricted areas, but there is no evidence that such a thing exists as optimum methods and practices for all farmers in an area. One can seldom say, without extended inquiry into the facts, that each farmer is not doing what is best for himself, or that what he does must constitute either desirable or undesirable practices for others. Unfortunately a contrary assumption has apparently prevailed. Undoubtedly there is an optimum method of operation for each farm in one area; but if farms differ widely one from the other there may be no discoverable optimum for all farms in the area. The use which a particular farmer can make of a generalization respecting farming in his area is necessarily governed by the closeness of the resemblance between conditions on his own farm and on

the "typical" farm; and in general we have more reason to suppose that close resemblances are few than that they are numerous. The dispersion is large, not small; variety, not uniformity, is characteristic.

In chapter v attention was given to the subject of controllable and uncontrollable causes of differences in costs. We saw that farm management investigators have tended to assume that differences in farmers' net incomes were due to differences in management rather than to differences in natural advantages. Although conclusive evidence is not at hand, partly because the question has been neglected, but partly because controllable and uncontrollable factors affecting costs so interact upon each other that the matter of deciding which was the more important is very difficult, this assumption may well be questioned. It would appear to be incumbent upon farm cost investigators to show that farmers as a group do not operate efficiently within the limits set upon them by natural conditions; yet little more has been offered in proof of inefficiency than the statement that methods and practices, costs and profits, do in fact vary. In so far as practices differ because natural conditions impose differences, inefficiency is not demonstrated by the differences. If the incomes of farmers are determined more largely by uncontrollable than by controllable causes, farm cost investigation loses some of its justification. The difficulty of separating controllable from uncontrollable causes of variation in costs and profits constitutes an important limitation on the validity of customary procedures and the general utility of cost inquiry. If individual farmers are to be aided by generalizations drawn from investigations, the generalizations must deal with influences susceptible of control.

The facts that variations in costs are characteristic and that they are presumably uncontrollable in considerable degree do not, of course, serve to demonstrate either that

farm efficiency is not in need of improvement, or that nothing can be done to improve it. The probability still remains that at any time many farmers are not operating their farms under optimum methods, and usable suggestions for changes in management can undoubtedly be made by investigators. In the present study the probability that farmers in general would benefit by keeping accounts for themselves is not discussed at length. We are concerned only with the usefulness of data gathered by investigators from groups of farms. The existence of differences and changes in costs and the presumption that these variations are due in considerable degree to uncontrollable causes are to be regarded as important limitations on the usefulness of statistical analysis. If both differences and changes in costs were small, or if they were due chiefly to controllable causes, there would be brighter prospects that averages of various sorts would be found useful by practicing farmers.

In a sense the limitations of farm management investigation are the limitations of forecasting costs, yields, and prices. As everyone admits, these three complex and interrelated factors are the major factors with which farmers are concerned in planning operations for the future. It is clear that a particular farmer, faced with the problem of obtaining the highest possible net income from his farm in the coming year, would like to know as accurately as possible what next year's prices, yields, and costs are likely to be for each of the products which he is able to produce within the limits imposed by nature, available equipment, and crop rotations. Given approximately accurate forecasts, he could settle the question of choice and combination of enterprises more satisfactorily than is possible without foreknowledge. Presumably natural and economic limitations would preclude the adoption of the combination of enterprises yielding the maximum net income every year, since a system of farm-

ing once established cannot be changed both radically and quickly, though such changes might be required in order to achieve the maximum net income every year. But over a period of time an approach to the average maximum net income could be made better than is possible without foreknowledge.

We need not enter upon a discussion of the probable development of forecasting; no one knows what may occur as work in the field expands. But certain aspects of the general problem require emphasis, chiefly because investigators have been inclined to envisage success and to minimize the difficulties; and because to some extent the favor with which "forecasting farm management"¹ is currently regarded rests upon the notion that much can be accomplished if only the work is undertaken.

So far as can be ascertained, it is proposed to "forecast farm management" within fairly restricted areas—not for the United States as a whole, since types of farming are known to be highly diverse in different areas, and not for such extended areas as the cotton belt, the wheat belt, or the corn belt. The first difficulty of the investigator would be to forecast all three of the major factors influencing net income—costs, prices, and yields. For the farmer needs to have foreknowledge of all three. Something might of course be gained by forecasting only one of the three for the area in question; but to go so far only is not to solve the whole problem. Of the three, cost is presumably the least important to individual farmers, especially those engaged in the production of annual crops which vary widely from year to year with respect to price and yield per acre. Costs also change from year to year; but in general it seems probable that the past experience of individual farmers provides them with a better basis

¹ This phrase, lately become common, is unfortunate in that farm management investigators do not intend to foresee what *will* take place in farm management, as the phrase implies, but rather to point out what *ought* to take place.

for foreseeing the future in respect to costs than in respect to yields and prices.

Thus far not much progress has been made in forecasting yields and prices of any sort, and more especially within restricted areas. Of course one cannot say that progress will not be made in the future. And it is unnecessary to forecast prices for particular areas, if, as appears to be the fact, fairly stable differentials exist between prices in central and in local markets; enough would be done if the central market price could be forecast. This is not true of yield, for there is no such stable differential between the average yield in the country as a whole and that in particular areas. One can say, it is true, that yield of a particular crop is normally higher in one area than another; but one cannot say, as one can of prices, that the differential between the local and the general figure will tend to be much the same in amount from year to year. Consequently a forecast of yield would be required for many areas within the country, though not so with a forecast of price.

One may reasonably doubt if forecasting of all three factors influencing net incomes is possible for all the products grown in a restricted area. Certainly the task is gigantic; but let us assume that it can be done. One may still inquire if it can be done in such a way as to be of use to farmers within the area. If it is to be of use in planning future operations, the information must be circulated well in advance of the spring planting season—for some crops, in advance of fall sowings. Now everyone knows that in general yield per acre depends chiefly upon weather conditions, after a crop is sown, and that price depends largely upon the volume of production. It may be possible to forecast next year's prices and yields, but not until after the spring planting season unless long-range weather predictions are possible. In order to be able to forecast yield and price of any of the major crops

in the United States at the planting season, forecasts of the weather during the growing season would be required; and for some crops like wheat, which is produced in many countries and has an international price to which American prices conform within limits, such forecasts would need to be made for several countries. It may become possible to make these general forecasts. But one may reasonably be skeptical of the possibility of long-range weather forecasting executed so as to be of use to farmers in restricted areas. The forecasts probably could not be reduced to a usable form. From the point of view of farm management not much is gained through knowledge that the coming year is to be good or bad generally in weather; what is needed is foreknowledge about its probable effect on the yield of the different crops between which farmers in a definite area are able to choose.

Apparently the most promising avenue for investigators who propose to assist farmers within specific areas in choosing the most profitable combination of enterprises is to set before them information on trends in costs, prices, and yields within these areas. This is not the same procedure as to point out more or less specifically what ought to be done next year, on the basis of forecasts of costs, prices, and yields. It is less ambitious but more practicable. Yet too much ought not to be expected from this device. Experience has shown that trends in yields, prices, and costs are difficult to determine and often do not appear; and every statistician knows that the existence of a line of trend in the past does not constitute conclusive proof that the trend will be the same in the future.

To the present writer it appears that the procedure apparently contemplated by those who would "forecast farm management" is not likely to render such noteworthy services to farmers as its proponents apparently assume. As yet, of course, forecasting is in its infancy. But one may reasonably be skeptical of its possibilities

merely because the task is obviously gigantic, and one may doubt if the problems of individual farmers can be solved even if great advances are made in forecasting. Farming is not a highly standardized business; natural conditions vary so greatly from farm to farm that uniformity of methods is neither practicable nor desirable. Many of the questions confronting individuals cannot be solved by the formulation of forecasts applicable to farmers as a group even if the possibility of formulating such forecasts be granted. Forecasting is still in so elementary a stage of development, and the obvious difficulties of procedure are so important, that far more modest projects for research in farm management or agricultural economics would appear desirable. There is ample opportunity for investigation which *prima facie* promises to yield significant results. The inherent difficulties of forecasting ought not to be minimized. No one ought to be led to believe that farm management investigation constitutes something in the nature of a panacea, and that investigators have developed methods of forecasting whereby they can foresee the future with considerable accuracy—hence that great things are to be expected if only the ample funds are put at the disposition of the various research agencies. While the newly developed methods of analysis remain in effect untested, it appears desirable to “go slow,” especially since there exist promising but more modest and less expensive approaches to the farm management problem.

CHAPTER VIII

TYPES OF FARM MANAGEMENT INVESTIGATION IN RECENT YEARS

In the present chapter we may consider in somewhat greater detail the more significant limitations of the several current types of farm management investigation. Most of these limitations arise because costs and profits vary widely from farm to farm in the same year and from year to year on the same farm; because these variations are presumably due in considerable part to uncontrollable causes; and because foreknowledge of costs is of limited value unaccompanied by foreknowledge of yield and price. We shall attempt to decide which types of inquiry promise to yield the most satisfactory and useful results from the point of view both of the practicing farmer and of the scientific investigator and hence might reasonably receive encouragement, especially if the expense of investigation is given consideration. It is unnecessary, and will be impossible in limited space, to consider all aspects of each type of investigation.

THE USES OF QUANTITATIVE COST DATA: PRODUCTION STANDARDS

Within recent years investigators have been much occupied with the collection, analysis, and presentation of quantitative cost data. In earlier years emphasis fell more largely upon money cost data. But recognition of the difficulties involved in employing accounting principles that did not destroy the significance of the data was instrumental in causing a general abandonment of attempts to analyze money costs of production per unit or per productive unit; and it has also been argued that

quantitative costs, since they presumably change less from year to year than do money costs because fewer changeable factors affect the quantitative expenditures, would permit more dependable conclusions to be drawn.

Quantitative cost data consist chiefly of records of the labor (man and horse or tractor) expended per acre in producing various crops or in conducting various operations upon the several crops. The seasonal distribution of labor on various products, and on farms as a whole, has also received attention. Data have been obtained on the quantities of seed, fertilizer, and twine used per acre in producing various crops; and much information has been compiled on the quantities of various sorts of feed employed in producing given units of meat and of animal products. Information of these sorts has been presented in most of the farm management investigations appearing in recent years, whether dealing chiefly with the choice of enterprises or with the choice of the cost factors, or merely with the analysis of quantitative costs.

Tables 6, 7, and 8 (pp. 135 ff.), adapted from three of the best farm management investigations appearing in recent years, serve to illustrate the forms in which such data commonly appear. As appears from these tables, the customary presentation is to give average¹ "quantitative requirements," usually compiled from material gathered in a restricted area such as a county and usually said to be applicable to the county. Sometimes, though not often, data for more than one year are averaged. The route, survey, and farmer's record methods of gathering data have been employed, the survey being on the whole most commonly used.

Some years ago quantitative data were regarded as important largely because they were thought to be "stable," and could be used as a means of calculating money costs merely by the application of current prices

¹ Modes are sometimes used instead of averages, but not often.

or rates. A hint of this use is given in Table 6. The usual statement of the value of quantitative data for calculating

TABLE 6.—THREE-YEAR AVERAGE HOURS OF LABOR AND QUANTITIES OF MATERIALS USED PER ACRE IN THE PRODUCTION OF DESIGNATED CROPS, 1919-21*

| Item | Wheat | Alfalfa hay | Sugar beets | Pota-toes | Beans | Red clover seed | Alsike clover seed |
|--|-------|-------------|-------------|-----------|-------|-----------------|--------------------|
| Direct labor per acre: | | | | | | | |
| Man labor, <i>hours</i> . . . | 25.1 | 30.8 | 131.6 | 101.4 | 57.2 | 24.9 | 21.7 |
| Horse labor, <i>hours</i> . . | 44.3 | 32.0 | 117.6 | 100.2 | 57.1 | 22.6 | 15.1 |
| Material per acre: | | | | | | | |
| Seed, <i>pounds</i> | 101.0 | 10.4 | 15.8 | 983.0 | 65.70 | 8.60 | 6.50 |
| Twine, <i>pounds</i> | 3.7 | .... | .... | 1.2 | .07 | .02 | .03 |
| Sacks, <i>number</i> | .6 | .... | .... | 141.0 | 2.90 | 2.00 | 2.90 |
| Fuel, <i>tons</i> | .04 | .... | .... | .... | .05 | .07 | .07 |
| Manure, <i>loads</i> | .6 | .... | 4.9 | .6 | 1.33 | .... | .... |
| Irrigation water . . . . . | .... | .... | .... | .... | .... | .... | .... |
| Total operating ex- pense represented by labor and mate- rials at current rates, per cent | 60 | 65 | 78 | 78 | 64 | 55 | 50 |
| Total interest charge represented by in- terest on real estate per acre, per cent . . | 95 | 97 | 92 | 91 | 94 | 97 | 98 |

* Adapted from Byron Hunter and Samuel B. Nuckols, *An Economic Study of Irrigated Farming in Twin Falls County, Idaho* (U.S. Department of Agriculture Bulletin 1421), October 1926, p. 72. Certain footnotes, unimportant to the present study, have been omitted.

money costs appears in the following quotation, taken from a bulletin published in 1921:¹

The basic acre-cost factors, such as hours of man and horse labor, amounts of manure and fertilizer applied, and quantities of seed and twine used, constitute much better measures of cost than the relatively unstable dollar. If these factors are known, labor rates and prices of materials can be applied for any given time,

¹ M. R. Cooper and R. D. Washburn, *Cost of Producing Wheat* (U.S. Department of Agriculture Bulletin 943), April 1921, p. 4.

TABLE 7.—LABOR REQUIREMENTS ON 10 ACRES OF VARIOUS CROPS IN ARKANSAS, BY MONTHS*

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|-------------------------------|------|------|------|------|-----|------|------|------|-------|------|------|------|-------|
| <i>Corn:</i> | | | | | | | | | | | | | |
| Columbia County— | | | | | | | | | | | | | |
| Man labor..... | ... | 3½ | 5½ | 6 | 8 | 5 | ... | ... | ... | 5½ | ... | ... | 33½ |
| Horse labor..... | ... | 7 | 8 | 8 | 7 | 3½ | ... | ... | ... | 5 | ... | ... | 38½ |
| Pulaski County— | | | | | | | | | | | | | |
| Man labor..... | 2 | 4 | 5 | 7 | 9 | 3 | ... | ... | ... | 7 | ... | ... | 37 |
| Horse labor..... | 5 | 9 | 11 | 8 | 8 | 5 | ... | ... | ... | 5 | ... | ... | 51 |
| <i>Cotton:</i> | | | | | | | | | | | | | |
| Columbia County— | | | | | | | | | | | | | |
| Man labor..... | ... | 3 | 4 | 4½ | 16 | 12 | 4 | 1 | 24 | 23 | 2½ | ... | 94 |
| Horse labor..... | ... | 6 | 7 | 6½ | 7 | 7 | 4 | ... | 2½ | 2½ | ½ | ... | 43 |
| Pulaski County— | | | | | | | | | | | | | |
| Man labor..... | 6 | 3 | 3 | 5 | 19 | 17 | 14 | ... | 8 | 17 | 12 | 7 | 111 |
| Horse labor..... | 4 | 4 | 5 | 9 | 10 | 9 | 8 | ... | 1 | 2 | 2 | 1 | 55 |
| <i>Oats:</i> | | | | | | | | | | | | | |
| Spring, Washington County— | | | | | | | | | | | | | |
| Man labor..... | 2 | 4 | 2½ | ... | ... | 3 | 2 | 2 | ... | ... | ... | ... | 15½ |
| Horse labor..... | 5 | 10½ | 6½ | ... | ... | 3 | 2 | 2 | ... | ... | ... | ... | 29 |
| Fall, Pulaski County— | | | | | | | | | | | | | |
| Man labor..... | ... | ... | ... | ... | 1 | 10 | ... | ... | 6 | 3 | ... | ... | 20 |
| Horse labor..... | ... | ... | ... | ... | 1 | 10 | ... | ... | 16 | 8 | ... | ... | 35 |

* Adapted from A. D. McNair, *Labor Requirements of Arkansas Crops* (U.S. Department of Agriculture Bulletin 1181), March 1924, pp. 7 f.

TABLE 8.—CULTURAL PRACTICES ON 47 FARMS IN BARRON COUNTY, WISCONSIN—POTATOES, 1919*

| | Farms | | Acres | | Most common crew | Rate per day (once over) | Times over | Hours per acre | |
|------------------------|--------|---------------------|---------|---------------------|------------------|--------------------------|------------|----------------|-------|
| | Number | Percentage of total | Covered | Percentage of total | | | | Men | Horse |
| Manure | 42 | 89 | 300 | 79 | 2-3 | 21.5 tons | 1 | 14.9 | 24.3 |
| Plow: | | | | | | | | | |
| Team | 44 | 94 | 348 | 91 | 1-2 | 2.4 acres | 1 | 4.5 | 11.7 |
| Tractor | 3 | 6 | 33 | 9 | 1 | 9 acres | 1 | 1.1 | .... |
| Harrow: | | | | | | | | | |
| Spike | 43 | 91 | 337 | 88 | 1-2 | 16.8 acres | 1.9 | 1.3 | 2.9 |
| Spring | 12 | 26 | 102 | 27 | 1-3 | 9.4 acres | 1.7 | 2.0 | 6.0 |
| Disk | 41 | 87 | 322 | 85 | 1-3 | 5.7 acres | 1.7 | 3.3 | 10.9 |
| Float | 2 | 4 | 19 | 5 | 1-2 | 16 acres | 1 | .6 | 1.3 |
| Marking off | 15 | 32 | 118 | 31 | 1-2 | 14.2 acres | 1.7 | 1.3 | 2.5 |
| Treating seed | 7 | 15 | 88 | 23 | 1 | 78 bushels | 1 | 2.8 | .... |
| Cutting seed | 47 | 100 | 381 | 100 | 1 | 20 bushels | 1 | 6.3 | .... |
| Planting | 32 | 68 | 262 | 69 | 1-2 | 4.7 acres | 1 | 2.5 | 4.5 |
| Planting by hand..... | 15 | 32 | 118 | 31 | 1 | 1.7 acres | 1 | 6.1 | .... |
| Cultivating: | | | | | | | | | |
| 1 horse | 25 | 53 | 200 | 53 | 1-1 | 4.8 acres | 3.7 | 7.8 | 7.8 |
| 2 horses | 39 | 83 | 320 | 84 | 1-2 | 5.3 acres | 3.9 | 7.6 | 15.7 |
| Spike tooth | 44 | 94 | 349 | 92 | 1-2 | 16.4 acres | 2.4 | 1.6 | 3.8 |
| Hoeing | 16 | 34 | 92 | 24 | 1 | 1.7 acres | 1.1 | 11.1 | .... |
| Spraying | 20 | 43 | 202 | 53 | 1-2 | 12.4 acres | 2.4 | 2.4 | 4.4 |
| Spraying by hand..... | 16 | 34 | 85 | 22 | 1 | 2.9 acres | 2.5 | 11.6 | .... |
| Dusting by hand..... | 15 | 32 | 104 | 27 | 1 | 4.6 acres | 1.8 | 5.3 | .... |
| Digging | 41 | 87 | 342 | 90 | 1-4 | 3.1 acres | 1 | 4.4 | 15.6 |
| Digging by hand..... | 4 | 9 | 15 | 4 | 1 | .2 acres | 1 | 39.0 | .... |
| Picking up | 47 | 100 | 360 | 100 | 4 | 2.1 acres | 1 | 27.3 | .... |
| Hauling to barn..... | 47 | 100 | 15,798 | 27 | 1-2 | 281 bushels | 1 | 8.0 | 13.6 |
| Hauling to market..... | 47 | 100 | 48,536 | 84 | 1-2 | 116 bushels | 1 | 14.7 | 29.5 |

* Adapted from W. C. Funk, *Costs and Farm Practices in Producing Potatoes on 461 Farms in Minnesota, Wisconsin, Michigan, New York, and Maine for the Crop Year 1919* (U.S. Department of Agriculture Bulletin 1188), April 1924, p. 19.

with the result that a close approximation of the total cost per acre can be obtained, which in turn will make possible a close estimate of the bushel cost when the yield per acre is known.

Where a solid foundation of such basic material is accumulated, it should provide a basis for the estimating of approximate acre and bushel costs for various products at the end of each crop year, so soon as the yield is known and before the crop is marketed. Thus, with the progress of the work in this field of investigation and as the detailed figures for a series of years are tabulated, the basic cost factors become increasingly valuable, because they serve as the basis of timely estimates which cannot be made with any satisfactory degree of accuracy without them.

One may well ask what good it will do anybody to be able to estimate per acre and per bushel money costs of producing various crops "at the end of the crop year, so soon as the yield is known and before the crop is marketed." The implication appears to be that farmers who knew their money costs would know what prices to ask and would stand a better chance of obtaining them; or perhaps that consumers would be glad to pay the cost price if only they could be told what it was. This view may be dismissed as scarcely worth discussion. One may reasonably doubt if the money costs computed for a given year by all the farmers in all areas after the crop is harvested can be made to affect price, except in so far as they may serve to stir Congress to fix prices. We shall deal with the subject of cost-and-price relationships in agriculture and with price fixing in other chapters. Here it suffices to say that, if quantitative cost data are to be compiled merely to enable someone to make a "timely" estimate of this year's money costs, public funds would be ill spent in gathering the data. But this particular use of quantitative data is no longer emphasized by farm management investigators.

It has also been thought, and many investigators still think, that data like those summarized in Tables 6-8 could be employed with profit by farmers in solving problems

of farm reorganization and operation. This view is perhaps most comprehensively stated in a study appearing as late as 1925, though some agricultural economists have felt that quite other forms of data ought to be presented:

With these data at hand, a farmer can measure the efficiency of the labor on his farm by comparing the performance of his crew at different operations with the accomplishment of crews at the same operations on other farms. With the purchase of a new machine of a size and type that has not been used on the farm, the information given here will enable the farmer to determine closely what the accomplishment of his men and mules with the new machine should be. There are wide variations from farm to farm in the size of crew used for such operations as plowing and harrowing. The information on the amount done per day by different-sized crews on different operations will enable a farmer to determine whether he has organized his labor in the best way for his farm. . . .

When a change in the cropping system is contemplated, such as a readjustment of the acreages devoted to the different crops, the introduction of a new crop, or a change in the acreage of the farm, the data in this bulletin will help determine in advance the maximum acreage of any crop or any combination of crops that can be handled by a given number of men and mules. A farmer can find what will be the busy times, if he adopts a changed cropping system, and how much extra labor, if any, will have to be hired to help out the regular force at such times.¹

The quantitative data are usually presented as averages, occasionally as modes. Now it is clear that these averages are not altogether useless; but neither are they particularly useful. They would be the more useful the more unfamiliar their users happened to be with the crops, crews, and machines described. A prospective farmer would undoubtedly be enabled to make a better plan of farm operation if he possessed in advance these average performance records of different crews and ma-

¹ L. A. Reynoldson, *Field and Crop Labor on Georgia Farms* (U.S. Department of Agriculture Bulletin 1292), April 1925, pp. 2 f. The critics of the process of setting up standard labor and materials requirements are the advocates of correlation analysis.

chines and these summary descriptions of quantities and seasonal distribution of labor on the several crops which he might grow. A practicing farmer contemplating a change in farm operation would find such averages useful if he were quite as unfamiliar with the crops and operations involved as the prospective farmer might be. But it is unlikely that practicing farmers within a restricted area are in fact unfamiliar with more than a few of the crops, operations, and machines known in the neighborhood. There would be a real danger in trusting more to these averages than to personal observation. In general there is reason to suspect that natural conditions vary so much from farm to farm within restricted areas that a practicing farmer would gain little by "comparing the performance of his crew at different operations with the [average] accomplishment of crews at the same operations on other farms." Comparison with the regional average is not the sort of comparison needed; what the farmer needs is comparison with performances on farms distinctly like his own, and preferably not with the average performance on these farms, but with performance on the farms which differ most in practices from his own. In order that either standard labor and materials requirements or performance records, applying to familiar rather than to unfamiliar crops and operations, should be made really useful to practicing farmers, investigators ought both to pay close attention to differences in soil and climate, and also to present ranges and quartiles or deciles as well as averages or modes.

An attempt to secure this information on differences between farms in natural conditions would be unduly expensive if the route method were employed, and it could not be secured by the survey or questionnaire methods. In the judgment of the present writer, the use of the farmer's record plan would be more appropriate in rendering to practicing farmers the service sought, though

the survey and questionnaire methods might well be employed where comparatively unfamiliar crops, methods, or machines are involved. This point of view will be clearer after we have examined the other types of investigation. In general we may conclude that quantitative cost data are considerably less useful in solving the practicing farmer's production problem than has commonly been assumed. The summarization of current methods and practices in the form of averages appears likely to be misleading to practicing farmers, though useful to prospective farmers because even unrepresentative averages convey more information than no data at all. Yet it remains true that the general notion of establishing some form of production standards is one of the most promising directions which farm management investigation can take.

THE APPLICATION OF CORRELATION ANALYSIS TO
QUANTITATIVE DATA

Within recent years a proposal has been advanced to apply the multiple or partial curvilinear correlation analysis to quantitative cost data, with a view to setting before farmers information by which they can readily calculate what has been called "the least-cost combination of inputs" and the "greatest-profit combination of inputs." The correlation analysis is proposed as the only device appropriate to determine with precision the net contribution to output of varying quantities of the several kinds of inputs: for example, to ascertain if larger or smaller gains per day in weight of beef cattle could be obtained by feeding more corn and less hay per day.

Only a few of the less technical aspects of the multiple correlation analysis need be considered here. The difficulties involved in interpreting correlation coefficients or ratios of low value—low values are to be expected in multi-variable problems, and agricultural production is a

multi-variable problem—are considered in the Appendix. The meaning of “least-cost” and “greatest-profit” combinations of “inputs” may better be ascertained directly from the publication in which they are explained; something of the nature of the data which it is proposed to compile for farmers appears from Tables 9–15 (pp. 143 ff.), which are drawn from the same document.¹

Now this bulletin, as well as the matter here adapted from it, was prepared to illustrate a method of analysis, not to enlighten farmers. As is evident from the tables, the “least-cost combination” appears only in tentative form. A complete analysis would show not only the most appropriate quantities of hay and corn, but also of pasture, protein concentrates, and whatever other feeds might be available at differing prices for each; and it would further take account of possible differences in initial weights of steers, possible different lengths of feeding periods, and possible different inputs of other cost-factors than feed (labor and interest, for example) at different prices. Clearly a complete analysis of this sort for any given enterprise is a tremendous task for any investigator; and in the end only the “least-cost combination” would be obtained. So far as the present writer is aware, no complete analysis has ever been made for any single farming enterprise. Possibly investigators capable of conducting such analyses are too few in number, and the analytical methods too recently developed. The fact is that the multiple correlation analysis has been applied not to quantitative data bearing on particular farm enterprises, as illustrated in Tables 9–15, but to the problem of measuring the relative effect on farm profits of the various factors affecting profits.

Consequently we need not consider in detail the pro-

¹ J. D. Black, H. R. Tolley, and M. J. B. Ezekiel, *Input as Related to Output in Farm Organization and Cost-of-Production Studies* (U.S. Department of Agriculture Bulletin 1277), September 1924. Tables 9–15 of the present study appear as Tables 20, 21, 24, 25, 26, 27, and 28 (pp. 21 f., 25–27, 30) of this bulletin.

TABLE 9.—NET RELATION OF VARIOUS FEEDING PRACTICES TO FEED REQUIREMENTS FOR BEEF PRODUCTION, AND FOR PORK BY-PRODUCT

| A. DIFFERENCES IN THE DAILY INPUT OF GRAIN | | | | |
|--|-------------------------|-----------------|---|-----------------|
| <i>Pounds per head per day:</i> | Daily gain due to grain | | Average grain required per pound of gain of | |
| | Beef | Pork by-product | Beef | Pork by-product |
| | <i>Pounds</i> | <i>Pounds</i> | <i>Pounds</i> | <i>Pounds</i> |
| 10..... | 1.15 | .149 | 8.7 | 67 |
| 15..... | 1.50 | .205 | 10.0 | 73 |
| 20..... | 1.81 | .238 | 11.0 | 84 |
| 25..... | 1.95 | .258 | 12.8 | 97 |
| 30..... | 2.10 | .268 | 14.3 | 112 |

| B. DIFFERENCES IN THE DAILY INPUT OF ROUGHAGE | | |
|---|----------------------------|---|
| <i>Pounds per head per day:</i> | Daily gain due to roughage | Average roughage required per pound of gain |
| | <i>Pounds</i> | <i>Pounds</i> |
| 8..... | 0.46 | 17.4 |
| 12..... | 0.66 | 18.2 |
| 16..... | 0.83 | 19.3 |
| 20..... | 0.98 | 20.4 |
| 24..... | 1.11 | 21.6 |

| C. DIFFERENCES IN THE LENGTH OF FEEDING PERIOD | | | | |
|--|----------------------------------|-----------------|---|-----------------|
| <i>Days on feed:</i> | Relative gains per unit of feed* | | Relative feed required per unit of gain | |
| | Beef | Pork by-product | Beef | Pork by-product |
| | <i>Per cent</i> | <i>Per cent</i> | <i>Per cent</i> | <i>Per cent</i> |
| 90..... | 108 | 138.5 | 0.925 | 0.720 |
| 120..... | 102 | 117.0 | 0.980 | 0.850 |
| 150..... | 97 | 101.7 | 1.030 | 0.785 |
| 180..... | 95 | 92.0 | 1.053 | 1.085 |
| 210..... | 94 | 87.4 | 1.065 | 1.143 |
| 240..... | 94 | 87.0 | 1.065 | 1.150 |
| 270..... | 94 | 87.0 | 1.065 | 1.150 |

* Taking the gains predicted by A and B as 100 per cent.

TABLE 9.—Continued

| Initial weight per head, pounds: | D. WEIGHT OF ANIMALS AT BEGINNING OF FEEDING PERIOD | | | |
|----------------------------------|---|-----------------|---|-----------------|
| | Relative gains per unit of feed | | Relative feed required per unit of gain | |
| | Beef | Pork by-product | Beef | Pork by-product |
| | Per cent | Per cent | Per cent | Per cent |
| 820..... | 102.0 | 137.3 | 0.98 | 0.73 |
| 860..... | 99.0 | 118.5 | 1.02 | 0.84 |
| 900..... | 96.0 | 104.3 | 1.04 | 0.96 |
| 940..... | 95.0 | 93.1 | 1.05 | 1.07 |
| 980..... | 94.0 | 86.5 | 1.06 | 1.16 |
| 1,020..... | 92.5 | 87.5 | 1.08 | 1.14 |
| 1,060..... | 92.0 | 89.2 | 1.09 | 1.12 |
| 1,100..... | 92.0 | 91.1 | 1.09 | 1.10 |

posal to analyze and present quantitative data in such a form that farmers, by a glance at a series of tables such as Tables 9-15 (though complete in all respects as these are not) could ascertain the least-cost combination of

TABLE 10.—ESTIMATED GRAIN INPUT PER POUND OF GAIN FOR A STEER WEIGHING 1,000 POUNDS AT BEGINNING OF FEEDING PERIOD, BY RATE OF FEEDING GRAIN AND LENGTH OF PERIOD
(In addition to gain due to roughage fed)

| Daily rate of feeding grain | Length of feeding period | | | |
|-----------------------------|--------------------------|----------|----------|----------|
| | 90 days | 120 days | 150 days | 180 days |
| | Pounds | Pounds | Pounds | Pounds |
| 10 pounds..... | 8.6 | 9.1 | 9.6 | 9.8 |
| 15 pounds..... | 9.9 | 10.5 | 11.0 | 11.8 |
| 20 pounds..... | 10.9 | 11.5 | 12.2 | 12.4 |
| 25 pounds..... | 12.7 | 13.4 | 14.1 | 14.4 |
| 30 pounds..... | 14.2 | 15.0 | 15.8 | 16.1 |

inputs for each of the products they are producing. As yet the compilation of such tables is visionary.

What farmers are chiefly interested in is in any event not so much the least-cost combination as the greatest-

TYPES OF FARM MANAGEMENT INVESTIGATION 145

TABLE 11.—PROBABLE DAILY GAINS PER HEAD FROM FEEDING VARIOUS COMBINATIONS OF CORN AND ALFALFA HAY TO STEERS OF 847 POUNDS INITIAL WEIGHT FOR 138 DAYS

(Computed from Table 9)

| Corn input per head per day (pounds) | Hay input per head (pounds per day) | | | | Pork by-product (pounds per day) |
|--------------------------------------|-------------------------------------|------|------|-------------------|----------------------------------|
| | 8 | 12 | 16 | 20 | |
| 10..... | 1.61 | 1.81 | 1.98 | 2.13 | 0.198 |
| 15..... | 1.96 | 2.16 | 2.33 | 2.48 | 0.273 |
| 20..... | 2.27 | 2.47 | 2.64 | 2.79 | 0.317 |
| 25..... | 2.41 | 2.61 | 2.78 | ^a | 0.343 |

^a Very few droves received as much as 20 pounds of roughage and 25 pounds of grain; hence this combination was not calculated.

TABLE 12.—ESTIMATED COST OF PRODUCING BEEF PER 100 POUNDS OF GAIN AT VARYING PRICES OF CORN, BY RATES OF FEEDING CORN AND HAY (847-POUND STEERS, ON FEED 138 DAYS; ALL COSTS OTHER THAN FEED \$11.20 PER HEAD; PORK BY-PRODUCTS 7½ CENTS PER POUND)

| Corn input per head per day | Hay input per head (pounds per day) | | | |
|---|-------------------------------------|---------|---------|---------|
| | 8 | 12 | 16 | 20 |
| Costs with corn at 40 cents per bushel, hay at \$10 per ton | | | | |
| 10 pounds | \$12.95 | \$12.63 | \$12.65 | \$12.70 |
| 15 pounds | 12.16 | 11.98 | 11.96 | 12.04 |
| 20 pounds | 11.94 | 11.78 | 11.78 | 11.86 |
| 25 pounds | 12.65 | 12.45 | 12.40 | ..... |
| Costs with corn at 50 cents per bushel, hay at \$10 per ton | | | | |
| 10 pounds | \$14.07 | \$13.61 | \$13.46 | \$13.45 |
| 15 pounds | 13.55 | 13.22 | 13.11 | 13.12 |
| 20 pounds | 13.51 | 13.23 | 13.13 | 13.15 |
| 25 pounds | 14.51 | 14.16 | 14.01 | ..... |
| Costs with corn at 60 cents per bushel, hay at \$10 per ton | | | | |
| 10 pounds | \$15.17 | \$14.60 | \$14.36 | \$14.39 |
| 15 pounds | 14.89 | 14.45 | 14.25 | 14.20 |
| 20 pounds | 15.08 | 14.66 | 14.48 | 14.43 |
| 25 pounds | 16.16 | 15.86 | 15.61 | ..... |

146 FARM COST STUDIES IN THE UNITED STATES

TABLE 13.—ESTIMATED COST OF BEEF PER 100 POUNDS OF GAIN AT VARYING PRICES OF HAY, BY RATES OF FEEDING CORN AND HAY (847-POUND STEERS, ON FEED 138 DAYS; ALL COST OTHER THAN FEED \$11.20 PER HEAD; PORK BY-PRODUCT 7½ CENTS PER POUND)

| Corn input per head per day | Hay input per head (pounds per day) | | | |
|--|-------------------------------------|---------|---------|---------|
| | 8 | 12 | 16 | 20 |
| Costs with corn at 60 cents per bushel and hay at \$10 per ton | | | | |
| 10 pounds | \$14.07 | \$13.61 | \$13.46 | \$13.45 |
| 15 pounds | 13.55 | 13.22 | 13.11 | 13.12 |
| 20 pounds | 13.51 | 13.23 | 13.13 | 13.15 |
| 25 pounds | 14.51 | 14.16 | 14.01 | ..... |
| Costs with corn at 60 cents per bushel and hay at \$12 per ton | | | | |
| 10 pounds | \$14.66 | \$14.28 | \$14.27 | \$14.38 |
| 15 pounds | 13.95 | 13.78 | 13.80 | 13.93 |
| 20 pounds | 13.87 | 13.72 | 13.74 | 13.87 |
| 25 pounds | 14.83 | 14.61 | 14.60 | ..... |
| Costs with corn at 60 cents per bushel and hay at \$14 per ton | | | | |
| 10 pounds | \$15.06 | \$14.94 | \$15.08 | \$15.32 |
| 15 pounds | 14.35 | 14.33 | 14.48 | 14.74 |
| 20 pounds | 14.26 | 14.20 | 14.35 | 14.58 |
| 25 pounds | 15.17 | 15.08 | 15.17 | ..... |

TABLE 14.—PROBABLE GAIN PER DAY AND TOTAL GAINS FROM FEEDING FIXED TOTAL QUANTITY IN PERIODS OF DIFFERENT LENGTHS TO 835-POUND STEERS

(Computed from Table 9)

| Length of feeding period | Daily input | | Daily gains | | Total output | |
|--------------------------|-------------|--------|-------------|--------|--------------|--------|
| | Corn | Hay | Beef | Pork | Beef | Pork |
| | Pounds | Pounds | Pounds | Pounds | Pounds | Pounds |
| 120 days..... | 27.0 | 8.0 | 2.45 | 0.32 | 294 | 38 |
| 150 days..... | 21.5 | 6.4 | 2.04 | 0.26 | 306 | 38 |
| 170 days..... | 19.0 | 5.6 | 1.92 | 0.22 | 326 | 38 |
| 210 days..... | 15.4 | 4.6 | 1.74 | 0.19 | 365 | 39 |
| 240 days..... | 13.5 | 4.0 | 1.56 | 0.17 | 374 | 41 |

TYPES OF FARM MANAGEMENT INVESTIGATION 147

TABLE 15.—ESTIMATED COST OF BEEF PER 100 POUNDS OF GAIN, FEEDING A FIXED TOTAL QUANTITY OF FEED IN PERIODS OF DIFFERENT LENGTHS

(Gains from Table 14)

| Length of feeding period | Computation of costs per head | | | | Beef gains | Net cost per 100 pounds of gain |
|--------------------------|-------------------------------|----------------------------|-----------------------------|--------------------------|------------|---------------------------------|
| | Fixed costs—feed, etc. | Variable costs—labor, etc. | Deduction for pork credits* | Net total costs of gains | | |
| | <i>Dollars</i> | <i>Dollars</i> | <i>Dollars</i> | <i>Dollars</i> | | |
| 120 days..... | 35.40 | 4.88 | 3.04 | 37.24 | 294 | 12.67 |
| 150 days..... | 35.40 | 6.10 | 3.04 | 38.46 | 306 | 12.57 |
| 170 days..... | 35.40 | 6.91 | 3.04 | 39.27 | 326 | 12.05 |
| 210 days..... | 35.40 | 8.54 | 3.12 | 40.82 | 365 | 11.18 |
| 240 days..... | 35.40 | 9.76 | 3.28 | 41.86 | 374 | 11.20 |

* Pork at 8 cents per pound.

profit combination. With immense labor, tables could probably be prepared which would enable farmers to ascertain this greatest-profit combination at any given moment for all of the products they produce, though every user of the tables would have to determine how far conditions on his own farm conformed to the average conditions in the area to which the data in the tables applied. This necessity in itself creates a certain limitation on the usefulness of the tables—the familiar difficulty of rendering averages or generalizations useful to individuals. But a more significant limitation is the fact that a farmer is interested in the greatest-profit combination not of the moment, but of some time in advance: he wishes to conduct operations now so that the financial results will be the best possible in the future. What he needs, in other words, is the best possible guess as to what prices of his products are likeliest to prevail between the beginning and the end of his operations. Price forecasts are needed under this form of analysis as well as under other less complicated forms.

From the investigator's point of view, difficulties must

arise with respect to employing data applying to one year only. In any given year the recorded quantitative inputs of which the correlation analysis takes account may have been affected by uncontrollable causes like weather or disease, so that different regression equations might be obtained for different years when precisely the same variables were correlated. Furthermore, there are certain technical difficulties in interpreting the results of partial correlation analyses, as appears in the Appendix. From the standpoint of appropriate allocation of research projects to different fields of research, it may be asked why the agricultural economists should contemplate extensive inquiry by correlation analysis into the factors affecting yield. Such inquiry is an essential part of the analysis leading to the determination of the least-cost combination; but the problem is one with which workers in agronomy and animal husbandry are also much concerned. The point deserves more emphasis than can be given it here. One would suppose that, if the existence of uncontrollable causes of variation in inputs throws doubt on the validity of conclusions drawn from input data gathered from a group of farms in one year, then the controlled experiments as usually conducted by agronomists and animal husbandrymen would be the more desirable approach to the problem.

Hence the correlation analysis ought not to be regarded as the analysis appropriate in farm management investigation. The expense of securing adequate data covering a sufficient period of years, and of applying an adequate analysis, would be extremely heavy. Doubtless excellent studies can be made by thoroughly competent investigators, though there will be certain limitations on the usefulness of results to farmers no matter how perfect the technique of investigation may be. It is much to be doubted if elaborate correlation analyses of quantitative data ought to be encouraged as a part of the research

programs in agricultural economics or farm management throughout the agricultural experiment stations, especially while price and weather forecasting remains in an elementary stage of development. Such analysis by itself does not constitute a solution of the farmer's production problem.

Nevertheless it is a more precise method of analysis than any heretofore developed. It ought not to be abandoned merely because it is difficult, expensive, and not a complete solution of the problem. But it constitutes the sort of research wherein more seems likely to be accomplished in the end by long-continued efforts of a few thoroughly competent investigators than by many hurried studies, conducted by investigators not thoroughly trained and working with palpably inadequate materials. The notion of substituting the correlation analysis for the prevalent simpler and less analytical procedures, both being intended to provide practicing farmers with usable data, does not appeal to the present writer as sound. The partial correlation analysis, either as applied to quantitative cost data or to the problem of measuring the factors affecting profits, is a device better suited to the laborious development of fundamental principles than to the process of providing farmers with helpful hints. It is more suitable for the scientific than for the practical aspect of farm management investigation.

DATA ON UNFAMILIAR MACHINERY AND METHODS

Attack upon the problem of providing farmers with production standards has occasionally taken a different form from that of collecting quantitative data pertinent to numerous different crops, machines, crews, and operations common within a restricted area. Particular machines have been regarded as worthy of special attention. Within recent years a considerable body of literature has sprung up in which the experience of farmers, notably

with tractors and motor trucks, has been summarized into convenient form. Work in this field—the field of “farm power”—has largely been conducted by the questionnaire method, though the survey method has also been used; little use has been made of the route method.

Most of the bulletins consist of compilations of farmers' experiences, together with figures showing costs of operation. A good deal has also been done with comparisons of the relative costs of maintaining horses and tractors. But such cost comparisons have not been over-emphasized; investigators have recognized that shifting relationships between feed prices and fuel prices were likely to invalidate conclusions drawn from data applicable only to a given year. The purpose in view has been modest—to gather together approximately accurate information on machinery obviously likely to be of importance to farmers, but not yet familiar to the great majority.

Such investigations are on the whole to be regarded with favor. There is reason to believe that they fill a real need. Some generalized form of statement regarding the chief advantages and disadvantages which the relatively few purchasers of new machines have encountered might reasonably be supposed to furnish prospective purchasers with information of a sort they would be unlikely to obtain from neighbors or from salesmen of farm machinery. The information could perhaps be presented in somewhat greater detail than is usual, especially with respect to the special advantages and disadvantages of particular makes of machines. But it is of some importance to non-owners to know, for example, that practically all owners of tractors have found the tractors valuable in accomplishing better plowing than they could do with horses, or that owners of motor trucks found them desirable in bringing better markets within their reach, or that the chief disadvantage of both tractors and trucks lay in the matter of avoiding breakdowns.

The essential value of such investigations does not lie in affording proof that a new machine is superior to an old for accomplishing the same task, but in providing data on what the new machine can accomplish that the old cannot accomplish. Often such information cannot be conveyed in statistical form. But it need not be so conveyed. When practically all of a large number of experienced farmers vote, so to speak, in favor of owning motor trucks and give good reasons not strictly in the form of cost comparisons, about as good evidence is afforded as elaborate cost comparisons could provide that non-owners would do well to purchase. The choice is often not a matter of involved calculation, but is fairly obvious. It remains for individuals to enter upon such calculations as they must. But on the whole the general information embodied in these bulletins appears to provide a reasonably trustworthy starting point for the calculations.

Questionnaire investigations dealing with comparatively new machines of course cannot be expected to solve fundamental problems. They are of an ephemeral nature, useful only until some still newer device appears. But they are cheap because the method of investigation is inexpensive; they can be conducted rapidly; and on the whole they may serve somewhat to hasten the adoption of new devices. On these grounds they might well constitute a part of a program for work in farm management. The chief danger lies in the possibilities that cost comparisons will receive undue emphasis, and that attempts will be made to reach permanently valid conclusions by elaboration of the data secured and by unnecessarily painstaking analysis.

Thus far we have spoken of inquiries which deal with expensive machinery like trucks, tractors, milking machines, and "combines." In typical enterprise cost surveys one often encounters comment upon less important and expensive devices—feed racks for cattle, or stanchions

operated by a single lever, or feed boxes on wheels. There is a fair possibility that even within a restricted area such minor labor-saving devices are known to some farmers with an inventive knack, but not to others; and in view of the great variety of ways in which the same operation can be conducted on farms, there is a possibility that the sum total of minor efficient devices known by various farmers (but not all practiced by any) might be of some importance. This would appear to be probable especially in animal husbandry of one form or another, where the same tasks are repeated daily. An inexpensive and perhaps significant survey covering a fairly large group of farms might yield some useful suggestions to farmers; and in many instances it would suffice to describe a promising device, since expense of installation need not always be of importance. So far as the present writer is aware, no such procedure has been attempted (perhaps because of its very simplicity; the use of statistical devices is currently in favor), but the procedure at least has the merit of cheapness, and on a priori grounds can be thought capable of yielding modest but useful results.

THE FARM BUSINESS ANALYSIS SURVEY: FACTORS AFFECTING PROFITS

We have thus far considered those types of farm management investigation in which attention has centered upon the problem of the choice and combination of the cost factors in the conduct of single farm enterprises. Many cost studies have been devoted to this general problem, but quite as much inquiry has been directed toward the broader problems of choice and combination of enterprises. The two broad types of inquiry are not, of course, sharply differentiated. Route cost investigations often deal with both subjects together, as may some investigations conducted by the farmer's record plan; and enterprise surveys conducted in areas where a single enterprise

is of outstanding importance deal, in effect, with the farm business as a whole as well as with the methods of conducting the single dominant enterprise.

Nevertheless the farm business analysis survey stands out as a fairly distinct type of investigation, perhaps the most common of any. It may be described as a diagnosis of and prescription for farm practice in a particular area. Income—profits—of some form on each of the farms in a group is the figure of central interest. Usually the objective is not only to explain the profits actually received on the particular farms in the particular year or years to which the data apply, but also to suggest either general principles of, or specific suggestions for, farm management in the area for which the farms constitute a statistical sample—principles and suggestions which, if followed, would result in higher future profits on many farms within the area. In this type of inquiry the scientific aspect of farm management is perhaps dominant over the practical aspect; consequently its value and its possibilities are difficult to adjudge.

The data customarily secured in the farm business analysis survey cover a wide range of subjects. In most inquiries information is secured, from each farm, on acreage and its allocation to various uses; yields per acre; numbers of animals of various sorts (often reduced to "animal units per farm"); the amount of human labor utilized (hired, family, and operator's) by months, weeks, days, or hours; capital investment subdivided into its various classes; receipts classified by principal sources; expenses distributed to many categories but not expressed in terms of costs per unit of particular products; quantities of various products sold, prices received per unit of product; value of operator's labor; and value of family living received from the farm. From the necessary data such significant figures are computed as labor income, operator's earnings, farm income, and per cent return on

capital invested. With such data in hand, the investigator's problem is to ascertain what factors seem to have caused variations in the significant figure which is said to measure "success," and to measure the relative influence of these different factors; and so far as possible to go farther in formulating definite suggestions for improvement in practice within the area in question.

Until recent years the approved form of analysis was by "cross-tabulation"—essentially a method of discovering (not measuring) "relationships." One might erect a very large number of tables by attempting to show, for example, the relationship of each of such factors as size of farm, capital invested, yield per acre, or numbers of animal units per farm either to labor income or to each other; or one might display the relationships between each of these factors and per cent return upon invested capital, if this figure were to be regarded as a more significant measure of success than the labor income figure. A hypothetical table showing the relationship of capital invested to labor income would appear as follows:

| Capital Invested (dollars) | Number of farms | Labor income (dollars) |
|-------------------------------|--------------------|------------------------------|
| 0- 5,000..... | 10 | 200 |
| 5,001-10,000..... | 15 | 300 |
| 10,001-15,000..... | 20 | 400 |
| 15,001-20,000..... | 20 | 500 |
| 20,001-25,000..... | 10 | 600 |
| Over 25,000..... | 3 | 700 |

From such a table the conclusions would be drawn that labor incomes tended to increase as capital invested per farm increased, or that the amount of capital invested was a significant factor affecting profits, or that farmers who wanted to make higher profits ought to invest more capital. As a matter of analytical procedure, the relation

of every one of the factors to every other or to the several measures of success might be displayed in this fashion; or the investigator might display only a restricted number of relationships which seemed to him likely to be most significant.

We need not enter into a detailed discussion of the difficulties involved in this procedure. One problem is to select an appropriate measure of success, and much discussion has raged about this subject. The question is important because by the cross-tabulation method one may perceive an apparent relationship between, let us say, size of farm and labor income, which does not appear between size of farm and per cent return upon invested capital. Hence one is not justified in laying down the rule that successful farmers operate large farms. Another difficulty now generally recognized is that the relationships made apparent from an analysis of one year's data may not appear if another year's data be analyzed, so that a study of one year's data must not be regarded as establishing permanently valid relationships or principles. A further problem is to define each of the factors affecting profits in such a manner that an apparently close relationship is simple and direct, not complex. Thus not much is shown if a close relationship appears between receipts per farm and labor incomes, since receipts obviously depend upon volume of sales and prices received, and volume of sales partly upon yields, and prices partly upon quality and time of marketing; so that the conclusion that a close relationship existed between receipts and labor income is not a conclusion of great assistance to farmers seeking to increase their incomes or to investigators who seek to teach them how it may be done. The difficulty, to which we have already referred, always arises of distinguishing controllable from uncontrollable factors affecting profits. A further problem is to measure the relative importance of different apparent

relationships. The cross-tabulation analysis can go no farther than to display the presence or absence of relationship between labor income and the various factors affecting it; when a relationship appears between labor income and each of several of these factors, one cannot perceive which has had the most important effect on labor income. To express the matter in more technical language, the cross-tabulation analysis is a crude form of scatter-diagram; but the scatter-diagram, while indicating roughly the existence or non-existence of a relationship, does not measure it.

The general problem is clearly one fitted for correlation analysis, and for the partial rather than the simple correlation analysis. By means of the partial correlation analysis it is possible not only to avoid the difficulties arising from the fact that the dependent variables are interrelated—size of farm and capital invested, or yield per acre and labor used in production, affect each other as well as labor income—but also to erect a numerical measure of the relationship existing between any given dependent variable and the independent variable. These facts have been recognized in recent years. There has been a tendency to emphasize the use of the partial correlation analysis, and furthermore to urge that the correlation method be adapted to account for curvilinear as well as rectilinear relationships. Application of the correlation analysis to the general problem of the factors affecting profits is considered in its more technical aspects in the Appendix, wherein the conclusion is drawn that less is to be expected from it than its proponents suppose.

Here we may conclude that what may be called the factors-affecting-profits analysis has not proved altogether satisfactory as a type of farm management inquiry, and that its difficulties are such that under any method of analysis it ought not to be regarded as an appropriate part of a general program of investigation for all of the

existing investigating agencies. No one can trust the conclusions drawn from investigations covering data of one year only, especially if the cross-tabulation method, with its failure to account for interrelationships between the factors affecting profits and to measure the relative importance of the factors, has been employed in reaching the conclusions. It would appear more desirable to secure trustworthy conclusions from the application of the correlation analysis to data of several years. But the correlation analysis so applied would be expensive and laborious as well as difficult, and hence appropriate for a few investigators thoroughly trained rather than for all or many investigators and agencies.

Even under the correlation analysis certain exceedingly difficult problems would remain, notably the definition of independent variables in such a manner that the factors which farmers can control are distinguished from those which they cannot. Something is to be gained by establishing beyond cavil the generalization that size of farm, or yield per acre, or acreage in corn, or crop acres per horse, are factors of such-and-such influence on incomes. These generalizations can be established by the partial correlation analysis in a manner far more satisfactory than by the cross-tabulation analysis, and it is for this reason that inquiry by the correlation method ought to be continued. But if the expressed objective in farm management is to be achieved, such generalizations constitute only a first step. One needs also to ascertain how far farmers can control their size of farm, yields, acreage in corn, or crop acres per horse, and thus to evolve suggestions that go beyond mere statements of fact and that can be acted upon.

In the judgment of the present writer, the factors-affecting-profits analyses, especially of one year's data and under the cross-tabulation analysis, have not in fact contributed greatly either to the scientific or to the prac-

tical aspects of farm management investigation. They have, however, made available a mass of statistical material descriptive of farm operation not otherwise accessible; and this material is by no means worthless. With the use of better data and analytical methods more significant and trustworthy generalizations can probably be reached. But the new analytical methods ought not to be regarded as a certain solution of the problem to which farm management investigators have addressed themselves, especially while much remains to be done in distinguishing the controllable from the uncontrollable factors affecting profits and costs. General adoption of the new methods of analysis is undesirable, so long as limitations both of expense and of probable results remain important. But the prospects for significant results of scientific rather than of practical value are such that experimentation with the new methods of analysis appears desirable.

REPLANNING FARMS FOR PROFIT

Conclusions drawn from farm management investigations of all sorts have frequently been of such a nature that farmers could not utilize them if they would. Under the pressure indirectly exerted by a general search for devices whereby the distress of farmers since 1921 might be alleviated, investigators in farm management directed their attention toward the formulation of tangible and usable suggestions from the various types of cost investigation. Within the past two years a few publications have appeared in which specific suggestions have been made for the reorganization of particular farms included in the studies. Such few studies of this type as have appeared may be regarded as models. One finds essentially the same scheme of analysis and presentation followed in each of the model bulletins, whether the data were secured by the route or the survey method.

These studies consist of three parts: a history and description, largely statistical, of the area in which the study was conducted; a discussion of standard labor and materials requirements in producing the several products of the area, together with data on seasonal distribution of labor; and a statement of the "principles" governing the choice of farm enterprises, followed by several concrete illustrations of farms which would profit by the application of these principles.¹ We shall be concerned in the present section only with the procedure followed in the final step in the analysis, since enough has been said already of the value of "standard requirements."

The "principles" which investigators have laid down as governing the choice and combination of crop and livestock enterprises—for it is chiefly to the problem of choice of enterprises, not choice of the cost-factors, that these investigations have been addressed—are set forth as follows in one bulletin:

From the information presented on the preceding pages, the following principles may be deduced which farmers in this area should bear in mind when selecting and adjusting farm enterprises to meet conditions existing on their farms:

1. Variations in a farmer's resources influence the selection of enterprises and the returns from farming.
2. Markets and marketing conditions vary for different farm products.
3. Farm enterprises vary in their demand upon the resources of the farmer.
4. Non-marketable resources must be used when and where available.²

In other bulletins one finds slightly different principles enunciated, e.g., that "succession of a large number of

¹ The illustrations are given in some instances principally to show farmers who read the bulletins how, if they secure similar data from their own farms, they ought to employ these data in planning their own operations.

² E. R. Johnson and S. B. Nuckols, *Farm Management Problems on Irrigated Farms in Hay and Potato Areas of the Yakima Valley, Washington* (U.S. Department of Agriculture Bulletin 1388), March 1926, p. 50.

different operations from season to season necessitates frequent labor adjustments"; that "use of intermediate products is a complicating factor";¹ and that the farmer should consider "regional adaptation of the different enterprises," "utilization of fixed resources," and "changes in prices or costs."² It may well be asked whether elaborate cost investigations were necessary in order to deduce these principles; but we need not discuss the matter here. Their substance is that farmers ought to utilize their resources to the fullest possible extent, allowing no available labor or materials to go unused, and that such changes in organization as investigators suggest ought to lie within the power of the farmer to adopt. So stated, the principles are both obvious and acceptable.

In applying these principles so as to suggest tangible, usable, and desirable suggestions whereby particular farmers ought to be able to improve the organization of their farms and hence their profits, investigators set forth first a description of the available resources of the farm—available labor supply, available land, available equipment; second, the labor and materials "requirements" on this farm for producing such products as were produced; third, a calculation of returns obtained under the existing allocation of enterprises; and fourth, a calculation of the returns to be expected if certain apparently feasible and desirable changes should be made in the existing organization.

The only step in this procedure which need be given attention is the final step—the calculation of probable returns. In this step certain assumptions have to be made respecting the probable prices and yields which the

¹ George A. Pond and Jesse W. Tapp, *A Study of Farm Organization in Southwestern Minnesota* (Minnesota Agricultural Experiment Station Bulletin 205), November 1923, p. 105.

² W. E. Grimes, J. A. Hodges, R. D. Nichols, and Jesse W. Tapp, *A Study of Farm Organization in Central Kansas* (U.S. Department of Agriculture Bulletin 1296), January 1925, p. 61.

farmer can secure in the future. Investigators employ what they call "normal" prices and yields. Exactly how these normal prices and yields are calculated is not altogether clear; but they are apparently averages of past prices and yields. The procedure, then, is to calculate returns from the existing farm organization: first one takes the recorded acreage in various crops and numbers of live stock, then a normal output of various products figured by reference to the assumed yield, then a calculation of gross receipts upon the basis of the computed output multiplied by the assumed prices, and finally a calculation of the value of feeds, materials, and labor which have to be purchased in order to conduct the existing organization—and this expense figure is subtracted from the figure for gross receipts. The investigator then considers if, under the same normal prices and yields, a larger figure for net receipts could be obtained by shifting acreage from one crop to another, by producing more live-stock products, and so on—always with reference to the available resources of the farm.

Clearly this procedure constitutes a more realistic approach to the problem of providing farmers with usable suggestions than, for example, does the factors-affecting-profits analysis; for the available resources of particular farmers are held continually in mind. But it is equally apparent that the suggestions for changes in combinations of enterprises can be valid only in so far as the assumed "normal" prices and yields turn out to be the prices and yields that actually prevail. Now one may grant that investigators render to farmers a useful service in showing them the sort of calculation by which they can exercise their best judgment in replanning farm organization. But the process of suggesting definite changes is a somewhat different thing, and a far more uncertain procedure so long as investigators themselves do not know what prices and yields are going to be on the various farms.

The method of calculation has already been shown; in order merely to demonstrate the method, there is no need to conduct cost investigations in many counties or areas where no investigations have been made. The reason for extending investigation to many localities must lie in the contention that investigators can accomplish much in making specific suggestions. Doubtless they can accomplish something; but the fact that they cannot foresee prices and yields renders their suggestions of uncertain validity. There is no certainty that an investigation will result in valuable suggestions for farmers in any area; there can be no assurance in advance that farmers will benefit from it. Carried out to the full, general adoption of this type of inquiry means that either route or survey investigations will be conducted in all or most of the agricultural experiment stations, and that the investigator in charge of each inquiry will enter upon these elaborate calculations for each of the farms included within each inquiry. No such thoroughgoing adoption or analysis is at present effective, so far as one can ascertain. In view of the weaknesses of the method, it is doubtful if plans for reorganization ought to be attempted for all farms included in all such investigations. The type of farm management investigation which involves the re-planning of farms by investigators rather than by farmers does not appear to be a type of investigation suitable for general adoption, principally because it throws a heavier burden on investigators than they ought willingly to undertake; they need to know more than they can know.

Furthermore, the expense of conducting such inquiries is very heavy. One of the model investigations was based upon route cost data collected during a three-year period. At least \$1,500-\$1,800 a year must be paid to the man who visits the farms; clerks must be paid for tabulating data as gathered; investigators must be paid for the time they spend in analysis. All told, it seems highly probable that

some \$25,000 must be expended in conducting a three-year investigation conducted by the route method. It is much to be doubted if the conclusions drawn from such investigations are worth the money, especially if they can be obtained by less expensive means. The survey is cheaper and hence more desirable; and in view of the necessity of guessing at future yields and prices in drawing conclusions under either method, it is presumably quite as likely to result in sound conclusions. But within recent years a method of investigation has been devised which serves as a still more promising alternative; and, though subject to the same fundamental limitations as other methods and not addressed to precisely the same problems, it has certain features that render it the most promising of all those methods of farm management inquiry which are fundamentally concerned with practical results rather than with scientific research.

THE CO-OPERATIVE FARM MANAGEMENT SERVICE

Late in 1924 a new type of farm management investigation was instituted by the College of Agriculture of the University of Illinois.¹ The so-called "farm bureau-farm management service" may be described as a co-operative form of efficiency service which may be used also to provide the data necessary for scientific research. The expense is borne chiefly by the co-operating farmers, partly by the farm bureaus of which they are members, and partly by the University of Illinois. The farmers themselves keep records in account books, following accounting procedures previously developed by investigators in the college, and assisted by a supervisor who visits each farm at least three times a year. At the completion of a year's records, averages of several sorts are compiled

¹ See H. C. M. Case, "Farm Bureau-Farm Management Service Project in Illinois," *Journal of Farm Economics*, July 1926, VIII, 311-23, and *First Annual Report of the Farm Bureau-Farm Management Service for the Year 1925*, Urbana, Illinois, April 1926 (mimeographed).

from the collected records by the supervisors; such conclusions are drawn as are possible; and a mimeographed or multigraphed report is circulated to the co-operating farmers, who are enabled to compare significant figures applicable to their own farms with averages compiled from the records of other farmers. "Tours" are also organized, in which farmers visit five or six selected farms. The fundamental feature of the plan is to permit individual farmers to compare records of their past performances with the records of performance on other more or less successful farms within their neighborhood, and to provide an advisory service available to members. A good deal of initiative is left to the co-operating farmers.

One may view this type of service as a compromise between the farm business analysis survey and extension work in farm management. Extension services have long been occupied with the development of methods of accounting for farmers, with standardization of account books, and with methods of convincing farmers of the value of account keeping. Of this work we have had little to say, except to note that analysis of the records kept by farmers in these account books constitutes what we have called the farmer's record plan of gathering data; but it may be described as desirable though not spectacular work, of real value to farmers because it stimulates them to solve their problems for themselves and makes no great claims toward solution of the farmer's production problems. This work is deficient in so far as it does not provide farmers with appropriate data to compare with their own data—essentially the procedure involved in a survey. The co-operative farm management service sets before farmers certain averages which they may use for comparison, unlike the farmer's record method in its simplest form; and at the same time it provides the farmers with data of their own, unlike the survey. It is better than either in that it does both things; and it is better than the

route method, which does both, because of its relative cheapness and less ambitious objectives.

At the end of the year, after each member of the co-operative project has closed his accounts, the supervisors present certain averages of certain significant figures drawn from the records of the group. The averages are for all farms in the group (of say 225 farms), for the 25 farms attaining the highest profits, and for the 25 farms attaining the lowest profits. The significant figures averaged are too numerous to be listed in full here (98 significant figures were presented in the first annual report of the farm bureau-farm management service project in Illinois); among others, data appear on capital investment of several sorts; receipts by sources; expenses by objects; value of operator's and family labor; rate earned on investment; labor and management wage; receipts and expenses per acre; size of farm; value of land per acre; investment per acre; yield per acre; percentage distribution of land to various crops; returns of live stock per acre, per \$100 of feed, and per \$100 invested; crop acres per man and per horse; and so on. The three averages for each of these significant figures are arranged in columns, with a blank column in which each farmer may supply similar data for his own farm and thus make comparisons.

Of course this is not a perfect procedure, infallible from the farmer's point of view. Much depends upon the significant figures which are presented for comparison. But the very number of possible comparisons is presumably helpful. Any farmer can at least form a notion about how well he compares with his more and less successful neighbors with respect to certain broad features of farm operation. He can at least tell that he deviates widely from the common practice of successful farms in some respects if not in others; and merely to know the practice wherein he differs most is useful in that it establishes the

presumption that here lies a real weakness or strength, a point worth further thought. If his farm shows considerably lower returns but higher land values per acre than the more profitable farms of the group, then there may be reason for him to call into question his valuation. This in itself would not increase his efficiency, but it would be a matter of some moment for him merely to see clearly that his ideas were out of line with his neighbors'. He would profit more directly by perceiving clearly that, as compared with farmers who made higher profits than his own, he kept far fewer hogs, or obtained far lower receipts per \$100 of feed fed to live stock. Problems would not be solved merely by knowing these facts; he would have to decide whether his or his neighbor's notions of the proper number of hogs were the better for next year, and whether his or his neighbor's feeding practices would be better for next year. He would need to make his own allowances for the extent to which the other farmer's good profits were due to good luck which he did not share. The figures set before him would not prove that he was inefficient; they could merely give him food for thought by establishing the presumption that perhaps he might have done better, and might do better in the future, if he paid more attention to particular problems. In short, he would be faced in his comparisons with the same difficulties of analysis that are faced by investigators, and fundamentally his problem would remain, under this method as under others, impossible to solve with precision.

Nevertheless something is to be gained by knowing, even in a rough way, in which direction to look for "leaks." This is the first purpose of record keeping, and record keeping is justified, if it goes no farther of itself—at least when discovery of leaks is not distinctly expensive. The merit of the co-operative farm management service is not that it provides definite suggestions whereby

each farmer of the group can certainly secure higher profits, not that it lays down general rules which all farmers should follow, but that it permits the farmer himself to diagnose his business and to some extent assists him in the diagnosis. It is quite unlike the use of the route method to suggest a plan of reorganization for each farm, and quite unlike the general proposal of investigators to "forecast farm management." It is a less refined procedure than either, and far less detailed than the procedure of investigation necessary in setting up standard requirements.

In the judgment of the present writer, this method of inquiry constitutes a distinctly promising departure. It does not involve claims to omniscience on the part of its supervisors; apparently they regard themselves as advisors but not as arbiters, as persons who can render real assistance to a farmer in explaining his successes or failures, but not as prophets. Under this method investigators are necessarily kept in the closest possible contact with farmers, and their attention is focused not upon the intricacies of difficult statistical analysis, but upon the outstanding differences between individual farms. The method does not constitute a drain upon public funds: in Illinois it cost each farmer of the 226 from \$10 to \$20 a year, and the College of Agriculture only \$2,000. The fact that farmers pay fees may well result in prompt compilation of data, and will serve as a realistic test of the value of the work. Such inquiry might well supplant much route and survey work. If it proved really useful, one might conceive of co-operating groups in most counties, perhaps supervised in part by the county agents. There can be no doubt that the material could be employed for more ambitious studies by those to whom it was available. Of all the types of farm management investigation, the co-operative farm management service appears to be the best adapted to fill a real need.

CHAPTER IX

A PROGRAM FOR FARM MANAGEMENT INVESTIGATION

We are now in a position to formulate some suggestions for changes in the existing programs of work aimed toward the increase of farm efficiency in the United States—work more specifically concerned with the process of teaching farmers the best choice and combination of enterprises and the best methods of conducting each enterprise. As we saw in a preceding chapter, leaders in agricultural economics and farm management are divided in their opinions as to what can and ought to be done. A minority school advocates that farmers be taught how to keep and analyze accounting records and how to interpret such data on prices and production as are currently published, and that changes in farm organization and operation be left to the farmers themselves. A majority school argues that farmers as groups if not as individuals must be told what is best for them to do by investigators who collect and analyze data for them.

In the judgment of the present writer, neither school holds altogether acceptable views. The minority school is more nearly right, since its members apparently recognize that decisions with respect to choice of enterprises and operations must largely be left to farmers, because only individual farmers understand the possibilities and limitations of themselves and their farms. But the minority school appears to contemplate rather too restricted a field of work; surely it lies within the province of investigators to lend a helping hand to individual farmers in making decisions. The majority school errs in envisaging the solution of problems far too large for any investigator to

solve. Its members propose to do too much. There are, after all, many significant limitations upon any of the analytical procedures that investigators can call to their service; and in the end, despite the accuracy of analysis, the appropriate course for farmers either as a group or as individuals cannot be marked out in advance with anything like certainty. The skilled investigator presumably can make a better guess than farmers untrained in economic problems; but he can make only a guess, and farmers ought not to be led to suppose that something more than a shrewd guess is being made for them. The proposal of the majority school is virtually "to mark off important areas . . . , to make an analysis . . . for each of these areas, and then to say to farmers . . . : This is what you need to get ready for in this region. This is the program into which you should begin to fit yourself." This is far too ambitious a proposal in view of the apparent limitations of available methods of analysis and the inherent difficulties of the problem. Members of this school appear to minimize the difficulties of the problem as well as to overestimate the virtues of their analytical methods.

To the present writer it seems desirable not to promise great things and to undertake far reaching and expensive programs of research while the road to accomplishment is still seen but dimly. In the history of farm management cost investigation there has already been too much of promising, too little of accomplishment; too much of a disposition to speak *ex cathedra*, to emphasize "principles," to think of cost investigation as a panacea and to use it to "save" agriculture despite itself, and too little unassuming and patient educational effort involving personal contact between farmers and investigators. A desirable program for farm management investigation is a program which makes modest claims, which involves the greatest possible co-operation between farmers and inves-

tigators and the least possible expense, and which is regarded merely as a part of a general program of agricultural education.

THE NUCLEUS OF A PROGRAM

Two allied forms of effort appear fundamental to a desirable program of work in farm management—work which may well be undertaken or expanded in every state. The first is organized effort to teach farmers how to keep simple accounts and to induce them to do so. Such effort is justifiable merely on the same ground that may be used in arguing the general desirability of keeping track of deposits and withdrawals in the stubs of a check book: a man knows more about his own affairs when he keeps a written record than when he does not; and the more he knows, the better basis he has for judgment. No one will dispute that far too many farmers operate by instinct or tradition, and exercise little or no judgment at all. There is good reason to suppose that the keeping of such elementary records as inventories, receipts, and expenses might well be more generally followed than in fact it is; and educational agencies are justified in their efforts to make account keeping more common. In the present writer's judgment little is to be gained by erecting an imposing array of intricate and accurate accounting principles; double-entry accounting appears unnecessarily intricate for most farmers, and cost accounting of doubtful value to more than a select few. A great deal of this unpretentious work in teaching account keeping is being conducted at present in the agricultural experiment stations, colleges, and high schools. It is a form of elementary education well worth while, though its value cannot be demonstrated by statistical means.

The second fundamental approach to the problem of increasing farm efficiency lies in the co-operative farm management service which we have already considered.

This service is also of an unassuming sort, closely allied to the matter of teaching account keeping to farmers. It carries teaching a step farther by providing farmers with data which they may use for comparison with their own records. In a sense this is accomplished by the more pretentious inquiries conducted by the route and survey methods; but the co-operative service provides data of more direct interest to the co-operative farmers, presents the material more promptly and in a more useful form, and does it more cheaply. The co-operative service compels close contact between its leaders and its members. Since members pay for the service, they are likely to make sure that they gain from it to the greatest possible extent; and since leaders are responsible to members, they may be expected to exercise due caution in suggesting changes. The co-operative service is of a sort which might be expected slowly to spread from locality to locality and from state to state, always standing on its own feet, tested by the results obtained from it and not by the opinions of academicians. It constitutes a form of efficiency service that ought to succeed if any form can succeed; and it might well be tested thoroughly before investigators turn to extensive utilization of that form of efficiency service which involves use of the route and survey methods. If the co-operative farm management service cannot be made to appeal to farmers, there is good ground for suggesting that efficiency engineering in agriculture in any form had better be discontinued altogether.

Much would depend upon the quality of supervisors of the co-operative groups. Such men ought above all to be familiar with the details of farming in the areas where they work, because they could probably gain the respect of farmers in no other way. But they ought also to possess a reasonably adequate knowledge of price theory, or at least to be in close contact with those who have. One man simply could not know all that he would need to know in

order to answer the questions which farmers would be likely to ask. But he could be in a position conveniently to refer particular questions to available authorities. It is fundamentally for this reason that the co-operative farm management service may best be organized by and directed from the agricultural colleges and experiment stations, and that real justification appears for supporting it in part from public funds. The various colleges and stations might properly undertake to support such services almost entirely at the outset, withdrawing support gradually as each service gradually proved its usefulness. The use of public funds in this manner appears considerably more appropriate than does their use in financing cost investigations by the route and survey methods.

UNDESIRABLE FEATURES OF THE EXISTING PROGRAM

Aside from efforts to teach farmers to keep accounts, a large part of the current work in farm management goes into route cost studies and farm business analysis surveys, the two forms of collecting data most widely employed in the processes of replanning farms for profit or in setting up standard requirements for labor and materials. In the judgment of the present writer, not enough is gained from route cost investigations to justify their continuance. As we have seen, these investigations (under the most recently developed methods) set up standard requirements and suggest plans of reorganization for farms included in the inquiry. The method is the most expensive of any, and deals with the fewest farms.¹ The co-operative farm management service, capably handled, could be made to yield quite as satisfactory results. It would not yield such detailed statistical material; but from the point of view of

¹ In the past, investigators have often gathered so much material by the route method that analysis was over-laborious; and much time and money have been spent in collecting detailed information which appears never to have been used partly because conclusions were out of date by the time they were obtained.

analysis there is some advantage in avoiding so great a mass of detailed material. The route method achieved its present popularity largely because the use of money cost data in price discussions during and after the war focused attention upon the absolute accuracy of money costs per unit of product, and the contention was raised that only the route method could yield the desired accurate money costs. But at present money costs per unit are not even calculated from data gathered by the route method, so that the necessity for absolute accuracy no longer appears. The replanning of farms for profit cannot be accomplished with utter precision by any method, since it involves forecasts; consequently the route method is not to be preferred over others for this purpose. The setting up of standard requirements is not of notable value under any method, but can be accomplished satisfactorily enough either by the survey method or through the co-operative service; consequently the route method is not indispensable for this second purpose. Sound reasons for continuing route cost investigations are difficult to discover.

Much the same may be said for many of the surveys. Not much is gained by surveys directed solely to the problem of establishing standard requirements for labor and materials; such standards as appear useful to set up might be gathered either by the co-operative service (labor standards) or by experimentation (feeding standards). Surveys directed toward the establishment of standard requirements ought not to become an essential part of the farm management work throughout the experiment stations. The replanning of farms for profit might be done better by the co-operative service than by the survey; the familiarity of supervisors with particular farms is greater under the co-operative scheme, and fewer mistakes would probably be made. To some extent the co-operative service might deal with the factors affecting profits, but not

in the formal and elaborate manner necessary to an adequate approach to the subject. The co-operative farm management service might well be substituted for surveys of several sorts, at least so far as it appears capable of yielding the results ordinarily expected from these surveys; but it could not displace the survey to the extent that it might replace the route method. The survey method might well be employed on the one hand to supplement the information obtained by the co-operative service, through special investigations dealing with particular problems; and on the other hand to develop widely applicable and demonstrably sound principles of farm management. Of these uses we shall speak further in subsequent paragraphs. For the moment we may conclude that the present tendency to employ the survey as the fundamental method of farm management investigation of the efficiency-service sort appears unfortunate, especially when these surveys deal with standard requirements and with the replanning of farms for profit.

DESIRABLE SUPPLEMENTARY TYPES OF INVESTIGATION

If co-operative farm management services should grow in favor until, let us say, several services were in operation in each of the states where agriculture is of considerable importance, other types of investigation would of course be essential if the various services were to achieve the best possible results. We may assume that what is desired is investigation that will equip the supervisors and organizers of the services with the information they need in order to be assured that their advice to farmers is as dependable as possible. Of course it is impossible to describe all of this information, since it would include the latest developments in agronomy, animal husbandry, genetics, and plant breeding; and we need consider only such investigations in agricultural economics as bear most directly on management of the farm.

To the present writer it appears that far too little is known at present about types of farming and their geographical distribution. Broad classifications of the United States into five or six type-of-farming areas have been made. But there is ample reason to believe that at least five or six fairly distinct types can be distinguished in every state. At present the facts are at best incompletely known; even the criteria for distinguishing one type from another have not been formulated with great precision. Yet it will be recalled that the majority school advocated informing farmers what to do in "certain important areas within which systems of farming are nearly uniform," so that a first step in their program would be to demarcate these areas; and it is clear that, if co-operative farm management services were to be established, a type-of-farming map for each state would constitute a useful beginning. From either point of view there would be distinct advantages in knowing in advance what areas were reasonably homogeneous in soil, climate, distance from markets, and established types of farming. Type-of-farming is a subject about which any agricultural economist would be glad to know more, and it is a field of inquiry nearly untouched with respect to its details. Investigation in this field appears fundamental to any coherent program for extending an efficiency service to farmers, and it would constitute a form of scientific research worthy of attention.

One need scarcely emphasize the fact that supervisors of co-operative farm management services would need to be as well informed as possible with respect to various fundamental economic phenomena. They need to be familiar with statistics of agricultural prices, yields, wages, interest rates, and land values, especially for the areas where they work, but also for larger areas; and they need to be familiar with such analyses of these phenomena as have been made. It is unnecessary to say that there exists

a wide opportunity for increasing human knowledge about these subjects and that this is pre-eminently the field of the agricultural economist as distinguished from the farm management specialist. But if any form of farm management investigation is to give real assistance to farmers, knowledge of such subjects must be included in it in one way or another. The best possible guesses at future prices and yields, the best available information on broad trends in prices, yields, costs, production, and consumption, need to be placed at the command of efficiency experts in agriculture in order to fortify their judgment. Investigation of these subjects is work for thoroughly trained specialists; it is in the first instance purely scientific research; and as such it may well be worthy of the encouragement given to it in recent years. But it is not the sort of investigation that can easily become a part of the routine procedure of farm management investigation. Its relation to increasing farm efficiency more nearly resembles that of plant breeding or entomology; it contributes vitally important information which the farm management investigator must not ignore, even though he cannot add to it directly.

All such inquiry may be described as the detection and measurement of changes in the economic environment of farmers. In so far as agricultural economists can perceive changes and foresee others, their findings would be of obvious value. Some progress has undoubtedly been made, and more will be made. The problem has largely to be dealt with piecemeal—a price analysis here, a study of land values there—and doubtless the time is far distant when enough is known of particular areas to remove even a small proportion of the farmer's major uncertainties. The success of any efficiency service for farmers depends largely upon successful research by the agricultural economists in detecting and measuring changes in the economic environment of farmers. The emphasis now being

placed upon research in this field is appropriate. But the facts ought to be recognized that much more remains to be accomplished than has been accomplished, and that the difficulties are more serious than agricultural economists have apparently been inclined to realize.

It is both unnecessary and impossible to specify precisely what types of investigation ought to be followed in dealing with broad problems of agricultural economics. At this point, however, some comment is desirable upon statistics of money costs of production per acre and per bushel, as compiled regularly each year for several important crops by the Bureau of Agricultural Economics and published in *Crops and Markets*.¹ Precisely why these data should be compiled yearly is not clear; no interpretation of them is offered. They have thus far been presented regularly in the form of averages applicable to geographical divisions of the United States, though a special publication has been issued showing costs by states. Collection of these data might well be continued, since in time they may well prove useful to students who wish to review broadly the historical aspects of differences in costs between different areas,² and their collection and compilation (by questionnaire from crop correspondents) is not a particularly expensive procedure. But their value would be considerably enhanced if averages applicable to states were presented annually, and if some attempt were made to point out their significance.

In addition to type-of-farming inquiry and general economic investigation leading to a better comprehension of changes in the farmer's economic environment, the co-

¹ Usually in the June *Supplement* prior to 1927. For an example of these figures, see chapter v, p. 86.

² For an attempt by the present writer to employ such statistics both for comparisons between years and between areas, see *Farm Costs of Wheat Production in the North American Spring-Wheat Belt*, WHEAT STUDIES OF THE FOOD RESEARCH INSTITUTE, July 1925, Volume I, No. 6.

operative service might be supplemented by three fairly specific types of occasional inquiry. The first two of these we have already considered—investigations dealing with new machinery and methods, and correlation analyses of the factors affecting profits. The third may be called the “local market” survey.

Little need be said of the collection of data on new machinery and methods. Such inquiries might be conducted at the expense of investigating agencies whenever occasion arose. Supervisors of co-operative farm management services would be in a position to recognize the need of such surveys or questionnaires, and even to conduct them. It is not to be expected that results of great and permanent significance could be obtained from these investigations. But lucid descriptions of new devices, and summary statements of farmers’ experiences with new machines, would probably prove of real use to many farmers. Only the roughest estimates of comparative costs would be desirable, partly because elaborate cost comparisons would not definitely settle the question of choosing between different machines, but partly because the expense of investigation ought to be kept to a minimum in view of the necessarily ephemeral results of this type of inquiry.

Investigation of the factors affecting profits constitutes a form of scientific investigation necessary in order to establish facts of fundamental and permanently valid significance. There is a real need of knowing with the greatest possible certainty what factors do affect farm profits, which are of greatest influence, and to what extent profits are and are not subject to control through good management. Since the improvement of farm efficiency must be a slow process, there is every reason for attempting to decide these questions in such a manner that broadly applicable generalizations, true of important types of farming in the long run rather than of un-

important types of farming in particular years, can be formulated. The multiple curvilinear correlation analysis applied to data from large numbers of farms—at least five hundred—in well-defined type-of-farming areas, and to data for several years, appears to be the only satisfactory procedure for reaching such generalizations. The correlation analysis is necessarily expensive as well as difficult, and ought therefore to be undertaken in but few states and only by thoroughly trained agricultural economists.

In the judgment of the present writer it by no means ought to be undertaken by more than a few of the agricultural experiment stations, and ought seldom to be applied to data obtained from fewer than five hundred farms. Two procedures would be possible in analyzing data for several years: one might run an analysis of each year's data as they are obtained, comparing results for each year; or one might wait until several years' data had been obtained, and then run analyses of averages of each variable. Presumably the former method would be the more practicable, since it might appear in the course of investigation that trustworthy conclusions might be secured from data for three or four years, and the necessity for obtaining data from precisely the same farms (implicit if the latter procedure were followed) would be obviated. The conclusions obtained from thoroughgoing analyses of this sort would prove of great value in establishing a sounder groundwork of farm management theory than has as yet been laid.

The "local market" survey is a type of investigation which we have not yet examined, since its connection with farm management cost inquiry is somewhat remote. The central feature of the local market survey is its emphasis not upon statistical analysis of farm profits or the details of farm operation, but upon opportunities open to farmers to market products in the central market most easily available to them. A few such studies have been under-

taken.¹ The procedure involves first an examination of trends of consumption of agricultural products in the central market, attention being given to population growth, per capita consumption of particular products, "imports" and "exports" of agricultural products, freight rates, and marketing facilities. Agricultural production in the contributing trade territory is next analyzed, each important enterprise receiving separate consideration. Finally recommendations are made for the expansion or contraction of the various farm enterprises. Thus farmers in the Roanoke trade territory were urged not to expand the dairying enterprise since feed prices promised to rise and increased production would have to be marketed at other than the high local prices; but it was suggested that better dairy cattle might well replace much of the existing stock, and that an advertising campaign aimed to increase the low per capita consumption of milk in Roanoke might prove advantageous. Farmers were urged to increase the size of their poultry flocks, since a large proportion of the eggs and poultry consumed in Roanoke was "imported" at high costs of transportation. These conclusions suffice to illustrate the results which may be obtained from these local market surveys. They do not deal with a mass of details, but with broad tendencies; and their particular virtue lies in the emphasis placed upon outlets for farm products. A standardized method of procedure presumably cannot be erected for such investigation, and particular studies of this type will probably prove useful to farmers in proportion to the ability of the investigator and his familiarity with local economic conditions. Agricultural economists co-operating with farm management specialists as well as with local farm bureaus and chambers of commerce might be expected to reach conclusions

¹ An example is J. J. Vernon and H. T. Richards, *The Agricultural Situation in Roanoke and Its Trade Territory* (Virginia Agricultural Experiment Station Bulletin 240), March 1925.

of real usefulness to farmers in many restricted areas. Furthermore, the expense of investigation might well be borne in part by farmers and business men.

With widespread effort to teach account keeping to farmers, with the establishment of co-operative farm management services in most states, and with the extension of general economic inquiry, type-of-farming investigation, analysis of the factors affecting profits, local market surveys, and simplified studies of new machinery and methods, one may envisage the possibility that farming in the United States might in time be conducted with greater efficiency than is the case at present. The foregoing scheme of attack on the problem is not submitted as a relief measure, but as a program capable of achieving useful results over a long period of time, and suitable for incorporation as a part of a general program for agricultural education and research. In the judgment of the present writer it is a program better calculated to assist farmers in making the best choice of enterprises and of the best methods of conducting enterprises than the programs currently proposed; in part because it does not promise more than can be accomplished; in part because it eliminates inordinately expensive types of investigation; in part because it involves co-operation with farmers; and in part because it leaves ample scope for research in agricultural economics of a scientific rather than of a practical nature. Such a program does not involve determination of the money costs of producing specific products except by a single inexpensive method. Money costs per unit are neither necessary nor desirable as data essential to the process of increasing farm efficiency.

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recent years have further been referred to specifically in footnotes to chapters vii-ix. Readers interested in the older forms of farm management investigation will find bulletins of particular interest as models in Willet M. Hays and Edward C. Parker, *The Cost of Producing Farm Products* (U.S. Department of Agriculture, Bureau of Statistics Bulletin 48), 1906, and W. J. Spillman, H. N. Dixon, and G. A. Billings, *Farm Management Study of Chester County, Pennsylvania* (U.S. Department of Agriculture Bulletin 341), January 1916. The former outlines procedures under the route method, while the latter exemplifies the factors-affecting-profits studies by the survey method, using cross-tabulation analysis. For a list of factors-affecting-profits studies in which the correlation analysis is used, see footnote citations in the Appendix.

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CHAPTER X

THE THEORY OF COST-AND-PRICE RELATIONSHIPS

We may now turn to a consideration of the uses of farm cost statistics for purposes other than those of farm management. The following three chapters, which constitute the fourth major division of the present study, deal with the theory of cost-and-price relationships in agriculture, with the use of cost statistics in price fixing, and with tariff making by cost determination.

Differences of opinion on the desirability and practicability of regulating the prices of agricultural products on the basis of costs of production largely arise from different views as to the normal and "just" relationship of agricultural prices to agricultural costs. Whether there is any relation at all; what this relationship is; whether the relationship is "fair"—these are pressing questions, not yet definitively answered. The present chapter does not pretend to provide definitive answers. It is intended rather to lessen the misunderstanding that unquestionably prevails between theoretical economists on the one hand and practical farmers on the other. The basis of the misunderstanding lies chiefly in the practice of economists in expressing abstract ideas in general terms which laymen find difficult to translate into concrete ideas in specific terms. Farmers or business men and economists often fail to meet on common ground.

THE THEORETICAL STATEMENT

If pressed for a statement in one sentence covering the relationship of agricultural costs to agricultural prices, most economists would probably agree to a formulation like the following: In the long run, the price of an agri-

cultural product tends to approximate the cost of producing the marginal portion of the supply; for, if the price exceeds or falls below the cost of the marginal portion, supply will be expanded or contracted, and (demand remaining the same) the price must subsequently fall or rise. Of course no economist would pretend that so condensed a statement could possibly convey an adequate idea of the relationship. Assumptions, definitions, and qualifications would be regarded as essential, and these might almost require a thick volume.

✓In outline the theoretical argument is as follows: We must in the first place assume free competition (a group of farmers producing and selling what and as they wish), a well-defined market (one in which producers and purchasers may freely meet and bargain), a standardized product (one free from variation in quality), and a stable general level of prices, so that values and prices may be said to coincide. Clearly several sorts of prices will result from the process of buying and selling. Every sale will be made at a specific price agreed upon and named by the buyer and the seller. But 100 sales may be made in the course of a day, not all at the same figure; hence, for a given day there are many prices, which, however, may cluster about a single figure, the "equilibrium" price for the day. Extending the concept farther, we may think of equilibrium prices for different periods of time—a week, a month, a year. The equilibrium of market price as conceived by economists need not be an actual price recorded in a sale; it is more in the nature of an average price obtained, say, from a price series of small dispersion.

According to the theoretical argument, the effective influences governing market prices differ from those governing long run or "normal" prices. The market price is said to be determined by marginal utility, or vendibility (in Professor Taussig's language), which is essentially an aspect of demand. The supply of wheat for a given short

period may be conceived of as fixed; there can be available for sale in a year only what wheat has been produced in that year.¹ But the quantity of wheat demanded is always variable in the sense that more will be purchased at low prices than at high prices. Every consumer will be willing to pay more for the first increments of a stock than for succeeding increments, because a point must be reached when additions to the stock will yield less enjoyment than the increments previously possessed. This is roughly the principle of diminishing utility. Consumers viewed in the aggregate will do likewise. But in the act of purchasing a stock they will pay not different sums for different units of it, but the same sum for each unit. Purchasers in the aggregate will be willing to absorb a given quantity of wheat at a given price per unit, a larger quantity at a lower price, a smaller quantity at a higher price. Therefore, when the quantity of wheat is approximately fixed, the price will be that price which consumers, viewed in the aggregate, are willing to pay for the last increment of the supply. The last increment to them is the marginal increment; the price which purchasers are willing to pay for this increment measures its utility to them and will be paid for each of the other increments of the supply; hence it is said that marginal utility determines market or short-run prices. Supply being fixed, demand is the active price-making force. ✓

Cost of production is not invoked as a factor influencing prices in this part of the doctrine, which deals only with short-time influences and market prices. Obviously, however, prices are continuous so long as wheat is produced and sold. When one thinks of prices over 50 years, the conception of a fixed supply is clearly untenable. Supply may vary from year to year with changes in yield and changes in acreage, due to the action both of

¹ The theoretical argument ignores questions of carryover and assumes that crops are everywhere harvested at about the same time of year.

nature and of man. Demand may change with changes in food consumption and growth of population. But changes in demand are presumably less erratic than changes in supply. Hence economists, in their search for influences affecting the course of prices over long periods of time, fix upon supply as the more important of the two general influences. The factor which is generally regarded as of greatest significance in its influence on supply, and through supply on price, is cost of production.

Why should cost of production exert any influence on price? In brief, because prices lower than costs will tend to cause producers to curtail their operations and hence contract the supply; or conversely, prices higher than costs will cause present growers to expand their businesses and producers new to the field to undertake production. Hence supply will be affected, and prices will be affected by supply.

The doctrine is further elaborated, particularly with reference to the meaning of cost. Economists classify agricultural products as products produced under varying costs. Here two concepts are involved: different men grow wheat at different costs; and different portions of the wheat grown by each man may be produced at different costs. By cost economists mean expenditures for labor and materials, together with interest at current rates on capital investment, and the current remuneration for management. Rent of land, however, is not to be regarded as a cost. Rent is considered a differential return, a result of price and not a factor determining price. A rise could not occur in rentals of wheat land, given stable prices of other commodities than wheat and no alterations in the technique of wheat growing, unless wheat prices rose first; but after wheat prices had risen, more or less permanently, men would perceive an opportunity for exceptional returns and would compete for wheat land, thereby raising its rent and its value. Each

tenant farmer would be willing to pay a rental per acre equal to the difference between the return received per acre from wheat and the cost per acre, defined as above, of producing wheat.

Economists hold that somewhere among the producers of wheat is a group which receives exactly the going remuneration for wages, management, and interest on capital, but no rent; at least there is an increment of the product which repays the labor and capital expended upon it, but yields no rent surplus. This producer or product is the marginal producer or product. It is the cost to this producer or of this product that tends to approximate price in the long run, that acts as a center about which short-time prices fluctuate, always tending to return.

The price of which economists speak in this connection, the "normal" price, has no exact counterpart in actual life or in statistics. It is not an average of daily, weekly, monthly, or yearly prices over a period of fifty years. Perhaps the closest statistical analogy to normal price would be a curve fitted free-hand to a series of average yearly prices. The curve might remain level, rise throughout its length, fall throughout its length, or rise and fall alternately. But no yearly price need fall on the curve. Economists conceive that yearly equilibrium prices, if they could be obtained, might for a stretch of several years range above or below the course of normal prices if these could be obtained; and similarly, monthly, weekly, and daily equilibrium prices might range above or below the yearly equilibrium price. Since equilibrium prices are those imaginary prices about which actual prices may be conceived to fluctuate, though the two need not coincide, a connection exists between normal price and any series of actual prices which may be selected. The connecting link is the entry and withdrawal of certain farmers from production; it is this entry and withdrawal which economists regard as the fundamentally important

influence upon prices over long periods of time. It is a force constantly operating, but never operating with such effectiveness that normal and actual prices completely coincide at all times.

COMMON MISCONCEPTIONS OF THE THEORY

Doubtless few laymen, and perhaps not all economists, can be said to entertain a well-rounded theory regarding the relationship of cost to price. Nevertheless there can be few farmers who have not gone so far as to discuss costs and prices; ideas of some sort they have, whether rigidly formulated or not. There are few farmers unaware of the truth of the general proposition that if their expenditures regularly exceed their receipts, they will eventually go bankrupt; and they give some thought to the fact. This proposition is not the same as the statement that when costs as defined above exceed prices, supply will be curtailed; but there is distinct family resemblance. The fundamental fact is being regarded from somewhat different angles.

There appear to be four major points in which the popular theory differs from the academic; more properly, there are four points in the economist's theory which many laymen fail to grasp. The first is the total absence of the notion of cost prices as fair prices; the second is the economist's treatment of the influence of cost of production as a fundamental factor never fully effective; the third is the economist's concept of cost defined to exclude land rent; and the fourth is the economist's concept of varying cost and a marginal producer or product. These notions, especially the last three, are closely interdependent.

Economists in their discussions of cost-and-price relationships under freely competitive conditions—in the absence of monopoly—say nothing about "fair" prices. Any price which may appear under free competition of both

buyers and sellers is fair. If actual prices should be recorded for every sale of wheat over fifty years, and these sales were all made under free competition, the economist would say that every price was fair. He would say this regardless of the relation, general or particular, of cost of production to price. If on certain days wheat that cost \$5.00 per bushel were sold for 50 cents, there would be nothing unfair or unjust in the transaction. The economist simply states that such circumstances cannot persist indefinitely, because in time the supply will be reduced by withdrawal of a portion of it. The assumption of free competition is here vital. Economists by no means deny that circumstances can arise when prices are unfair; but their theory of prices rests upon the assumption of competition.

A complete discussion of "fair" price would lead us too far afield, into such questions as *laissez faire* economy and free competition versus the specializing state, free trade versus protection, and the benefits of division of labor. It suffices here to point out that these are problems to which economists give much thought while farmers do not, and that in economic theory the doctrine of cost-and-price relation forms only one part of a system with which farmers are unfamiliar. But the notion of cost price as fair price is no part of this system. The economist may say that price always tends toward the cost of the marginal portion of the supply, but he does not say that the marginal or any other cost is fair, and that steps ought to be taken to make prices conform at all times to marginal or any other cost.

The economist's theory of cost-and-price relationships is, as we have indicated above, a long-time theory. Prevailing prices in a particular year are related to costs only remotely. They may be far below or far above even the marginal cost. They may run persistently below or above marginal costs for a period of years. But neither

circumstance can persist indefinitely. In time a portion of the supply will be withdrawn and the prices will rise, or the supply will be augmented and prices will fall. Over a century there need be no correspondence whatever of actual prices and actual costs; costs may run above prices for a few years, below for the next few, above for the next, and so on. In a particular year—in each particular year—the supply may be regarded as fixed, and demand, or marginal utility, determines price. Farmers often fail to grasp the distinction between influences affecting prices over long and short periods of time. Agreeing with economists generally that cost tends to govern price in the long run, many are apparently inclined further to assume that it is the dominant factor in short periods as well.

Economists define cost of production to include charges for labor and capital expenditures and for wages of management, all calculated at rates current in the community;¹ but they do not include rent of land as an element of cost. The reasons for this exclusion are not easy for laymen to grasp. A tenant farmer, for example, is at any given time under contract to pay a fixed sum as rent. Obviously, from his individual point of view, he must plan his operations so as to obtain returns sufficient not only to cover charges for labor and materials, interest and management, but rent as well. Otherwise he faces the danger of being displaced. Owners are accustomed, at any given time, to regard their investment in land as essentially the same as their investment in buildings or live stock. They want a return sufficient to yield interest as well as wages. When a relative decline in the prices of agricultural products occurs, they argue that they are

¹ Precisely how current rates on these items are to be determined is not made explicit in the theory. It may be taken for granted that some sort of a representative average rate is contemplated for each—not wage rates of railway engineers or interest rates on a few selected bonds. Both wage rates and interest rates in fact vary rather widely, so that the selection of rates to be applied in cost investigations is largely a matter of opinion. Theorists have not formulated rules of selection in such specific terms that disagreement is impossible.

producing below cost, and the precise definition of cost is not entirely pertinent. They feel a return insufficient to cover rent momentarily quite as severely as a return insufficient to cover wages. Their concern is not with the particular form of income that is being reduced, but with the decline in total income, actual or imputed. They do not even distinguish between the forms of income.

The economist's theory, however, probes more deeply into fundamental influences. What economists believe is not that farmers have no immediate concern with the amount of rent they do or do not pay or receive, but that in the long run rent is not the same as interest or wages. For what follows, in a broad view, if the relative prices of agricultural products rise in a country where free land is not available? Land values rise, and cash rentals rise; they rise because people will perceive an opportunity for profit and bid higher than before. Rent rises because land is limited in quantity and of different grades of fertility. Some men must farm good land, some poor. But any sane man, able to farm 10 acres and to obtain a known price per unit, and aware that he could obtain 100 bushels from plot A, 200 bushels from plot B, at nearly identical expenditures of labor and capital, could be expected to be willing to pay something for the privilege of farming plot B. He would pay more if the known price per unit of product were high than if it were low. Consequently rent must be ultimately a result of price, not a cause of it. All men are, in the economist's view, economic men who calculate in this manner, though perhaps vaguely. In a broad view there must be land for which a high rental will be paid, other land for which nothing will be paid, still other land which will not be farmed at all. In the long run land can be farmed, when farming is the mode of life rather than a hobby, only when it yields current rates for wages and capital; but it need not yield a return in the form of rent. When the relative prices of agricultural products fall,

rents upon all parcels of land will fall, and some land previously cultivated will be abandoned; and conversely if relative prices rise.

Upon these grounds the economists rest their case for the exclusion of rent as an element of cost. They would concede that the amount of rent to be paid or received is of concern to individuals at any given time. But they deny that in the long run the volume of supply would be affected by cost calculations of individuals involving consideration of the amount of rent. Logic and historical evidence indicate that an increase in relative prices is followed by an increase in rent paid or received, or conversely. In general, economic self-interest dictates that the bids of tenant farmers for land must be smaller when relative prices of agricultural products are low than when they are high, other costs remaining constant. If so, the general scale of rents paid or received must be smaller. Rent is therefore a differential return, a result and not a cause of price; in the long run it does not enter into the cost-and-price comparisons of individuals which affect the volume of supply, and it is not an element of cost. No economist contends that the cost-and-price comparisons of farmers are precise and immediately effective over a whole society. There are lags and maladjustments due to the existence of contractual relationships, to bargaining power, and to misjudgments of price trends and the productivity of land. Nevertheless over long periods of time it seems clear that the calculations of farmers, though blurred, are fundamentally as described by economists, and that the superstructure of the doctrine respecting the exclusion of rent as a cost is essentially correct. The unwillingness of farmers to subscribe to the doctrine apparently lies in the inherent difficulty of abstract argument and in inability to grasp the issue involved, not in honest disagreement with the point at issue. It is probable that, when buying or renting land, farmers would agree with

the economist's description of rent in all particulars, but that when occupied in production on land already purchased or rented under a contract for fixed cash rental, they would disagree violently. In the one case they desire to purchase or rent at terms advantageous for future operations; in the other they wish to sell their produce at terms advantageous for past investment and present operations.

Closely allied to the definition of cost as excluding rent is the concept of agriculture as an industry wherein variable costs prevail. Economists in speaking of variable costs of course mean costs excluding rent. They in fact argue that forces are in action making for uniformity in costs including rent. Rent being a differential return, that increment of the supply which involves the lowest cost of production excluding rent will yield the largest rent, while that increment produced at highest costs excluding rent will yield no rent at all. The concept of variability is reached by thinking about addition to and subtraction from supply over long periods of time: economists ask whether or not supply (of all agricultural products in an isolated state, for example) can be indefinitely increased in such a manner that the additions to supply will never cost more than the various portions of the existing supply. They conclude that additional increments can be obtained only at additional cost, because a time would come when no new land would be available, and additions to supplies would have to be obtained by applying more capital and labor to a fixed amount of land.¹ But (reducing capital to labor) it would be impossible forever to secure 10 additional pounds of food by employing 10 additional hours of labor. Diminishing returns would be encountered; the first 10 additional hours of labor might yield 10 pounds of food, the second 9, and so on.

¹The same point can of course be made by assuming that new land is available but is less productive than land already cultivated.

Clearly this method of argument assumes a hypothetical, not an actual, situation. It is a statement of an ultimate condition, not a condition that necessarily exists in any particular country. Probably no economist would deny that from the historical point of view, production costs per bushel of corn have been lowered in the United States, not raised, during the past century. But this might be explained by reference to improvements in productive processes; economists would nevertheless maintain that increasing and variable costs were ultimately characteristic of agriculture. Laymen are frequently unfamiliar with the economist's abstract method of reasoning. It is perhaps possible that the economist's notion of rent as an equalizer of total costs has contributed to the current fallacy respecting the uniformity of costs as between different producers. For if cost is to be defined as including rent, as so many farmers are inclined to define it, then even the economists admit that an effective tendency toward uniformity must exist. The gap between the popular and the academic theory of cost-and-price relationships cannot be bridged so long as the disputants fail to meet on common ground in their definition of cost and in their conception regarding the period of time which is to be considered.

The economist's conception of a marginal producer or product is likewise none too easy for laymen to grasp. Like the notion of variable and increasing cost, it is reached by a process of abstraction from reality. One thinks of adding to or subtracting from the supply, and it appears that if the various increments of the supply must be produced at increasing cost, defined as economists define it, then the last increment is always higher in cost than the one before it. It is the last increment imagined by theorists that is the marginal increment; this final increment must cost more than the others, and would be the one to be withdrawn from the supply if and when

price did not remunerate the labor and capital employed to produce it. There need not be, in the economist's theory, a direct identification of the marginal product and the marginal producer.¹ The increment of the supply which exactly repays wages of labor and superintendence and capital costs (the marginal increment) need not be produced by a marginal producer. A given producer, according to the theory, may produce a part of the supply at marginal costs, other parts below marginal costs. Supply can be curtailed quite as effectively by the decision of all producers not to produce so much as before, as by the decision of some producers not to produce at all. The general concept of marginalism is by no means easy to grasp; it is not accepted by all economists; and that farmers fail to grasp it is not surprising. It is intimately related to the distinction between land and capital, the exclusion of rent as a cost, the concept of variable costs, and the distinction between long-time and short-time influences. Unwillingness or inability to accept any of these doctrines involves rejection or imperfect comprehension of the concept of marginalism; and comprehension of these topics is by no means common among farmers.

We may conclude that popular acceptance of the economist's theory is visionary, sound though it may be as an analysis of fundamental influences affecting the relation of cost to price. The abstract reasoning involved in obtaining a consistent theory is far too difficult. The very number of interrelated doctrines necessary to build up the theory is so great that effective exposition in popular form is practically impossible. The most important single factor making for misunderstanding between theorists and practicing farmers is apparently a divergence in

¹This point is not often made explicit in the textbooks, since economists find exposition much facilitated by an assumed identification of the marginal producer and the marginal product.

the approach to the problem of cost-and-price relations. Farmers are obviously concerned with the relationship this year and next and with its effect on their individual businesses. Economists, when they speak of cost of production, are concerned with cost-and-price relationships over long periods of time, and with the effects upon society as a whole. Normal price, variable and increasing costs, costs defined to exclude land rent, and marginal producers and products are conceptions useful and necessary in explaining the forces which act over long periods of time. But they were not devised to be given direct application to the problem of major interest to farmers—the regulation of market prices so as to conform to costs of production including rent over short periods of time, thus rendering prices “fair.”

BEARING OF STATISTICAL INVESTIGATION ON PRICE THEORY

The economist's theory of cost-and-price relationships was evolved by deduction, not by investigations of actual costs incurred on farms and subsequent analysis of the resulting cost curves. It may well be asked whether the statistics of actual farm costs compiled in recent years demonstrate the necessity for alterations of the currently accepted theoretical doctrines. In general it may be said that they do not, chiefly because the cost curves resulting from statistical investigations have not been comparable with the cost curves employed by theorists in their discussions.

The two types of curves are in the first place frequently not comparable because cost is not defined in the same manner in each. As we have seen, most statistical investigations include rent of land as a cost, while economists exclude it. There is probably not in existence a single collection of cost statistics that economists would regard as compiled on definitions of cost strictly compa-

rable with the definitions employed in theoretical analysis. In the actual collection of cost data investigators are forced to adopt exceedingly rough estimates of going rates for labor, management, interest on capital, and depreciation. In the adoption of rates the theorists are not helpful beyond suggestion that "current" or "going" rates ought to be used, and just what going rates may be is not made clear.

But a greater discrepancy appears with respect to the meaning of the two types of cost curves. The theorist draws a line inclining upward throughout its length from left to right. He employs this line merely as a convenient representation of the fact that agriculture is conducted fundamentally under conditions of increasing costs. He means this line to portray graphically the fact, reached on a priori reasoning, that each additional increment of a supply must be produced at a cost (rent excluded) larger than the cost of the next preceding increment. The line describes not cost conditions in any particular year, but the fundamental characteristics of costs at all times and over long periods. The theorist's cost curve can be drawn without reference to the absolute amount of costs; any scale, either 1 cent to \$10 or \$100 to \$10,000, can be employed. The only essential is the upward inclination of the curve throughout its length; it need not begin or end at a particular numerical point, and it is not strictly a finite curve. It does not specifically measure anything; it merely provides a graphic representation of the law of increasing costs. A single point on the curve (a scale of costs being assumed) may be taken to represent the hypothetical cost per unit of producing a given increment of a potential supply; but no single point represents the actual cost incurred in any particular period by an actual producer. The theorist's curve applies to any length of time, not to a single year or a precisely defined period of years.

The cost curves compiled from statistical data may be

presented either as frequency polygons or as cumulative frequency curves.¹ The latter bears a superficial resemblance to the theorist's curve: it slopes upward from left to right. But this is practically the only point of resemblance. Such a curve must be read with reference to an unchangeable scale of numerical values. If it is found that wheat costs farmers from \$1 to \$20 a bushel to produce, then the wheat cost curve based upon the data must be read according to this scale. A particular point on a cumulative curve of wheat costs means one of two things: either that a certain number of farmers produced wheat at a cost of say \$2 per bushel; or that a certain proportion of the total amount of wheat grown on the farms under investigation was produced at a cost of \$2 per bushel.² There is no implication whatever here regarding the cost of each increment of the supply: each point on the curve is an average cost of the several increments produced by a particular individual, and some of these, for all the curve tells us, may have been produced at high cost, others at low. There is further no implication concerning the law of increasing cost or diminishing returns. Unsorted original data showing a series of average costs per unit of producing wheat on each of a group of farms could quite as well be arranged with highest costs on the left, the cost curve inclining downward throughout its length. But this arrangement would not demonstrate that farming was conducted under the law of decreasing costs in the year to which the data applied, or in any other year; nor would it controvert the theorist's contention that agriculture is subject to the law of diminishing returns.

¹ For graphic representations of frequency polygons, see above, p. 67. A cumulative frequency curve of the sort usually presented in cost investigations is shown below, p. 225. It is to be observed that such curves are not precisely the same as the cumulative frequency curves ordinarily employed in statistical texts or investigations. But the difference is slight.

² Most cumulative cost curves have been compiled by weighting each farmer's average cost per unit by the volume of output on his farm, so that a point on such a curve ordinarily has the latter meaning.

It appears, in fact, that statistical cost curves have no direct bearing whatever on the theorist's fundamental arguments about cost-and-price relationships, in which a differently conceived cost curve is used for illustrative purposes. If the theoretical position is to be shaken, it must be proved invalid by the use of other devices than statistical pictures of agricultural costs. Mere similarity of inclination in the two types of curves is not sufficient to permit the assumption of identity in structure and meaning. The use of cumulative curves in statistical inquiries has probably acted to foster misunderstandings about cost-and-price relationships rather than to throw light upon the subject. For most purposes the use of the frequency polygon serves quite as well.

According to the theorists, rent acts as an equalizer: the curve of costs excluding land rent slopes upward, but the line representing costs defined to include land rent is a horizontal line. But it is noteworthy that, if so arranged, a given set of figures showing farm costs of production per unit will apparently yield an upward-sloping cost curve, whether or not land rent is included as a cost. This appears at first glance as an effective refutation of the academic analysis. In fact it is not so. The theorist does not maintain that costs including land rent must be equal in a given year either as between producers or between increments of product. He states simply that forces are always working to bring costs including rent into a position of uniformity. He does not say how long a time is required to affect this uniformity: he implies, indeed, that in a dynamic society uniformity would never be altogether attained. How active the equalizing forces are in fact, or how active they are likely to become, are points not enlarged upon in the textbooks. But in order to discredit the theoretical position, something more is necessary than a demonstration that statistical cost curves incline upward whether or not rent is figured as a cost.

The essential questions are still with respect to the validity of the law of diminishing returns, of the conception of rent as a differential return, and of expansion and contraction of supply as a result and not a cause of price. Discussion of these matters lies more largely in the realm of deduction than in that of statistical induction.

QUALIFICATIONS OF THE THEORETICAL ANALYSIS

Indirectly, however, the investigation of actual farm costs has provided a basis for some slight qualifications of the theorist's position.

What we may call the doctrine of entry and withdrawal of a portion of the supply in response to changes in price is clearly an important element in the accepted doctrine. Price may be said to conform to marginal cost only if it is reasonable to assume that the increment of product which yields no rent will be withdrawn in the event of a semi-permanent or permanent decline in the relative price. Now the marginal product has to be produced by somebody, and its withdrawal must be regarded as a voluntary act undertaken for good and sufficient reasons. Consequently the accepted theory of prices involves certain assumptions regarding the psychology of producers. But these assumptions are not always clearly stated by the theorists, and the mechanism of entry into and withdrawal from production is a subject which receives attention but infrequently.

Presumably the response of farmers to changes in relative prices is considerably more uncertain and wavering than the theorists imply. In order to simplify their arguments and bring fundamental principles into clear relief, they often assume a sharp division of farmers into landlords, cash tenants, and laborers, with rent accruing to the one class, profits and wages to the others. Price levels—often the prices of all products except the one under discussion—are assumed to be stable, and yield is as-

sumed to be invariable. Of course these conditions have not prevailed in any country. The theorist would hold that under the conditions assumed, normal price would correspond with marginal cost quite closely. Knowing that under existing conditions none of his assumptions is strictly valid, he would concede that the cost calculations of entrepreneurs are necessarily blurred and uncertain, and that the divergence of actual prices from marginal costs must be both ever present and wide. In so far as the theorists neglect to make clear their assumptions and thus mislead laymen into regarding the correspondence of cost and price as close and definite, they are at fault. But the fault is more frequently in exposition than in analysis.

Economists often give readers the impression that all agricultural products are subject to the law of cost-and-price correspondence in an equal degree: that expansion and contraction of supply would occur at the same rate for all products if cost-and-price discrepancies were equal between different products. Statistical evidence on the subject is not obtainable. Yet it is clear that alterations in supply can occur more rapidly for some products than for others. The supply of orchard and of live-stock products is susceptible to less rapid variations (yield considered constant) than that of annual crops. The supply of crops grown in elastic rotations can be altered more rapidly than that of those grown in inelastic rotations. Crops like oats, which from the point of view of maintenance of soil fertility and employment of available labor fit well into a rotation centering about corn (and hogs or cattle), would continue to be produced despite cost-and-price discrepancy. This means, from the theoretical point of view, that a sudden decline in the prices of all products would affect cost-and-price relationships differently. Discrepancies between costs and market prices would continue much longer for apples than for grapes, for beef than for

pork, for oats than for wheat. The elasticity of supply for different agricultural products is a matter not yet worked out in detail; but that different degrees of elasticity exist is certain, and the fact is of sufficient significance to form a part of the general theory of cost-and-price relationship.¹

A further point not often touched upon in theoretical analyses is the rapidity and duration of expansion and contraction of supply in agriculture as a whole. If the relative prices of all agricultural products rise, is expansion of production more or less rapid than contraction would be if the relative prices of all agricultural products fell? Again statistical evidence is deficient. There is nevertheless good reason to believe that expansion of supply is likely to occur with greater rapidity than contraction, at least in a country like the United States where ownership of farms by operators prevails and where cultivation is not particularly intensive. A corollary is that agricultural prices are likely to remain below marginal costs for longer periods than they are likely to remain above marginal costs.

The essential reasons are that a very considerable opportunity to expand operations exists, while contraction is inevitably combated by the nature of the farming business and the calculations of operators. Mere habit of thought plays an important part. It has been commonly observed, for example, that farmers tend to regard a rise in agricultural prices (in relation to prices of industrial goods) as a permanent phenomenon, a decline as a temporary phenomenon. With unemployed acreage at their disposal, they are prone and able to expand operations in the expectations of greater profits per farm; but when a decline in prices occurs, individual farmers always face the problem of maintaining profits either by further ex-

¹ For a detailed pertinent discussion of the probable effect of a bounty on wheat on the expansion of wheat supplies, see *The McNary-Haugen Plan as Applied to Wheat: Operating Problems and Economic Consequences*, WHEAT STUDIES OF THE FOOD RESEARCH INSTITUTE, February 1927, III, 220-31.

pansion or by contraction. A smaller product sold at a higher price might not result in higher profits than a larger product sold at a lower price, unless costs remained the same; and since costs in farming consist largely of labor of the farmer and his family, a price decline may be combated by longer hours and harder work rather than by contraction of operations and hence of supply.

The extent to which the gross volume of agricultural operations can be maintained during periods of low prices is noteworthy. Given cash incomes large enough to meet taxes and mortgage payments and small expenditures for equipment and clothing, farmers can continue in business for a long time despite low prices. They have no house rent to pay, they need buy but little food and fuel, they may allow equipment to depreciate for several years without replacement. Individual farmers may for a period of several years incur labor and capital expenditures calculated by "current" rates, which result in costs considerably higher than current prices; their continuance depends on their willingness to accept rates lower than the "current" rates. Only very drastic and long-continued price declines can force farmers out of business if they wish to continue, with a resultant contraction of supply. A few pertinent figures are available. Statistics of labor incomes, calculated for identical farms over a series of seven years, show that of 100 farmers in Clinton County, Indiana, 54 received house rent and home-grown produce but no return for labor whatever, and less than 5 per cent on the value of their investment in land and buildings, in two of the seven years; 33 farmers for three years out of seven; 16 farmers for four years out of seven; 10 farmers for five years out of seven; 3 farmers for six years out of seven.¹ If we assume that equal pro-

¹ Dixon and Hawthorne, *Farm Profits: Figures from the Same Farms for a Series of Years* (U.S. Department of Agriculture Bulletin No. 920), December 1920, p. 51. This bulletin, one of the very few publications giving detailed

portions of the product were produced by each farmer in each year, it appears that some 10 per cent of the supply was produced by farmers who failed to obtain any return for their labor during five-sevenths of the time they were producing. The receipt of house rent and food and a small percentage on investment was sufficient to keep them in business.

These data are not, of course, in such a form that they test the theoretical doctrine directly. But they do suggest that farmers are both able and willing to resist unfavorable cost-and-price relationships by other means than withdrawing portions of the supply.

If, then, reluctance to restrict supplies and ability to resist unfavorable cost-and-price relationships over long periods is common, while expansion of supply is easily accomplished, it seems inevitable that marginal costs may exceed prices for longer periods of time than prices may exceed marginal costs. This possibility seems of sufficient importance to require recognition in the general theory.

Essentially these qualifications deal with the frictions which under actual farming conditions act to obscure and retard the action of forces long recognized and described by economists in their analyses of the relation between cost and price. They do not in the least invalidate the general propositions adduced in theoretical discussions. But in so far as qualifications serve to bring theory and fact into closer correspondence, they deserve appropriate emphasis. No subject (the theory of international trade excepted) seems to be surrounded by greater misunderstanding between practical men and theorists than that of cost-and-price relationships; and any attempt to bridge the gap seems worth the effort.

figures of labor incomes on identical farms in different years, also lists data for 25 farms in Washington County, Ohio, 1912-18, and 60 farms in Dane County, Wisconsin, 1913-17. These figures show essentially the same facts as those applicable to Clinton County, Indiana.

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CHAPTER XI

PRICE FIXING AND FARM COSTS

The present chapter deals with the history and theory of that form of price regulation which involves direct utilization of farm cost statistics in ascertaining the appropriate price of an agricultural product. Other aspects of price influencing or price control, in themselves important and interesting, lie for the most part beyond the scope of this inquiry.¹ We are concerned principally with the adequacy of farm cost statistics to serve the purposes contemplated by those who believe that prices of farm products ought to be made to conform to farm costs of production. It happens that few historical instances appear wherein an attempt was made not only to ascertain a "fair" price for an agricultural product by an analysis of cost data, but also to render the ascertained price effective on the markets. But not a few cost investigations have borne chiefly upon the ascertainment of "fair" prices; and the broad notion that prices ought to be made to conform to costs unquestionably persists even in the face of recently increased knowledge of the nature of farm cost data.

We shall be concerned in the present chapter to summarize briefly the course of price fixing of agricultural products in the United States, to point out the fallacies involved in what may be called the popular theory of price fixing, and to indicate what practical difficulties

¹It is impossible to consider in limited space such matters as the legal machinery required to enforce observance of fixed prices; devices aimed at price regulation but not price naming; for example, the surplus-disposal schemes as represented by the recently vetoed McNary-Haugen bill; or mere price designation by producers' organizations, as exemplified by the announcement in advance of a season's tentative price for cranberries.

arise in an effort to calculate a fair price on the basis of farm cost statistics.

HISTORY OF AMERICAN PRICE REGULATION

The general notion that prices ought to be made to conform to costs of production reaches back to the Middle Ages.¹ It has most frequently been brought forth as an argument to support governmental regulation of monopolies. But since statistical investigations of farm costs were practically unknown in the United States before 1890, earlier attempts at price regulation of agricultural products are not of immediate interest. The few extensive investigations of farm costs appearing before 1900 were not specifically addressed to the problem of obtaining data which should serve for fixing prices. These data were rather intended to show that "fair" or remunerative prices did not (or did) prevail; but the remedy for depression uppermost in farmers' minds during the 'nineties was cheap money rather than price fixing. The idea that prices ought to be fixed on the basis of costs presumably hovered vaguely in the minds of many, but it was subordinated to the notion of monetary reform.

Between 1900 and the outbreak of the war, farm cost investigations increased in number. But for the most part they contained few references to "fair" prices or price control, and were rather addressed to the problem of increasing the efficiency of farm operation through cost reduction. Professor E. G. Nourse suggests² that prior to 1914 price fixing became an increasingly popular doctrine among consumers, who felt obscurely the increased cost of living due to the rise in the relative prices of foods. But there is little evidence that the argument of consumers assumed a form more definite than the argument

¹ See Ely and Others, *Outlines of Economics*, 3d revised edition, 1918, pp. 183-85.

² *American Economic Review, Supplement*, March 1919, IX, 272 f.

of farmers in the preceding decade: though the general notion of price fixing undoubtedly became increasingly popular, the evidence is not clear that the particular doctrine of price fixing by cost analysis was widely endorsed by consumers. Presumably, however, both the general and the particular formulations of the price-fixing doctrine grew in popularity. For the most part farmers were content with current prices, which on the whole were increasing from 1900 to 1914. There were a few exceptions. Milk producers found prices unsatisfactory on account of increased costs following urban insistence on sanitary regulations, and in some milk cost investigations the notion of price fixing on the basis of cost of production was clearly formulated. There seem to be no instances on record, however, of a price of any agricultural product actually fixed on any basis. On the whole it seems likely that the notion of price fixing by cost determination grew somewhat in popularity from 1900 to 1914 among both consumers and producers, though in fact no single instance appeared of a price so fixed.

Rising prices of food products after 1914 unquestionably intensified public interest in price regulation, and European regulation furnished precedents. Shortly after the entrance of the United States into the war, price fixing by government became an almost inevitable policy. The general attitude is summed up in the words of Mr. Joseph Davies of the Federal Trade Commission: "The problem is then, briefly, to fix a price based upon the cost of production that will give a fair return in profit and will at the same time not starve production."¹ The broad argument was based upon the contention that consumers' interests were threatened by extreme price fluctuations due to pressure of foreign demand, speculative holding, and profiteering by producers. That cost of production

¹ "Price Control," *Annals of the American Academy of Political and Social Science*, November 1917, LXXIV, 224-35.

was the appropriate basis for price fixing was generally admitted. Legal authority for price fixing was provided by the Lever or Food Control Act of August 10, 1917. Control of prices was in most instances delegated to the executive; and actual administration of price control lay with the Food Administration, the Fuel Administration, and the Price-fixing Committee of the War Industries Board. Various organizations, among which the Federal Trade Commission was the most important, collected such cost data as were employed.

The regulation of prices of agricultural products during the war rested with the Food Administration. Price control was effected chiefly by agreements with dealers, limitation of margins of profits to dealers, and a system of licensing. For many commodities the procedure was as follows: dealers met with Food Administration officials, and agreed, among other things, upon proper selling or buying prices and/or upon proper margins of profit. Dealers were licensed by the Administration. Trade for the most part pursued its normal course; agreements were enforceable by withdrawal of licenses. This method involved little investigation of farm costs of production and no direct fixation of farm prices, though of course the agreed buying or selling prices affected farm prices indirectly. Farmers were by no means unconcerned with this type of indirect regulation, and cost data were occasionally brought to bear upon the "fairness" of agreed prices. The problem of regulating prices in conformity to costs of production was constantly under discussion, though the indirect method of price regulation prevailed in practice.

Cost investigations of wheat, hogs, and milk were conducted more or less under the auspices of the Food Administration. The fixation of wheat and milk prices, by comparison with other agricultural commodities, involved cost investigation most extensively and attracted the greatest attention. The price of No. 1 Northern wheat

at Chicago for the crop of 1917 was definitely fixed at \$2.20 per bushel¹ on August 30, 1917, after a special committee had investigated costs. The experiences of this committee, as briefly reviewed by Dr. F. M. Surface, are illuminating.

The problem before the Committee was to determine upon a price which would yield the farmer sufficient profit to stimulate production and which would still not be too oppressive upon the wage earner and consumer. . . .

An investigation, instigated by the Committee and carried out hurriedly by the Department of Agriculture through the County Agents, furnished some information relative to the probable cost of producing wheat harvested in 1917. The average costs by geographic divisions, as determined from these telegraphic reports, ranged from \$1.42 per bushel in the South Atlantic States to \$2.41 in the West South Central States. In the big wheat sections of the East North Central and West North Central States, the average[s] of the costs reported were \$1.44 and \$1.68 respectively. The weighted, average cost of production for all wheat growing States as determined from these reports was \$1.71 per bushel.

Other reports from different sources and different parts of the country varied widely as to the 1917 costs of production. One member of the Committee from an agricultural section of the middle west stated that two months before a price of \$1.85 at Chicago would have been regarded as a fair price by the farmers, but under present conditions, with the shortage of labor due to the draft and other factors, he did not believe they would be satisfied with less than \$2.25. Telegraphic inquiries to different parts of the country indicated that in many places the farmers would be satisfied with a price of from \$1.50 to \$1.75 per bushel, while in other sections the replies indicated upwards of \$3.00 as the minimum.

The two representatives of organized labor on the Committee took the attitude that \$1.75 was a fair price to the farmer and by

¹ Appropriate differentials were worked out for other classes, grades, and markets. A minimum guaranteed price of \$2.00 for the crop of 1918 had been fixed by Congress in the Food Control Act of August 10, 1917. The Act also provided for the appointment of a Grain Corporation to maintain this price by purchase and sale, and a revolving fund of \$150,000,000 was appropriated for its use. The price of \$2.20 (with the later addition of 6 cents to cover increases in freight rates) was subsequently applied to the crops of 1918 and 1919.

adding a differential of nine cents, favored fixing the price of No. 1 Northern at Chicago at \$1.84.

For several days the Committee was deadlocked, four of the six farmer representatives contending for a price of \$2.50, one for \$2.30, and one for \$2.25. The two representatives of labor voted for \$1.84, while the other members were voting for prices from \$2.10 to \$2.25. Finally, on the evening of August 30, the Committee voted unanimously to recommend that the price for No. 1 Northern Spring wheat be fixed at \$2.20 per bushel at Chicago. A statement was prepared and presented to the President on the same day.¹

The intention of both Congress and the Food Administration in fixing the price of wheat was not simply to determine a "fair" price; it was rather to guarantee a price sufficiently attractive to result in increased production of wheat, increased production being regarded as necessary for successful prosecution of the war. In this instance consumers' interests, though not forgotten, were subordinated to war aims. Such was the case with hog prices, which for a time were fixed on the "ratio" basis: the price of 100 pounds of pork was to be held equal to the price of 13 bushels of corn. The contention was advanced (but not accepted by all) that in general, under pre-war conditions, the price of 100 pounds of pork had about equaled the price of 11.5 bushels of corn. The figure of 13 bushels of corn was chosen in preference to a lower figure in order to encourage hog production, fats being urgently needed for war purposes.

Both the purposes and the methods of fixing milk prices were different. Milk has no dominant central market like wheat or hogs, and could not be exported in bulk, fresh, to the seat of the war. The Food Administration made no direct effort to control milk prices. But producers complained bitterly of low prices in many localities, notably the larger metropolitan areas, and

¹ *The Stabilization of the Price of Wheat during the War and Its Effect upon the Returns to the Producer*, Washington, 1925, p. 44.

there were milk strikes.¹ Commissions representing producers, distributors, and consumers were organized to determine "fair" prices, and representatives of the Food Administration met with these commissions or reviewed their findings. Milk price controversies were particularly bitter because of the existence of large distributing companies, semi-monopolistic in nature, and well-organized associations of producers; and consumers also displayed much bitterness because of the sociological interest attaching to milk—food for babies. There was in most instances no legal machinery for enforcing the observance of prices determined by the commissions; this permitted violations of agreements by any party, and violations kept the bitterness of the dispute aflame.

The policy of encouraging the production of some agricultural products but not others naturally gave rise to complaints from producers of the latter class of products: if wheat and hog growers were to receive highly remunerative prices, why not producers of beans, cotton, and prunes? This form of argument sometimes failed specifically to include the basic contention that prices of all articles should be precisely equal to the cost of production; but in general producers contended that they ought to receive at least cost of production—perhaps something more, if something more was to be allowed on some products. Cost of production statistics inevitably attracted increased attention. Many of the farm management cost investigations of the war period, though ostensibly conducted merely for the purpose of discovering weaknesses in farm management, contained sections dealing with cost-and-price comparisons; and there is ample reason to believe that these sections were of more interest to farm-

¹ Cost-and-price disputes with regard to milk occurred in many localities. But it is impossible without excessive labor even to ascertain the precise number, and the records are incomplete even for the metropolitan areas. What is said of the milk situation subsequently is based chiefly upon the course of events in Chicago.

ers than the sections dealing with possible improvements in farm organization.

The course of events after the war was such as to increase rather than decrease public interest in farm cost statistics. In 1919, after the war was over but before the decline in relative prices of agricultural products, a farm management demonstrator in close touch with Nebraska farmers summed up the situation as follows:

Now that the war is over and city papers are clamoring for a decrease in the cost of living, there is a feeling that farmers need cost of production figures in self-defense, should an attempt be made to force farm prices down out of line with other prices.¹

Little was definitely said regarding price fixing on the cost basis during this brief period of high relative prices. But it must be remembered that the fixed price of wheat was continued until June 1920, that the precedent of price regulation was established, and that the old belief respecting the correspondence of costs and prices retained its strength.

The prices of agricultural products began to fall sharply from late in 1920. Farmers clamored for relief; and of the many types of measures for relief subsequently submitted to Congress, plans embodying price fixing on the basis of cost data constituted no small proportion. During this period the cry for price fixing came not from consumers, but from producers; and what was sought was not prices covering costs and somewhat more, but prices merely covering costs. It was argued that governmental interference with prices had curtailed farm profits during the war, and hence that government should reimburse farmers for its earlier error. The precedent of price fixing combined with the popular theory of cost prices as fair prices gave support to current proposals and greatly enhanced interest in cost data. Cost investigations were

¹ P. K. Whelpton, "Demonstration Work on Cost of Production Records in Nebraska," *Journal of Farm Economics*, September 1919, I, 48.

urgently demanded by farmers; and, though farm management investigators for the most part insisted that their work bore not on price fixing but on cost reduction, the investigations were indirectly brought to bear on the problem of price fixation. Nevertheless there was no instance of actual price fixing after the guaranteed wheat price for the crop of 1919 was abandoned.

From the side of producers popular demand for price fixing by cost determination probably reached its height in 1922 or 1923. Subsequently several factors have been effective to diminish the popularity of the notion. Readjustment of agriculture to new price relationships has progressed, though it is not complete; and the severity of the depression is less notable than before. Discussions of farm cost statistics and of price theory have doubtless convinced many that price fixing, either in itself or on the cost basis, is unsound and impracticable. Less direct methods of price influencing have attracted increasing attention. Nevertheless it is probable that the notion of price fixing by cost determination remains firmly imbedded in the public mind. Given the recurrence of a special situation—either a sharp rise or a sharp decline in the relative prices of agricultural products as a whole, or of single commodities—it is possible that demand for price fixing by cost determination may again become urgent. It may originate with either producers or consumers. For fundamentally the concept of cost price as fair price is common to both classes; and it is a persistent doctrine.

That cost price is fair price and that disruptions of this relationship ought not to be permitted may be regarded as the economic philosophy of the average man, common to producers and consumers alike. Fundamentally it reflects human objection to changes in economic environment, and represents a rationalization of these instinctive objections. Producers, whether farmers or manufacturers, simply do not like to alter their accustomed methods, to

turn to other pursuits, to face bankruptcy. Consumers do not like rising prices—particularly food prices—while incomes rise less rapidly. When profound disturbances in price relationships occur and the necessity for considerable alteration in customary procedures threatens, the cry for price control through artificial means grows loud.

POPULAR AND ACADEMIC THEORIES OF PRICE FIXING

In chapter x, it was pointed out that the theory of cost-and-price relationship as formulated by economists differs in several important particulars from the vague popular theory. The academic theory constitutes merely an explanation of the forces affecting prices over long periods of time; cost of production is not regarded as the significant factor affecting prices over short periods. Market prices do not in fact and need not in theory coincide with the cost of producing the marginal product or with any kind of a cost figure whatsoever. The academic theory of cost-and-price relationship is commonly misinterpreted with respect to the period of time to which it applies, the definition of cost which it postulates, and the sort of a cost figure which it discusses.

The popular theory is so vaguely conceived that it cannot even be formulated with precision. At most it states that prices ought to conform to cost of production because cost price is fair price. The form which the popular theory most often assumes is that farmers are entitled to cost of production plus a reasonable profit. Whether every farmer ought to receive cost plus a reasonable profit, and how cost and reasonable profit should be defined, are not specified. But at least a few points in the popular theory become clear from a review of the literature on price fixing. The price-fixing notion involves some attempt at a formulation of price theory. It seems clear that the prices which advocates of price fixing by cost determination desire to fix are market prices: prices

for the season or at most a few seasons, not prices over ten- or twenty-year periods. There may be confusion on collateral points—whether to fix all prices or a few, wholesale or retail or farm prices, the appropriate agencies and machinery of enforcement—but on this matter there has been substantial agreement. It is market prices which are to be fixed by cost determination; it is market prices which ought to depend upon cost of production. On a second point experience with cost statistics has brought substantial agreement: price ought to be fixed at what is called the bulk-line cost, not at the average cost. This notion, which we shall have occasion to consider in a subsequent section, has been regarded as an adaptation of the academic theory. In most instances the procedure envisaged by advocates of price fixing involves the fixation of a price which conforms to the ascertained cost of producing the bulk of the supply. Given the bulk-line cost, one is supposed to know what the price ought to be.

Two general classes of objections to this procedure may be advanced. The first and most important is a general objection to price fixing as such; the second constitutes both a general objection and several specific objections to the use of cost of production data. We may consider in the present section only the two general objections—why price fixing is in itself undesirable, and why cost data are *prima facie* inappropriate for the fixation of market prices. In subsequent sections we may consider the specific objections to special parts of the generally contemplated procedure in employing cost data for price fixing.

The fundamental problem involved in interference with prices established in competitive markets by economic forces is to anticipate whether or not interference will eventually prove more beneficial than non-interference. The effects which will follow interference with

prices must be envisaged in advance. Many economists regard price fixing with disfavor simply because they see no possibility of anticipating the ultimate consequences of it; and they argue in effect that nothing is to be gained by embarking on uncharted seas. Producers, of course, are concerned only with immediate consequences; they want higher prices, and they have no doubt that higher prices will at least postpone the difficulties of readjustment which otherwise they would have to face. But many economists admit that postponement or facilitation of readjustments inevitable after a decline in relative prices is desirable, if only it can be achieved without giving rise to a situation equally or even more serious in the future. They seldom fail to envisage such a situation.

A pertinent illustration is afforded by the recently vetoed McNary-Haugen bill for lifting the price of wheat.¹ This plan does not involve price fixing by cost determination. But it clearly involves the maintenance of the domestic price of wheat, behind a tariff wall and by the device of governmental purchase and disposal of the exportable surplus, at a higher level than would otherwise prevail. Hence the fundamental purpose is the same as in price fixing by cost determination—the maintenance of higher price—though the price is to fluctuate and is not to be named, and the machinery of enforcement is of a special sort. The plan may be regarded as an extension or revision of price-fixing doctrines.

So far as can be foreseen, what would follow with respect to changes in consumption and production if this plan were adopted? Consumption would presumably be little affected. But the evidence indicates that wheat production would be expanded both by cultivation of new

¹ The analysis in subsequent paragraphs substantially summarizes that embodied in *The McNary-Haugen Plan as Applied to Wheat: Operating Problems and Economic Consequences* and *The McNary-Haugen Plan as Applied to Wheat: Limitations Imposed by the Present Tariff*, WHEAT STUDIES OF THE FOOD RESEARCH INSTITUTE, Vol. III, Nos. 4 and 5.

land and by shifting land from the production of other crops to the production of wheat. There would be a temporary price advantage to wheat producers—enough certainly to induce this expansion. But, even allowing for increasing consumption due to population growth, with increased production there would be a larger exportable surplus. The surplus would have to be sold abroad for what it would bring. As the surplus grew in size, the price per unit which it would bring would tend to decline; for an increased world supply would be consumed only at a lower world price. The decline in the world price would be reflected back to American producers. Eventually they would obtain a price no higher than would have been obtained had the plan never been put in operation. Thus even so elaborate a scheme as the McNary-Haugen plan could not permanently eliminate the operation of economic forces; it would merely modify their action; and some time in the future essentially the same problem of readjustment of productive processes would have to be faced as was intended to be solved by the application of the scheme.

Hence what is perhaps the economist's principal objection to any form of governmental interference with competitive prices, and more especially the prices of products which originate in thousands of establishments, is that interference on a large scale is at best a dangerous experiment. The very fixation of prices sets in motion forces which tend to nullify the fixation, and to create a new set of maladjustments; and one cannot determine in advance whether or not something would be gained by fixing the price.

Roughly stated, this is the general but not unqualified conclusion of most thoughtful people, whether economists or not. Interference is, however, justifiable under special circumstances, and to greater or less degree. In time of war, for example, national self-preservation may seem to

justify deliberate encouragement of the production of some commodities, and discouragement of others; in such circumstances immediate results are of paramount importance, and ultimate consequences may properly be disregarded. There may be good reason for regulation of interest rates, monopoly prices, and the prices of services rendered by public or semi-public utilities. But in general productive processes as followed by great numbers of individuals, and the prices to which production adjusts itself, are better left without interference. The ultimate consequences of interference must be considered; and the results of interference either cannot be foreseen as a usual thing, or else appear (in specific instances) undesirable.¹

The second and much less significant indictment of agricultural price fixing by cost determination concerns the irrelevance of cost data to the problem in hand. The advocates of price fixing wish to fix market prices; they argue that cost normally fixes price, and that cost price is fair price. The retort is that cost does not determine market prices. Cost data bear only remotely upon the problem of a price-fixing board in determining the "fair" market price.

Cost data are in fact extraneous to the problem, *if what is sought is the fixation of a fair market price*, and if competition is free. Yet advocates of price fixing by cost determination have not based their argument upon the

¹ It may be argued that fixation of prices even in time of war ought not to occur in view of predictable consequences. The point cannot be considered here. It suffices to say that war-time price regulation in retrospect appears justifiable in that it facilitated achievement of the immediate and pressing ends sought at the time, though it may have contributed to the severity of the agricultural depression following the war. And it established an unfortunate precedent, of which farmers and their representatives made extensive use during the post-war period of readjustment. Whether or not price regulation for purposes of alleviating agricultural distress in times of peace is quite as justifiable as price regulation intended to further the conduct of a war is doubtless a vital question, and one which cannot be discussed in limited space. But it would appear that a war gives rise to more pressing problems than do price fluctuations in times of peace, and that measures appropriate to meet the one situation need not appear appropriate for the other.

contention that competition was not free, and they have assuredly contemplated the fixation of prices over short periods, not long. What they desire is not a fair price fixed either by free competition or by reference to costs: it is simply a price higher than the prevailing price, a price high enough to obviate the immediate necessity for painful readjustments either of production or consumption, regardless of the ultimate consequences.

Under the circumstances which give rise to public demand for price fixing, a price figure reached by the most impartial analysis of the most accurate cost data would probably not serve to satisfy farmers if it were a figure below the current price, or consumers if it were above the current price. Reasons would be found to show that the figure was wrong, and discussion would probably degenerate into mere recrimination, as has so often occurred in cost-and-price disputes in the past. The arguments that price influencing in general is likely to defeat its own ends, and that cost data are inappropriate for the fixation of market prices are in themselves sufficient to discredit projects for price fixing by cost determination. But these arguments, depending as they do upon an involved theory of cost-and-price relationships, are not easy to grasp. Certain more specific and more familiar objections to the use of farm cost statistics merit recapitulation.

ACCOUNTING PRINCIPLES AND VARIATIONS IN COSTS

A price-fixing commission purposing to fix a fair price on the basis of cost data must secure the data; compile them on one or another set of accounting principles; and fix upon some single cost figure from the resulting array of individual costs. Merely to secure data that are clearly unbiased and at the same time constitute an adequate sample gives rise to some problems which cannot be considered here. As we have pointed out in chapter iv, the formulation of appropriate accounting principles is not a

simple matter because valuation of non-cash cost items is difficult and because the allocation of costs between joint products can proceed only on an arbitrary basis. Nor is the process of choosing an average a purely arithmetical procedure, since differences in costs are wide.

With respect to accounting principles the propriety of charging home-grown feeds at market prices, less costs of hauling from market to farm, has received the greatest attention. Farm management cost investigations have practically without exception followed this practice. It encountered criticism when milk prices were disputed during the war; for feed constitutes a large proportion of the cost of producing milk, and those who desired low prices perceived that the accepted principle led to higher costs (and hence a higher price) than would the principle of charging feed at cost of production. The advocates of the feed-at-market-price principle based their argument upon the contention that the price of the product must cover such a charge, else farmers would curtail production. Opponents of the principle, when they did not speak merely about the accepted industrial accounting principle of "cost or market, whichever is lower," argued that sensible farmers would not curtail production for such reasons.

Thus the point at issue resolves itself into the question of the manner in which farmers calculate—how and why they produce more of this and less of that. Now this question, as we have seen, constitutes one of the knottiest problems in economic theory. It can be discussed only with difficulty even when long-time adjustments in agricultural production are being considered, and only highly generalized statements can be formulated. We have already indicated some grounds for believing that the calculations of farmers are even more vague and uncertain than economists suppose, on account of the very nature of the farming business. To the specific problem, whether

farmers in fact charge feeds at market prices in their calculations, there appears to be no solid ground for an unqualified answer affirmative or negative. The most that can be said is that advocates of the feed-at-market principle have apparently envisaged a more precise sort of calculation on the part of farmers than the nature of the farming business would seem to justify,¹ and in so far as costs have been inflated by adoption of the principle, an erroneous picture of farm prosperity has been painted.

The customary methods of calculating other cost items in farm cost data have also been questioned. Essentially the same problem is involved, at least when the data are to be used in price fixing: what in fact are the calculations of farmers? Academic theory and farm accounting practice for the most part agree on labor rates; labor is to be charged at going rates for its equivalent in the community. True, these rates are not always ascertainable; and some cost investigators content themselves with charging labor not at rates that the farmer could obtain, but at rates he would like to obtain. Interest is often computed upon both valuations of property and rates higher than could in fact be secured. Community rates for wages of management are so ill defined that this charge is often omitted. Rent of land, ordinarily computed on land values multiplied by the assumed interest rates, is usually included. Economists admit that rent of land is practically inseparable from interest, but they erect a reasonably convincing argument for not giving it co-ordinate place with other costs in guiding farmers in general to expand or contract production.

The net result of all these principles and practices is

¹ Conceivably sympathy for the plight of farmers, or mere partisanship, has led to a wider advocacy of the feed-at-market principle than has honest and clear-sighted conviction. This is more readily suspected than proved; but the fact cannot be ignored that cost investigators have almost invariably chosen to justify the use of the accounting principles leading to the highest possible cost figures.

that most, though not all, farm cost statistics are presumably inflated. It is reasonable to believe that the costs shown are higher than the costs upon which farmers base their vague calculations leading to expansion or contraction of production, and that unfavorable cost-and-price relationships have been depicted when perhaps they did not exist, at least in the degree implied. In so far as accepted principles of farm cost accounting result in inflated costs, they are inadequate principles. Unfortunately, however, specific suggestions for their improvement cannot readily be formulated; for the customary calculations of farmers, which ought to provide the criterion for accounting principles, are necessarily so vague that precise formulation of a set of appropriate principles is impossible. In a sense, then, the problem of a price-fixing board cannot be solved in a manner generally acceptable. But an impartial board might well conclude that the currently accepted principles of farm cost accounting lead to misrepresentation of the facts.

Of the difficulties of allocating costs to joint products little need be said. Here the same conclusion applies: there is no certain basis upon which the validity of accounting principles can be demonstrated. The customary procedures involve either the treatment of by-products as credits (usually calculated at market prices) or the allocation of costs on the basis of percentage receipts from joint products. Either method is arbitrary, without a solid foundation in logic. Clearly different methods of allocation can result in different cost figures for particular commodities. The difficulty is real. But for most products costs requiring allocation do not constitute a heavy proportion of total costs: cotton and cottonseed, wool and mutton, are the exceptions rather than the rule. Allocation assumes major importance when the view is taken that the farm should be regarded as a unit, and that no specific costs per unit of product should be calculated.

Something is to be said for this view, for reasons too obvious to be detailed. It suffices merely to point out that its acceptance necessarily involves abandonment of price fixing as it has been envisaged by its proponents. What has in fact been sought in price fixing is statistics of cost leading to the appropriate price for a particular product, not for farm products as a group.

Much has been written of the difficulty of securing a representative cost figure from arrays of individual costs per unit of product. In chapter v we observed that costs per unit differ widely between different farms in the same year; and that costs change from year to year on the same farms. Most writers have emphasized merely the difference in costs, not the changes. In order to reach a representative figure, the so-called "bulk-line theory" has been formulated. Farm management cost investigations familiarized farmers with the concept. It was given considerable publicity by the Tariff Commission, the Federal Trade Commission, and the War Industries Board, and it has been extensively employed in theoretical discussions of cost-and-price relationships in economic journals. There is no historical instance of a price of an agricultural product actually fixed on the bulk-line principle. But there can be no question that advocates of price fixing by cost determination have regarded the bulk-line cost as the figure most appropriate for price-fixing purposes. We may consider briefly some of the weaknesses of the theory.

WEAKNESSES OF THE BULK-LINE THEORY

Briefly stated, the theory is as follows. Accurate cost data are obtained from a number of farms sufficiently large to provide an adequate sample. Data applying to a given year suffice. The individual costs per unit of product are arranged in a cumulative curve showing the percentage of the total product produced at the various costs, as shown in the hypothetical curve in Figure 2. Thus

about 10 per cent of the product was produced at or below a cost of \$1.30 per unit, about 60 per cent at or below a cost of \$1.60, and about 85 per cent at or below a cost of \$1.80. It is argued that a commission armed with such a curve could ascertain the fair price within reasonable limits. The appropriate price is said to be that price

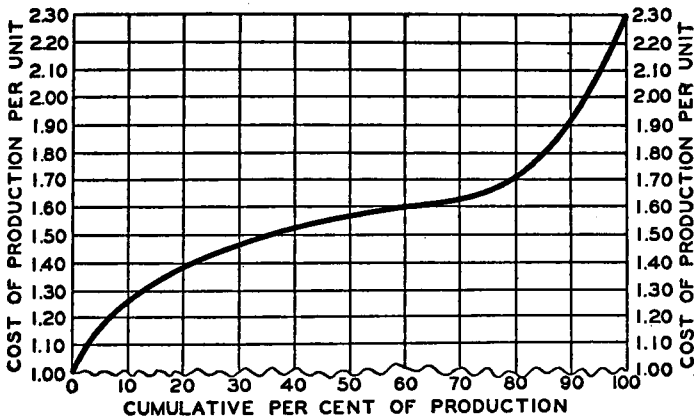


FIG. 2

which covers about 85 per cent of the production—in our hypothetical illustration a price of \$1.80. This is said to be the appropriate price because such a price would induce producers whose costs were below \$1.80 to continue in production, some of the low-cost producers perhaps expanding their production in such wise as to maintain the supply at 100 per cent. Producers whose costs exceed \$1.80 need not be considered because they must be on the point of withdrawing in any event. The producer whose cost is \$1.80 is to be regarded as the marginal producer whose cost determines price.

Thus the theory assumes an air of plausibility. It ostensibly locates the cost which is regarded by theorists as

the price-determining cost. Now we have already seen¹ that the price-determining cost of economic theory is not the average cost per unit incurred in any particular year by any particular producer in producing his 1,000 bushels; it is the cost of producing the marginal product. The theoretical and statistical cost curves are constructed on altogether different hypotheses. We have seen that the theoretical cost curve is not finite, must incline in only one direction, applies to an indefinite period of years, and defines costs in a special sense. The reasons why the statistical cost curve is by no means the same in meaning as the theoretical cost curve scarcely require repetition. It is clear that the bulk-line theory is a decidedly imperfect adaptation of the academic theory of cost-and-price relationships, and is not properly adapted to price fixing merely because it bears a superficial resemblance.

But the practical question before a price-fixing board would be to decide whether the bulk-line theory would result in a price figure too low or too high. Although the statistical curve might be admitted to be fundamentally different from the theoretical curve, it remains the only available picture of actual costs; and hence it must be used if costs are to be used at all. The rational criterion for determining whether a bulk-line figure is too low or too high is to ask the familiar question: how would production and consumption be affected if the bulk-line cost were made the fixed price? But this criterion has in fact seldom been applied. The whole question is begged in most discussions. It is begged in the very adoption of currently accepted principles of farm cost accounting, and it is begged in the selection of the bulk-line figure rather than an average of some form, or a median, or the highest or lowest figure, or the cost at the upper or lower quartile or decile.

The following quotations are typical.

¹ See above, pp. 193-95.

When it is required to fix a price to represent the cost of producing milk for any section or group of dairymen, it is evident that if the actual average cost is used for this purpose then one-half of the milk is produced at a cost greater than the sum fixed. Therefore, if the price of milk is based on the average cost of production it would tend to discourage production and decrease the supply.¹

The price of farm products should be more than the average cost of production or the nation will eventually be faced with the problem of under-production.²

But how is a commission to know that the bulk-line must be used as a price figure if production is to be maintained, even if it be assumed that this maintenance is desirable? Clearly it cannot be argued that producers whose costs are high in one year incur the same costs in the next year;³ the evidence indicated that costs change from year to year; hence why should the high-cost producers of one year withdraw their product in the next? Whether or not the cumulative cost curve is generally inflated must require consideration; and the presumption is that if accepted principles of farm accounting were employed, inflation would be found. Hence the price actually needed to maintain production might prove to be a price considerably lower than the bulk-line cost, if costs are computed on the customary principles.

It is perhaps gratuitous to add that the choice of a cost figure covering about 85 per cent of the production is largely arbitrary. Precisely why 85 per cent is a more appropriate figure than any other is not clear. Such a figure has been endorsed merely because it looks like a more appropriate figure than, say, 50 per cent of produc-

¹ J. B. Fain, E. J. Posson, and Ralph H. Hotis, *Unit Requirements for Producing Market Milk in Vermont* (U.S. Department of Agriculture Bulletin 923), February 1921, p. 14.

² B. H. Frame, *The Cost of Crop Production in Missouri in 1921* (Missouri Agricultural Experiment Station Bulletin 190), December 1921, p. 14.

³ See above, pp. 87-98.

tion.¹ It appears appropriate partly because the assumption has prevailed that producers maintain their relative positions on the cost curve year in and year out; and the choice of a figure of 85 per cent rather than 98 per cent constitutes a concession to the obvious fact that some producers are inefficient and ought not to be maintained. Thus far there is logic in the argument, though to assume that individual producers incur about the same costs from year to year is clearly a mistake. But the choice of the bulk-line figure doubtless in part is traceable back to the circumstances which give rise to demand for price fixing. What then is wanted is a price higher than the prevailing price, and the bulk-line theory always yields a higher "necessary" price than would be yielded by a theory calling for an average of costs. If farm cost statistics had invariably shown a bulk-line figure of 85 per cent which ran below prevailing prices, we should presumably have had a new theory proposed in which the proper figure was named as about 95 or 98 per cent. In so far as this general attitude has prevailed, logical considerations supporting the bulk-line theory have played a subordinate part. There is in fact no demonstrated reason for fixing upon the figure of 85 per cent.

In summary, the use of farm cost statistics for price-fixing purposes is fallacious on several counts. Price fixing is at best dangerous because its consequences can seldom be foreseen. Cost data are logically unfitted for the fixation of market prices. The bulk-line theory is fallacious in particular because it involves the use of inflated costs, ignores changes in costs, employs a questionable

¹ Mr. Simpson, however, has attempted to show, inductively, by comparing cost curves with prices, that in general price stands at a point corresponding to the cost of producing 84 or 85 per cent of the output. Mr. Simpson has not employed agricultural cost statistics except in a few instances; hence his conclusions need not receive detailed analysis here. The present writer is unable to accept these conclusions even as applied to industrial costs, chiefly because too few sets of cost statistics have as yet received analysis. Mr. Simpson's analyses are referred to in the Bibliographical Notes to chapters x, xi, and xii.

form of average, and begs the fundamental question respecting the calculations made by farmers in adjusting production to changes in price. This question is not only of paramount importance, but is also impossible of precise solution. But the accepted reasoning of economic theory appears to constitute a closer approach to the truth than does the popular theory of cost-and-price relationships which underlies the recent agitation for price fixing by cost determination.

In view of the numerous objections to price fixing by cost determination, it is not surprising that actual instances of the fixation of agricultural prices during the war and the subsequent depression were extremely few. In retrospect price fixing by cost determination appears insignificant at least in the historical sense. The subject is of interest chiefly because it focuses attention upon an erroneous but persistent theory of cost-and-price relationships.

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CHAPTER XII

TARIFF MAKING BY COST DETERMINATION

The employment of farm cost statistics in the calculation of tariff duties, like the use of cost data in price fixing, presents an example of a widely acclaimed theory which has in fact been applied but seldom. Wheat, wheat flour, millfeed, live bob-white quail, butter, Swiss cheese, and cherries comprise the list of agricultural products upon which existing tariff rates have been calculated by means of statistical investigations of costs of production at home and abroad, though Schedule 7 of the Tariff Act of 1922 names well over 200 agricultural products upon which duties shall be paid.¹ The extent to which cost data, as distinguished from extensive statistical investigations of costs, have been employed by Congress in recent tariff acts is not determinable. But it is doubtful if more than a very few of the existing duties on agricultural products would be regarded by the most ardent advocates of the "true principle" of protection as exact statements of the differences in cost of production at home and abroad. Interested parties have presented cost statements in tariff hearings, but there is no conclusive evidence that the statements were accepted by Congress and embodied in the law. The United States Tariff Commission has published the results of extended statistical investigations of the cost of producing wool and sugar; but neither investigation resulted in duties precisely representing the differences in costs thereby tentatively ascertained.

Nevertheless, the Republican party in 1908 officially

¹ This number is an exceedingly rough count. The tariff acts draw distinctions between products finer than need to be observed in the present study. Schedule 7 of the Act of 1922 contains 80 paragraphs, and practically every paragraph prescribes several duties and names several products.

maintained that the true principle of protection was the erection of duties equal to the difference in the cost of production at home and abroad; and this principle was reaffirmed in the Tariff Act of 1922. The Democratic party, while avoiding the formal statement endorsed by the Republican, has long maintained its belief in duties "that will promote effective competition." The difference between the two parties in their stated views upon the fundamental purpose of a tariff is regarded by most students as negligible,¹ though to the average voter a "competitive" tariff sponsored by Democrats presumably means a lower scale of duties than an "equalization" tariff sponsored by Republicans. The precise shades of meaning attached by business men and farmers to the words "equalizing cost of production," and the precise extent to which the notion is supported, are of course impossible to ascertain. But that the concept of fixing tariff duties by measuring the difference between cost of production at home and abroad is both attractive and popular cannot be questioned. In Professor Taussig's words:

The doctrine has an engaging appearance of fairness. It seems to say, no favors, no undue rates. Offset the higher expenses of the American producer, put him in a position to meet the foreign competitor without being under a disadvantage, and then let the best man win. Conditions being thus equalized, the competition will become a fair one. Protected producers will get only the

¹ "When . . . analyzed, the underlying purpose of the tariff appears to be much the same for the two great parties. The one stands for a 'competitive' tariff which will allow foreigners to compete on equal terms with domestic producers; the other, for a tariff which by 'equalizing costs of production' will allow domestic producers to compete on equal terms with foreigners. It is not in aim but in application that the policies diverge; Republican tariffs have always been higher than Democratic."—Thomas Walker Page, *Making the Tariff in the United States*, 1924, p. 68.

"A 'competitive tariff' would seem to be one under which domestic and foreign producers can compete in such a manner that both should get reasonable profits. Fairly and consistently applied, therefore, the principle of a competitive tariff cannot be said to differ in essentials from that of a tariff equalizing cost of production."—F. W. Taussig, *Tariff History of the United States*, 7th ed., revised, 1923, p. 419.

profit to which they are reasonably entitled, and the domestic consumers are secured against prices which are unreasonable.¹

To the rank and file of American business men and farmers, the fundamental charm of the principle apparently lies in its seeming innocuousness. Sweeping application could harm nobody but domestic monopolies, and these in any event ought not to be cherished. If the non-monopolistic American producer is always to be able to meet foreign competitors on equal terms, no risks other than those incident to purely domestic competition are to be feared. And what ought the principle to mean but permanent equalization—whether because differences in costs at home and abroad continue of the same size, or because changes in their size will be taken care of by continued cost investigations? So long as the “true principle” is applied, neither increases nor reductions in rates are to be regarded as injurious to producers or unfair to consumers and foreign competitors. The principle seems capable of assuaging fears of certain avoidable disturbances in business, of crushing abhorrent domestic monopolies, of placating consumers, of assuring fair play to foreigners, and of removing the process of determining duties from the field of politics and log-rolling to the field of book-keeping and mathematics. Yet in spite of its apparent promise, the principle has not been applied to an appreciable number of the articles dutiable under recent tariffs.

EMPLOYMENT OF FARM COST DATA BEFORE 1922

An attempt to demonstrate how far duties on agricultural products, as finally embodied in tariff acts of recent years, have actually been based upon cost data can be couched only in the most general terms. Tariff making in the United States is a function of Congress. The construction of schedules and determination of rates—the framing of the tariff act—follow the customary procedure in the

¹ *Free Trade, the Tariff, and Reciprocity*, 1920, p. 134.

enactment of laws. The act must pass through the appropriate House and Senate committees. Public hearings upon it are held. Debate and amendment occur in both branches of Congress. Divergent views are ordinarily bridged in the Conference Committee. The act, as approved by both branches of Congress, must ordinarily receive presidential approval before becoming law. The origin of particular duties on particular commodities is often impossible to trace: they may have been evolved in the mind of a friend of a friend of a committee member, or brought forth in the public hearings, in debate, in amendment, or elsewhere. From the formidable mass of data it is usually impossible to winnow out the particular arguments which led to the adoption of rates of duty finally specified in any tariff act. The Congress itself has never conducted statistical cost investigations of any sort. Its committees have listened to and presumably considered testimony on comparative costs—though how attentively and with what conviction no one can say.

A cursory glance at hearings on the Dingley Tariff of 1897—even the McKinley Tariff of 1890—indicates that cost data in one form or another were at least submitted. But in the 'nineties the "true principle" had not been evolved: the Republicans in their platform of 1896 endorsed "such an equitable tariff . . . as . . . will protect American labor from degradation to the wage level of other countries." In the platform of 1904 a closer approach to the "true principle" appeared: "The measure of protection should always at least equal the difference in the cost of production at home and abroad." Between 1904 and 1909 the notion of cost equalization appears to have become more widely accepted.¹ It was erected to

¹ The growth in popularity of the cost equalization principle is not clear in all its aspects. Republican leaders, frightened by popular clamor against protected monopolies and in favor of downward revision of the Dingley Tariff, apparently adopted the formula as the readiest solution of their temporary difficulties. By adopting it they might endorse downward revision in cases where

the rank of a "true principle" in the Republican platform of 1908: "In all tariff legislation the true principle of protection is best maintained by the imposition of such duties as will equal the difference between the cost of production at home and abroad, together with a reasonable profit to American industries." The precise meaning attached to the words "at least" in the pronouncement of 1904 and the phrase "together with a reasonable profit to American industries" in the platform of 1908 has never been made clear; they may or may not have been regarded as loopholes permitting consistency if duties of any height whatever should be enacted.

With the Republicans victorious in the elections of 1908, tariff revision was undertaken. Evidence does not appear that the duties on agricultural products erected in the Act of 1909 were supposed by Congress or anyone else to equal the difference between cost of production at home and abroad. Table 16 affords a convenient contrast of duties on selected agricultural products, covering a wide range, as between the various tariff acts since 1890. For the most part the duties erected in the Dingley Tariff of 1897 remained unchanged in the Act of 1909. In the hearings there was not a little discussion of the cost of producing sugar, tobacco, oranges, lemons, olive oil, hops, rice, pineapples, and wool; and it seems clear that the chairman of the House Committee on Ways and Means, Mr. Payne, assiduously sought information on costs. But

the cost data showed duties to be excessive, and so placate the then insistent public clamor against domestic monopolies; and at the same time they might adhere to their historic policy of protection. In the Presidential campaign of 1908 considerable emphasis was placed upon the principle. Mr. Miles, president of the National Association of Manufacturers, stated in 1908 that his organization had before 1908 brought the notion "clearly and emphatically to the public mind" for the first time. See "Tariff Making—Fact and Theory," *Annals of the American Academy of Political and Social Science*, September 1908, XXXII, 406. This issue of the *Annals*, in combination with the testimony of witnesses in the various series of tariff hearings, provides the best available information on the views of practical business men as distinguished from economists with respect to the cost equalization doctrine.

TABLE 16.—TARIFF DUTIES ON SELECTED AGRICULTURAL PRODUCTS, 1890-1922*

| | 1890 | 1894 | 1897 | 1909 | 1913 | 1921 | 1922 |
|---|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| Barley | 30 cts. bu. | 30% av.* | 30 cts. bu. | 15 cts. bu. | 15 cts. bu. | 20 cts. bu. | 20 cts. bu. |
| Corn | 15 cts. bu. | 20% av. | 15 cts. bu. | 15 cts. bu. | Free | 15 cts. bu. | 15 cts. bu. |
| Oats | 15 cts. bu. | 20% av. | 15 cts. bu. | 15 cts. bu. | 6 cts. bu. | 6 cts. bu. | 15 cts. bu. |
| Rice, cleaned | 2 cts. lb. | 1½ cts. lb. | 2 cts. lb. | 2 cts. lb. | 1 ct. lb. | 2 cts. lb. | 2 cts. lb. |
| Rye | 10 cts. bu. | 20% av. | 10 cts. bu. | 10 cts. bu. | Free | Free | 15 cts. bu. |
| Wheat | 25 cts. bu. | 20% av. | 25 cts. bu. | 25 cts. bu. | Free | 35 cts. bu. | 42 cts. bu. |
| Wheat flour | 25% av. | 20% av. | 25% av. | 25% av. | Free | 20% av. | \$1.04 cwt. |
| Hay | \$4.00 ton | \$2.00 ton | \$4.00 ton | \$4.00 ton | \$2.00 ton | \$2.00 ton | \$4.00 ton |
| Beans, dried | 40 cts. bu. | 20% av. | 45 cts. bu. | 45 cts. bu. | 25 cts. bu. | 2 cts. lb. | 1¼ cts. lb. |
| Peas, dried | 20 cts. bu. | 20 cts. bu. | 30 cts. bu. | 25 cts. bu. | 10 cts. bu. | 10 cts. bu. | 1 ct. lb. |
| Onions | 40 cts. bu. | 20 cts. bu. | 40 cts. bu. | 40 cts. bu. | 20 cts. bu. | 40 cts. bu. | 1 ct. lb. |
| Potatoes | 25 cts. bu. | 15 cts. bu. | 25 cts. bu. | 25 cts. bu. | Free | 25 cts. bu. | 50 cts. cwt. |
| Bacon and hams | 5 cts. lb. | 20% av. | 5 cts. lb. | 4 cts. lb. | Free | 25% av. | 2 cts. lb. |
| Beef, fresh | 2 cts. lb. | 20% av. | 2 cts. lb. | 1¼ cts. lb. | Free | 2 cts. lb. | 3 cts. lb. |
| Mutton, fresh | 2 cts. lb. | 20% av. | 2 cts. lb. | 1¼ cts. lb. | Free | 2 cts. lb. | 2¼ cts. lb. |
| Pork, fresh | 2 cts. lb. | 20% av. | 2 cts. lb. | 1¼ cts. lb. | Free | 2 cts. lb. | ¼ cts. lb. |
| Poultry, dressed | 5 cts. lb. | 3 cts. lb. | 5 cts. lb. | 5 cts. lb. | 2 cts. lb. | 2 cts. lb. | 6 cts. lb. |
| Milk, fresh | 5 cts. gal. | Free | 2 cts. gal. | 2 cts. gal. | Free | 2 cts. gal. | 2½ cts. gal. |
| Butter | 6 cts. lb. | 4 cts. lb. | 6 cts. lb. | 6 cts. lb. | 2½ cts. lb. | 6 cts. lb. | 12 cts. lb. |
| Cheese | 6 cts. lb. | 4 cts. lb. | 6 cts. lb. | 6 cts. lb. | 20% av. | 23% av. | 5 cts. lb. |
| Lard | 2 cts. lb. | 1 ct. lb. | 2 cts. lb. | 1¼ cts. lb. | Free | Free | 1 ct. lb. |
| Eggs, dried ..... | ..... | ..... | ..... | 15 cts. lb. | 10 cts. lb. | 10 cts. lb. | 18 cts. lb. |
| Apples, dried | 2 cts. lb. | 20% av. | 2 cts. lb. | 2 cts. lb. | 1 ct. lb. | 1 ct. lb. | 2 cts. lb. |
| Prunes, plums, pears, peaches, dried | 2 cts. lb. | 20% av. | 2 cts. lb. | 2 cts. lb. | 1 ct. lb. | 1 ct. lb. | ½ ct. lb. |
| Almonds, shelled | 7½ cts. lb. | 5 cts. lb. | 6 cts. lb. | 6 cts. lb. | 4 cts. lb. | 4 cts. lb. | 14 cts. lb. |
| Walnuts, shelled | 6 cts. lb. | 4 cts. lb. | 5 cts. lb. | 5 cts. lb. | 4 cts. lb. | 4 cts. lb. | 12 cts. lb. |
| Peanuts, shelled | 1½ cts. lb. | 20% av. | 1 ct. lb. | 1 ct. lb. | ¾ cts. lb. | 3 cts. lb. | 4 cts. lb. |
| Tobacco, wrapper, unstemmed | \$2.00 lb. | \$1.50 lb. | \$1.85 lb. | \$1.85 lb. | \$1.85 lb. | \$2.35 lb. | \$2.10 lb. |

* Compiled from *Crops and Markets*, February 1927, IV, 74 f., and appropriate tariff acts. This table is not intended to give a complete list of the duties on agricultural products under various tariff acts, but merely to display general changes. Certain important products, notably wool and sugar, are not included on account of the difficulties involved in tabulation; and certain qualifying notes necessary for accurate interpretation of particular duties in the table have been omitted.

* Ad valorem.

the data submitted were at best fragmentary; they covered few products, and in most instances comprised either estimates not based upon statistical investigations, or costs incurred by individual domestic producers.

The Tariff Act of August 5, 1909 (Section 2), authorized the President to "employ persons" for the purpose of securing information enabling him to determine whether or not there were countries which unduly discriminated against the United States, and which accordingly were properly subject to retaliation by application of the maximum tariff (rates prescribed in the Act plus 25 per cent ad valorem). President Taft appointed a Board in September 1909; but under the law it was not specifically authorized to investigate costs of production at home and abroad. An appropriation bill of June 25, 1910, however, specifically stated that the President might utilize the funds appropriated "for . . . purposes . . . including . . . investigations of the cost of production of commodities . . ." The Board, which in 1912 was discontinued because appropriations were not forthcoming from a Democratic Congress, published an elaborate report upon wool and manufactures of wool, including a mass of cost data. The report on raw wool (the only farm product of which the costs were investigated) had no apparent effect upon the actual duty. The Democrats won the Presidential election of 1912, and the tariff revision of 1913 was therefore not conducted with a view toward erecting rates equal to the difference between cost of production at home and abroad.

In the hearings on the Act of 1913, however, cost data were quite as frequently employed by witnesses as in the hearings on the Act of 1909. These data scarcely influenced the duties finally appearing upon agricultural products. As is shown in Table 16 (p. 237), many products were placed on the free list, including wool, cotton, wheat, and corn; and duties on other commodities were

reduced. The cost statements presented by witnesses, however, in general were intended to demonstrate the need for retention or increase of the duties existing in the Act of 1909. Apparently Republicans continued to endorse the notion of cost equalization, though nothing was said of it in the campaign platform of 1912.

In an act of September 8, 1916, the Democratic Congress, having allowed the Tariff Board to lapse in 1912, established a Tariff Commission which was given the power, among others, "to investigate . . . cost of production." Before 1922, the Commission made few efforts definitely to ascertain differences in the cost of production of agricultural products at home and abroad.¹ The costs of producing sugar in the United States (both cane and beet), Cuba, Porto Rico, and Hawaii were investigated; and the findings were published in 1919. But questionnaires were addressed not to farmers respecting the farm costs of producing cane or sugar beets, but to factories respecting the cost, including cane or beets, of manufacturing raw sugar. Considerable discussion of the farm costs of producing wheat, oats, potatoes, and hay appeared in a study on agricultural staples issued in 1920. But no effort was made to obtain data directly from large groups of farms; most of the cost data discussed had been gathered in 1910 and 1911 by the United States Department of Agriculture. The Commission obtained information on the costs of raw wool production in 1918-20 by direct inquiry from American ranchers, but not from wool producers in Australia (the chief competitor), though a few estimates were obtained from Argentina. Data on the costs of beef production in Argentina and the United States were published in 1922, but for the most part were compiled rather than collected by the Commission. Up to 1922, therefore, no thoroughgoing attempt had been made by any agency, except the Tariff

¹ See Bibliographical Note.

Board in its investigations of wool, to determine the precise difference between domestic and foreign production costs of any agricultural product.

The Emergency Tariff Act of May 27, 1921, applied only to agricultural products. It was formulated hurriedly in response to pressure from agricultural interests suffering from the severe collapse of prices beginning in 1920. Costs were discussed in the hearings;¹ but there is no evidence that the rates finally adopted were supposed to represent precisely the difference between cost of production at home and abroad. The common procedure, both of witnesses in hearings and of Congressmen in debate, was to cite figures showing domestic costs exceeding prices received. This apparently was thought to prove that a tariff higher than that existing ought certainly to be erected, though precisely how high the new duties ought to be was not indicated by available figures.

Prior to 1922, therefore, despite the popularity of the "true principle," the existence of a Tariff Board or a Tariff Commission authorized to investigate costs, and considerable discussion of agricultural costs in tariff hearings, there were few thoroughgoing attempts even to ascertain the difference between foreign and domestic costs of production. The origin of precise figures is necessarily obscure, but such duties as appeared in Tariff Acts appear to have been determined from other data than cost data, and upon other principles than the "true principle."

EMPLOYMENT OF COST DATA SINCE 1922

The Emergency Tariff of 1921 was soon superseded by the Act of 1922, approved on September 21. In general the rates on agricultural products were increased. (See Table 16, p. 237.) There is again no evidence that the

¹ The hearings of the Emergency Tariff of 1921 are not readily distinguishable from the hearings on the Act of 1922.

duties as enacted were regarded as representing the difference between domestic and foreign costs; and, since the duties of the Act of 1922 are still largely in effect, it does not appear that present duties, except in a few instances presently to be mentioned, are regarded by their sponsors as conforming to the "true principle." In the hearings, however, cost statements played a large part. Most of these statements had to do with domestic costs only, though in some instances attempts were made (chiefly by citing wage rates) to show that foreign costs were lower than domestic. In these hearings, as in earlier ones, witnesses frequently adverted to the higher wage rates in the United States as compared to foreign countries, as if costs per unit of production must necessarily be higher at home than abroad if wage rates per day or per week are higher. The frequency with which this notion is tacitly endorsed in the tariff hearings well illustrates the inability or unwillingness of the American public to grasp the fact that certain commodities have been and can be produced more cheaply in the United States than elsewhere despite higher wage rates here—that the efficiency of labor is frequently more significant than its cost per day.

The Act of 1922 was of particular significance for its provisions respecting the investigation of costs by the Tariff Commission. Heretofore the Commission might investigate costs, but the results of its inquiries might be ignored altogether. Under the present law, however, the President is authorized, in the so-called "Flexible Provision" (Section 315), to proclaim changes in the duties set forth in the Act of 1922 if an investigation of comparative costs by the Tariff Commission shows that changes are necessary in order to equalize costs of production at home and abroad. Equalization of costs may legally be secured either by (1) changing the classification of an article so as to make it dutiable under a different rate; (2) changing

the basis of assessing the rate of duty from the foreign to the domestic value of the article; or (3) changing the rate of duty. In no case must the change exceed 50 per cent; transfers must not be made from the free list to the dutiable or vice versa; and ad valorem rates must not be made specific and vice versa. A cost investigation by the Tariff Commission must precede all changes. We need not inquire into the reasons why Congress delegated to the Executive the power of altering duties, circumscribed though that power might be by the legal limit of 50 per cent on changes. Mr. Page regards the flexible provision as "the result partly of a state of nerves and partly of a disagreement between the Senate and the House of Representatives as to what the proper sedative for the state of nerves should be"—as "a temporary excrescence on our commercial policy . . . regarded as such when it was adopted."¹ But that the public was as little pleased with a definite step toward rendering the "true principle" effective, as Mr. Page apparently supposes, may well be questioned. The "true principle" has never been acclaimed by economists; it has apparently lost rather than gained adherents in official circles; but it seems still to retain its popularity.

The actual procedure under the flexible provision is as follows. The Commission receives complaints, from whatever source, that particular duties are too high or too low. By means of a preliminary inquiry it determines whether or not the complaints appear well founded; if so, an investigation of costs is ordered. Preliminary reports of the findings are compiled and circulated, and public hearings are held. Thereafter, the Commissioners compile a final report to the President, recommending such change in the duty as the evidence suggests is legally required. The President may proclaim the recommended change if he sees fit; but he is not bound to do so.

¹ *American Economic Review, Supplement*, March 1926, XVI, 192.

Up to November 1926, the Tariff Commission had ordered thorough investigations to be undertaken on the comparative costs of producing 12 agricultural products: wheat (wheat flour and millfeed also), sugar, butter, Swiss cheese, live bob-white quail, milk and cream, peanuts, soy beans, cottonseed, onions, flaxseed, and eggs and egg products.¹ Final reports to the President have been prepared with respect to wheat and wheat products, live bob-white quail, sugar, and butter. The President proclaimed increases in the duties on wheat, wheat flour, and butter; decreases in the duties on live bob-white quail² and on the by-products of wheat milling; and no change was made in the duty on sugar. In 1927, therefore, it appears that five out of something more than 200 dutiable agricultural products listed in the tariff now effective are dutiable at rates supposed to represent accurately the difference between foreign and domestic costs of production. The rates on the remaining dutiable agricultural products may or may not be intended to equal the difference between domestic and foreign costs; and they may or may not actually equal the difference. About these matters nothing conclusive is known. The presumption is, however, that a Republican Congress felt that the rates at least equalled differences in costs—perhaps exceeded them by indeterminate amounts. With respect to the relationship between actual differences in costs and existing rates, the presumption is simply that the rates have remained stable, while differences in costs must

¹ The list excludes halibut, which need not for our purposes be defined as an agricultural product; and also a few products upon which only preliminary investigations were ordered. Applications were received for changes in the rates upon a long list of commodities, but the Commission regarded investigations as justified in only the few instances cited. Precisely why some applications receive attention, and others not, is not a matter of record.

² The reduction of the duty on quail, like the duty itself, may be regarded as mere "solemn nonsense," a gesture apparently intended to convince the public that the flexible provision does not always result in increased duties under a Republican Congress and Administration.

have fluctuated; and whether or not there has at any time been any correspondence between rates and differences is quite impossible to say.

It is clear that the popular conception of a set of tariff duties exactly equal to differences in the domestic and foreign costs of producing the articles upon which duties are affixed has in fact never attained reality. Even in recent years there have been but few attempts even to ascertain the cost differences required under the true principle. As a practicable principle in tariff making the cost equalization doctrine appears to be discredited by its historical record; after twenty years of popularity it would seem that it would have been more frequently utilized if the doctrine were suitable for, and susceptible of, general application.

THEORETICAL CRITICISMS OF THE COST EQUALIZATION DOCTRINE

Economists have almost uniformly characterized the cost equalization principle as both unsound and impracticable; and their arguments remain valid in the light of recent experiences. Critical discussions have commonly touched upon the problem of erecting a cost-finding body of some sort which would be free from partisan or doctrinaire bias.¹ But, though this problem is unquestionably of major importance, it need not be examined here. We may assume for purposes of theoretical discussion that the ascertaining of differences in foreign and domestic costs rests with an impartial and disinterested body, empowered by law to alter, erect, or abolish tariff duties whenever a thorough cost inquiry indicates that a change is necessary in order to equalize costs of production at home and abroad. Whether or not such a commission would find rigid application of the cost equalization prin-

¹ See especially the discussions by Taussig, Bernhardt, and Page in *American Economic Review, Supplement*, March 1926, XVI.

ciple either appropriate or feasible is the question to which economists have chiefly addressed themselves; and it is the question—particularly with respect to the determination of appropriate rates of duty on agricultural products—which concerns us here.

The most important single indictment of the doctrine lies in the contention—essentially the free trader's position, best stated by Professor Taussig—that its thoroughgoing application must result in an extreme of protection. Unflinching application of the doctrine must result in encouragement of the domestic production of anything and everything, regardless of the suitability of natural and economic conditions of production; for, according to the principle, the greater the American disadvantage in production, the higher the duty must be. And yet the cost equalization doctrine has always been represented as a device certain to result in moderate rates; it is not endorsed by extreme protectionists. Adherents of the doctrine apparently cling to the ancient protectionist dogmas that domestic production of any commodity is in itself desirable, and that high wages in the United States have not only resulted from the tariff but cannot be maintained without it. The free trader's argument that a nation gains by concentrating its resources on the production of those commodities in which it is relatively efficient is utterly ignored.

It may be doubted that advocates of the cost equalization doctrine would actually endorse duties high enough to equalize domestic and foreign costs of producing many tropical products—coconuts, bananas, coffee, and the like. Differences in natural advantages in the production of many other articles, and hence differences in costs of production, might, and probably would, appear even to extremists as too great to justify application of the doctrine. If customary domestic consumption of an article could not be satisfied at approximately the ruling prices,

because no duty of whatever height promised to bring forth domestic investment in a project palpably absurd, it is questionable if a duty equaling the difference in foreign and domestic costs would be supported by anybody. Much the same may be said of duties on unimportant articles of consumption, in the production of which only trivial investments already exist. Nevertheless, the unqualified cost equalization doctrine calls for protection in this form, and implies nothing respecting the nature or use of the articles to which it is apparently to be applied. As a doctrine susceptible of general application, it clearly ignores the fundamental questions regarding what commodities ought to be encouraged, why, and how far. It fails to meet the free trader's fundamental arguments at any point.

As Dr. Page has pointed out, general application of the doctrine cannot be made consistent with other general policies respecting the encouragement or restriction of international trade. Are there industries which ought to be encouraged because of their vital importance in case of war? If so, will adequate encouragement result from duties equal only to the difference between foreign and domestic costs; or ought the duties to be higher, if only to hasten development? Are there "key" industries which require more than equalized money costs in order to develop as rapidly as may seem desirable? Ought costs to be equalized for products which cannot conceivably be produced at home in adequate supply—certain minerals, for example? Ought duties equal to differences in costs to be placed upon lumber and petroleum, among others, when conservation policies have been prosecuted for years? Ought not the question of monopoly, whether at home or abroad, to be considered? Of these matters, largely of recognized importance, the cost equalization doctrine says nothing. Dr. Page concludes that the field in which the doctrine may be applied, in view of contra-

dictory policies of long standing, is decidedly restricted. It appears at best as a doctrine necessarily subject to numerous and important exceptions, one which cannot conceivably be employed as a quasi-automatic solution of the tariff problem.

To these fundamental theoretical criticisms little can be added. It is of interest, however, to observe that a tariff policy based on the cost equalization principle and an agricultural policy including governmental efforts to increase farm efficiency are not altogether consistent. The tariff on agricultural products has among its objects that of eliminating the necessity for farmers to dread foreign competition. So much, at least, is implicit in tariff theory; the form of competition is to be minimized if it exists. In strict logic this can only mean that American farmers need not attempt to reduce their costs because of competition from abroad, though they may seek to do so for other reasons. Broadly viewed, the cost equalization doctrine tends to put a premium upon American inefficiency.

The Tariff Commission's recent report on Danish and American costs of producing butter provides a case in point. Danish costs were found to be lower than American by 11.92, 10.58, 13.57, or 14.95 cents per pound laid down in New York, depending on the manner in which costs were calculated and conversion was made from Danish to American currency. But production of milk per cow per year on the American farms from which cost data were obtained was only 4,872 pounds, while in Denmark production per cow on the farms included in the inquiry was 6,590 pounds. These figures, though not strictly comparable, may be accepted as of sufficient accuracy. Whether or not this difference may be attributed to superior efficiency on the part of Danish producers is not strictly determinable; but it is highly probable. It is apparent that the tariff, based upon differences in Danish

and American costs, must be regarded as something of a premium on American inefficiency. Yet the United States Department of Agriculture, by investigations in both farm management and animal husbandry, has for over twenty years sought to convince American farmers that higher production of milk per cow was both profitable and possible, if only reasonable attention should be given to breeding and to the elimination of "boarders." In view of the current active campaign for improvement in the United States, it would appear that the agencies responsible for changing the duty on butter from 8 to 12 cents might well have given some attention to the difference in yield in the two countries. Yet neither the President nor the Tariff Commission is specifically directed to consider such matters; and the current doctrine ignores them altogether.

PRACTICAL OBJECTIONS

Many advocates of the cost equalization doctrine apparently regard their solution of the tariff problem as automatic—a mere matter of simple arithmetic, involving nothing more difficult than the ascertainment of costs at home and abroad, and the subtraction of one figure from the other. Critics of the theory have not failed to point out that the process of ascertaining costs is by no means simple. The list of commonly recognized difficulties necessarily to be encountered in securing the desired figure is impressive. With accounting principles not clear on the definition of cost items, the valuation of non-cash items of cost, and the allocation of costs among joint products; with wide variation in costs giving rise to dispute regarding the proper choice of an average; with bookkeeping so uncommon that accurate records are largely unobtainable; with foreigners presumably unwilling to provide accurate data if they could; and with enormous expenditures of public funds required in order to conduct any

appreciable number of investigations—it would appear that tariff making by cost determination could never be expected to prove either quasi-automatic or scientific or generally practicable.

Further difficulties confront the Tariff Commission experts in the execution of a cost investigation under the law. The commodity to be investigated must be defined; and in view of numerous grades within a commodity such as wheat, butter, sugar, or meat, definition is not easy because it may be utterly impossible to secure costs for the single grade in question, as distinguished from other grades, or because the imported grade is not actually produced domestically. Furthermore, the law calls for the determination of costs in the principal competing country; and when there are several competing countries, the selection of the principal competitor may rest on uncertain grounds. One country may be the principal competitor in one year, another in the next. In the Tariff Commission's recent investigation of butter, Commissioner Costigan in a dissenting argument regarded Canada, not Denmark, as the principal competing country. Occasion may arise, moreover, when it is not easy to designate the precise American market from which costs shall be measured (including transportation costs, which have been ruled by the Attorney-General as a necessary part of the costs to be investigated by the Commission). These difficulties are real, though presumably significant with respect to some commodities and not to others; and they add to the weight of the general argument against the cost equalization doctrine. But they need not be discussed here, largely because they are difficulties likely to be encountered in any rational inquiry into problems of rate making.

The experience of the Tariff Commission seems on the whole not to have justified the contention that foreigners would refuse to furnish information or would falsify what

they furnished.¹ Nor is it altogether certain that the expense of cost investigation would prove prohibitive if the information secured appeared satisfactory. These objections may be dismissed as of minor importance. If the utmost precision is sought by adherents of the doctrine, it seems clear that inaccuracies arising from problems of valuation and allocation must make the procedure unsatisfactory; but that the utmost accuracy is sought seems improbable. The desired end is rather to institute a procedure as much more accurate and objective than log-rolling as can be achieved. Consequently critics may readily be placed on the defensive by the argument that, given consistency in applying principles of valuation and allocation in the process of securing data from both countries, the resulting arrays of large numbers of individual costs would be sufficiently accurate for practical purposes; they would at least provide the raw material for measuring roughly the competitive advantage held by one country over another.

This argument carries some weight. If, for example, labor constituted a much higher proportion of total money costs per unit abroad than at home, the use of high valuations on labor would result in a somewhat lower duty than the use of low valuations, and similarly if all items of cost were valued at the highest possible rates rather than the lowest possible in both countries. Accounting principles would probably prove of varying significance as different commodities were investigated. But on the whole it seems unlikely that widely different results would often be obtained merely from varying the bases²

¹ Early in 1928, however, it was reported in the press that Argentinians had not heartily welcomed a projected investigation of the cost of corn production in Argentina.

² The present writer does not wish to minimize the significance of accounting procedures in calculating tariff duties. Much, however, has been said of the difficulties involved, not only in the present study, but also in other sources (see Bibliographical Note); and it seems desirable here to emphasize other problems.

of valuation and allocation in the process of determining comparative costs of particular commodities. More significant problems arise with respect to the length of the period for which cost data ought to be secured, the inclusion or exclusion of land rent as a cost, and the form of average which ought to be employed in arriving at the final figures.

Exactly what ideas are held by adherents of the cost equalization doctrine respecting fluctuations in the difference between foreign and domestic cost is not altogether clear. But in general the notion appears to have prevailed that the tariff ought to be made to equalize permanent differences in costs. President Taft employed the word. The concept of permanent differences is consistent with the common misconception of uniform costs. The majority of the Tariff Commission in the investigation of wheat favored the use of average costs applying to the three years 1921-23 rather than to the single year 1923, and President Coolidge accepted the 1921-23 figures.

It is obvious that differences in cost of any sort cannot be supposed to be permanent as between periods in which the general levels of prices have fluctuated widely, and in different directions or to different degrees. No one, perhaps, believes in the persistence of a given difference in foreign and domestic costs over a period of one hundred years. But in a briefer period, say twenty or thirty years of peace, in which the exchanges are stable and movements of the general price level small, are permanent or semi-permanent or normal differences in cost of production likely to prevail? Clearly not in certain commodities which are suddenly subjected to new processes of production as a result of improved technical devices. The impact of the new methods would presumably fall earlier and more heavily in one country than in another. But improvements are effected more slowly in agriculture than in industry, and we may disregard this influence.

Nevertheless the assumption of semi-permanent differences in costs is not too well founded even with respect to agriculture. In one year yield per acre may be high in one country, low in the other; in the next year the situation may be reversed. Yet total outlays, under the conditions we have assumed, may not be appreciably different in each country as between the two years; consequently cost per unit of product may in one year be higher in country B than in country A, while in the next year the reverse proves true. The difference in cost, far from remaining at the same figure, may fluctuate widely, or disappear, or change its incidence. This possibility is of course of greatest significance with respect to products of widely variable yield—field crops as compared with tilled crops, tilled crops as compared with animal products. But even the costs of animal products are subject to variation because of epidemic diseases prevalent perhaps in one country but not in the other.

If semi-permanent differences in costs are sought, then it becomes necessary to choose some definite period of years unless a single year can be designated as normal. Few students would venture to describe a normal year in agricultural production. Fewer still can feel assured that a recent period will provide a reasonably accurate picture of a period to come. A practical illustration of the general problem appears in the present duty of 42 cents on wheat. The duty was based on a comparison of Canadian and American costs for the period 1921–23. If it had been based on the period 1921–24, a duty of about 12 cents would probably have appeared to be appropriate, on account of the variations in Canadian and American yields per acre.¹ What it would be for the period 1921–28 or 1921–31, no one can say.

The only known method of securing cost data from

¹ For the calculations resulting in the figure of 12 cents for 1921–24, see *WHEAT STUDIES OF THE FOOD RESEARCH INSTITUTE*, May 1925, I, No. 6.

large groups of farmers involves investigation in the year in which costs are incurred, or at least not much later. No one would expect farmers to remember their costs of five years ago. Consequently, if semi-permanent differences in costs are to be secured, for general application of the cost equalization doctrine, there must be long-continued investigation of over a hundred commodities. Such a procedure is too absurd to require comment. Furthermore, duties based upon long-time averages would be appropriate only over long periods, not in particular years. The alternative procedure of calculating duties anew each year appears equally impracticable. The machinery requires time to work, and few people desire constant disturbances in rates. Conceivably some cheap and simple procedure could be devised to calculate approximate differences in costs once yields were known; but such a procedure would scarcely be appropriate under the present law; it would probably not be acceptable even to adherents of the cost equalization doctrine; and it would presumably result in as frequent changes in duties as would appear necessary if extended inquiries were undertaken every year. The absence of stable differences in costs thus renders tariff making by cost determination impracticable and unsatisfactory from every point of view.

Whether or not land rent should be included as a cost for tariff-making purposes is a problem of theoretical though not of practical interest. Land rent is treated by economists as an equalizing influence, on the ground that those producers whose other costs are low will receive a differential return, or will pay a land rental, sufficient to bring their total costs up to the level of the costs (excluding rent) incurred by producers less favorably situated. In an assumed agricultural society composed of tenant farmers and landowners, the tenants whose costs excluding rent were low would be willing to pay higher rentals

than those tenants whose costs excluding rent were high; and the tendency would be for costs including rent to be the same for each producer. Actual cost data applicable either to single years or brief periods of years, however, show that costs including land rent vary among producers in practically the same way as costs excluding land rent.¹ The difference between average foreign and domestic costs would apparently be of about the same size whether or not land rent was reckoned as a cost, provided data were secured for only a brief period of years: there is no difference in the results of subtracting \$1.50 from \$2.00 or \$1.00 from \$1.50. If a twenty- or thirty-year period were chosen, it might appear that costs including land rent approached uniformity among the producers in each country, and that the difference between average costs proved small or negligible. Such an outcome would be probable if the process by which economists conceive land rent to work as an equalizer were entirely effective. But how long a period would be required to effect such an outcome is utterly uncertain; and in any event it seems unlikely that cost data applicable to periods as long as twenty years will ever be employed in tariff making. The inclusion or exclusion of land rents in cost is therefore of minor importance in the practical application of the cost equalization doctrine.

The question of the appropriate form of average to be chosen in reducing arrays of individual costs to single figures has attracted considerable attention, since different rates of duty can be secured by the use of different averages. Discussion has centered chiefly about the relative merits of the weighted arithmetic average and the bulk-line figure, the median, mode, simple arithmetic average, or the less familiar forms of means being ignored. The Tariff Commission, using a weighted arith-

¹ See the Tariff Commission's *Wheat and Wheat Products*, tables on pp. 62-65, and *Costs of Producing Sugar Beets: Part I—Michigan*, chart on p. 42.

metic average, found that Canadian farm costs of wheat production were 33 cents lower than American for the period 1921-23.¹ If a bulk-line figure, the bulk of production being defined at 90 per cent, had been used, Canadian costs would have appeared roughly 58 cents lower than American. Using 1923 costs, the Commission found a difference in favor of Canada of 52 cents. Had the bulk-line cost (at 90 per cent of production) been used, the difference would have been roughly 80 cents.² Using a bulk-line figure at 95 per cent of production, the differences in 1921-23 and 1923 costs respectively would have been about 82 cents and 99 cents. There is no established rule respecting the proportion of production which the bulk-line figure must cover; the selection is arbitrary. The duty on wheat would have been higher had it been used, and this is the probable outcome with respect to most agricultural products. But the difference between two bulk-line figures as compared to the difference between two weighted averages depends upon the relative shape of the two cumulative cost curves; and wider experience might show that for some commodities the use of the bulk-line figure would result in lower duties than the use of the weighted average. For tariff-making purposes, it is apparent that the choice of one form of average over the other must depend not upon general scientific principles, but upon the degree of protection desired and the political pressure brought to bear upon the selection of the higher or the lower rate.

A further argument for use of the bulk-line figure has been advanced respecting the necessity for protecting a relatively large rather than a relatively small proportion of the individual domestic producers. It would appear, for example, that the higher duty obtained through use

¹ This was the difference in *farm* costs, not in costs including transportation charges.

² See *Wheat and Wheat Products*, charts on pp. 8, 9.

of the bulk-line cost comparison would protect a larger number of producers than would the use of the comparison of average costs. In general this proposition is scarcely open to dispute. But valid conclusions can be stated only in the most general terms, since, as appeared above,¹ high-cost producers in one year may be low-cost producers in the next. The response of producers to increased or diminished duties is thus necessarily far more uncertain than might otherwise be assumed. Neither the extent to which domestic prices would be raised or lowered by a change of duty, nor the degree to which production of a commodity could be expected to expand or contract in response to a change, are matters ascertainable by any known methods. One may properly conclude that a given increase in duty will probably increase production in most instances, but one cannot often say how much. The fact that changes in costs occur on individual farms as between different years is important because it complicates a problem already extremely difficult. Any calculation, based upon the assumption that a particular group of producers will act in a predictable manner because they are known to be high-cost producers, is necessarily subject to a wide margin of error, though the general truth respecting the response of production to changes in relative prices may be accepted.

In conclusion, it appears that tariff making by cost determination as applied to agricultural products is unsound in theory and impracticable as a quasi-automatic device. The cost equalization doctrine ignores altogether the fundamental tariff problems, what industries shall be protected and why. It conflicts with other established policies, such as conservation of natural resources and encouragement of efficiency in production. It has not in fact been applied, in more than a few instances, despite its popularity of more than twenty years. It is essentially

¹ See pp. 87-98.

an extreme protectionist doctrine, not, as its adherents have argued, a device insuring moderate duties. In practice the difficulties of ascertaining costs have loomed impressively numerous. Of these the most significant appears to be non-existence of permanent or semi-permanent differences in the costs of producing commodities at home and abroad. The differences must fluctuate widely, and the rates of duty, if determined on the cost equalization principle, ought to fluctuate similarly. But this constitutes a situation presumably not acceptable, even to ardent adherents of the doctrine.

BIBLIOGRAPHICAL NOTE

A mass of first-hand information on the use of agricultural cost data in tariff making is available in *Tariff Hearings* held chiefly before the House Committee on Ways and Means some weeks before the passage of the several Acts. Original statistical data appear in official reports of investigations by the United States Tariff Board and the United States Tariff Commission. Of the Tariff Board's investigations, the *Report on Wool and Manufactures of Wool* (2 vols., 1912) alone deals with a farm product. Of the Tariff Commission's investigations, in addition to its *Annual Reports*, the following, arranged in chronological sequence, deal with farm products:

Cost of Production in the Sugar Industry (Tariff Information Series No. 9), 1919.

Agricultural Staples and the Tariff (Tariff Information Series No. 20), 1920.

The Wool-Growing Industry, 1921.

Cattle and Beef in the United States (Tariff Information Series No. 30), 1922.

Sheep and Wool Production in Argentina, 1922.

Wheat and Wheat Products, 1924.

Sugar, 1926.

Butter, 1926.

For discussions of duties on specific products, see three books of the Institute of Economics series of Investigations in Interna-

tional Commercial Policies: Philip G. Wright, *Sugar in Relation to the Tariff* (New York, McGraw-Hill, 1924); Mark A. Smith, *The Tariff on Wool* (Macmillan, New York, 1926), especially chapter viii; and Lynn R. Edminster, *The Cattle Industry and the Tariff* (New York, Macmillan, 1926), especially Appendix A. Some comment on the tariff on wheat appears in *Farm Costs of Wheat Production in the North American Spring-Wheat Belt*, WHEAT STUDIES OF THE FOOD RESEARCH INSTITUTE, May 1925, I, No. 6.

Arguments in favor of tariff making by cost determination are few and usually surrounded by qualifying phrases. Perhaps the best idea of the general argument is to be obtained by reading the following articles as a group:

BERNHARDT, JOSHUA. "The Flexible Tariff and the Sugar Industry," *American Economic Review, Supplement*, March 1926, XVI, 182-91.

EMERY, HENRY C. "Economic Investigation as a Basis for Tariff Legislation," *ibid.*, March 1912, II, 19-26.

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MILES, H. E. "Tariff Making—Fact and Theory," *Annals of the American Academy of Political and Social Science*, September 1908, XXXII, 399-408.

WELD, L. D. H. "'Costs' and the Tariff Board," *Journal of Political Economy*, May 1912, XX, 492-508.

For the case against the use of cost statistics in tariff making, see the following:

PAGE, THOMAS WALKER. *Making the Tariff in the United States* (Institute of Economics, Investigations in International Commercial Policies), New York, McGraw-Hill, 1924. Chapter iv is especially significant.

TAUSSIG, F. W. "Cost of Production and the Tariff," in *Free Trade, the Tariff, and Reciprocity*, New York, Macmillan, 1920.

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WILLIS, H. PARKER. "Costs and Tariff Revision," *Journal of Political Economy*, May 1911, XIX, 361-84.

———. "Economic Investigation as a Basis for Tariff Legislation," *American Economic Review, Supplement*, March 1912, II, 19-26. This issue of the *Review* in addition to articles by Profes-

sors Emery (see above) and Willis, contains a discussion by E. V. Robinson.

More recent articles bearing directly or indirectly on the work of the Tariff Commission in ascertaining agricultural costs are as follows:

SCHULTZ, HENRY. "Cost of Production, Supply and Demand, and the Tariff," *Journal of Farm Economics*, April 1927, IX, 192-209.

SIMPSON, KEMPER. "Average or Marginal Costs for the Flexible Tariff?" *Journal of Political Economy*, August 1926, XXXIV, 514-24.

TAUSSIG, F. W. "The United States Tariff Commission," *American Economic Review, Supplement*, March 1926, XVI, 171-81. This issue of the *Review*, in addition to Bernhardt's article (see above), contains valuable discussions by T. W. Page, F. R. Rutter, F. D. Graham, and E. P. Costigan.

CHAPTER XIII

CONCLUSIONS

We are now in a position to summarize briefly our conclusions respecting the value of farm cost investigation in the United States. The outstanding facts are that statistics of money costs per unit of product have proved to be less useful than has been supposed for any of the purposes for which they have been collected, and that the considerable effort and expense which have gone into the collection and analysis of such data have largely been ill-spent. Statistics of money costs per unit of product are of negligible value in a program intended to increase farm efficiency; they contribute next to nothing to the theory of cost-and-price relationships in agriculture; and they do not provide a sound basis for price fixing or for tariff making. Such data as are of value for farm management purposes are not statistics of money costs per unit of product.

Statistics of money costs of production are inherently untrustworthy. Money cost data can be compiled only by the adoption of certain arbitrary rules of accounting procedure. It is impossible by any method definitively to separate charges for interest from charges for rent of land, and certain elements of cost, notably interest on growing crops and wages of management, are usually omitted because calculation is in effect impossible. Joint products are so numerous in agriculture that allocation of costs becomes a serious problem; yet allocation must be made on some arbitrary basis. Non-cash cost items predominate in agriculture, and valuations have to be made on uncertain bases. These difficulties of accounting procedure are so numerous and significant that practically no

farm cost study can be found to which reasonable objection cannot be raised regarding the accuracy of the data; and, since a coherent and generally accepted body of farm accounting principles has never been developed, few investigations are properly comparable with one another. Conclusions of any sort drawn from statistics of money costs must therefore be scrutinized with care. Careful scrutiny is all the more essential because the methods of collecting data which yield a satisfactory statistical sample are inherently inaccurate, while methods yielding the most accurate data usually cannot provide a satisfactory sample. In general it appears that, in instances where farm cost statistics have been intended to portray the sort of costs upon which farmers calculate in determining whether to increase or decrease production, the costs portrayed have been inflated by the inclusion of rent of land as a cost, by charging home-grown feed at market prices, and by over-valuation of items such as operator's and family labor, wages of management, and interest.

Farm costs of production, whether money costs or quantitative costs, vary widely from farm to farm and area to area in the same year, and from year to year on the same farms or in the same areas. It is erroneous to suppose either that farmers in a homogeneous area incur uniform or nearly uniform costs, or that the low-cost producers of one year remain low-cost producers in the next year. Variety, not uniformity, is characteristic of farm costs of production. Consequently average costs are not to be accepted as representative, and conclusions drawn from comparisons of average costs are usually questionable. There is reason to believe, though conclusive proof does not exist, that both differences and changes in costs are due quite as largely to uncontrollable natural causes—weather, diseases, and pests affecting costs through yield—as to causes controllable through good

management. Farm management investigators appear not to have treated this possibility or its significance with the attention it deserves.

It seems desirable to reconsider present proposals for a program of work in the field of farm management. The notion that farmers in restricted areas all over the United States can and ought to be told by investigators what to produce and how to produce is far too ambitious a proposal in view of the inherent difficulties of the problem. Money has already been wasted in farm management investigation, especially by wide use of the route method; and the conclusions obtained through the other hitherto popular method of collecting data, the survey method, have in great part failed to carry conviction. It would be desirable in farm management investigation not to endeavor to undertake to set forth specific suggestions to farmers on what and how to produce in every state. For the facts that even quantitative costs of production differ widely from farm to farm, change from year to year on the same farm, and are in large part not subject to control render the erection of production standards a hazardous procedure; and the investigator who properly informs farmers what to do in the future must know what prices and yields as well as costs are going to be in the future. Investigators cannot yet hope to solve the farmers' problems in planning for future operations, and it would be desirable to admit the fact frankly.

Something, however, can be done toward increasing farm efficiency through work with farm accounts. The first essential of a desirable program for work in farm management is development of co-operation with farmers. The expensive route method ought in large measure to be abandoned as a part of a program; the survey ought in some instances to be made less elaborate, in others more elaborate. The nucleus of a desirable program would be organized effort to teach simple accounts to

farmers, and the establishment of co-operative farm management services (of which an example exists in Illinois) in which farmers bore the greater part of the expense for supervisors. These supervisors might be aided in their work by the collection of data on new machinery and methods, by correlation analyses of the factors affecting profits, by type-of-farming studies, by local market surveys, and by broader studies of trends in production, prices, and consumption. A program so constituted does not place upon investigators the burden of fulfilling promises impossible of fulfilment. It is less ambitious than the program now in vogue, but in the long run bids fair to yield better results. It leaves full scope for progress in research of a scientific nature, but it has the merit of placing the work of the efficiency expert closely under the eye of the farmers for whom such work is intended. In common with the program now in use, it relegates the collection and analysis of money costs of production to an unimportant position.

Farm cost statistics contribute little to the general theory of cost-and-price relationships in agriculture. Farmers and farm cost investigators often fail to grasp important doctrines of accepted economic theory. In the literature of farm costs there has been a notable tendency to ignore the fact that theorists do not regard cost prices as "fair" *market* prices; to forget that costs of production are significant only for a long-time theory of price; to misinterpret the economist's reasons for excluding rent of land as a cost; and to misunderstand the theorists' concepts of varying cost and a marginal producer or product. Such statistics of farm costs as have been gathered have practically no bearing upon the doctrine of cost-and-price relationships as set forth by theorists, because the statistical cost curves have not been and cannot be made fairly comparable with the cost curves employed by theorists. Statistical cost curves involve a different definition of cost

from the economists' definition; they are not erected on the fundamental postulate of the existence of a law of diminishing returns; and they cannot be compiled to give expression to the fact that costs of production not only differ between establishments, but also between different increments of the product of each establishment. Indirectly, however, statistical investigation of farm costs has served to show that farmers expand and contract their production following cost-and-price calculations considerably more obscure and uncertain than the theorists apparently assume. It has further provided grounds for believing that there is a considerable difference in the elasticity of supply for different products, and that, in general, expansion of supply takes place more rapidly than contraction.

Price fixing on the basis of cost of production has often been proposed but seldom attempted. Advocates of price fixing have usually envisaged the fixation of market prices over short periods, and have conceived that bulk-line costs, not average costs, should be selected as indicators of appropriate prices. The major difficulty in price fixing is to foresee what effect the fixed price will have upon the volume of supply. Cost statistics are of no assistance in solving this problem, and they are not relevant to the fixation of market prices, upon which costs have only a remote influence. The bulk-line theory does not indicate with any precision what cost ought to be selected as the cost to which price should conform. In most investigations the whole statistical cost curve has been elevated by the calculation of costs higher than the costs which farmers must employ in determining whether to expand or contract production; and the designation of a single cost figure as the bulk-line cost is an arbitrary matter, yielding different results as different points on the curve are chosen. The bulk-line theory is fallacious in that it ignores the fact that costs of production change from year to

year. Cost statistics are in fact entirely useless in providing a "scientific" basis for the fixation of market prices.

For more than twenty years it has been thought that tariff duties on agricultural as well as other products might be scientifically determined by ascertaining the difference between costs of production at home and abroad. Yet only seven agricultural products out of well over 200 on the dutiable list bear duties which have been based definitely upon cost investigations. The cost equalization doctrine ignores altogether the major problem of tariff making—what industries and products shall be protected, and why. It is inconsistent with other established policies, notably conservation of natural resources and encouragement of efficiency in production. It is a theory apparently based upon the assumption that differences in costs of production between countries remain the same from year to year; but this assumption is unsound. Duties of different sizes on a single commodity can be secured if different accounting principles and different types of averages are employed, and generally acceptable principles or averages have not been developed. Consequently cost statistics can contribute little to the problem of tariff making.

These conclusions are largely destructive. Yet it is hoped that a reconsideration of objectives and attainments in the field of farm cost investigation may prove useful. Something may be gained by clarification of current notions respecting the significance of farm cost statistics. Merely to point out the limitations of farm cost statistics may assist in directing attention to more promising methods of attack upon important economic problems as well as to emphasize the fact that certain problems of cost-and-price relationships are more difficult than has often been supposed.

APPENDIX

CORRELATION ANALYSIS IN FARM MANAGEMENT RESEARCH

I

Within the past few years there has been an increasing disposition among experts in farm management and agricultural economics to employ elaborate forms of the correlation analysis as the best method of conducting research in farm management. A major aspect of the problem to which farm management investigators address themselves is that of evolving certain generalized statements respecting the factors affecting farm profits in well-defined areas. Such investigation has been conducted for many years, until recently by the device of "cross-tabulation" or "grouping and averaging"—that is, by carefully contrasting in tables the variations in "profits" successively with variations in such factors as the size of farms, yields, receipts from various crops, and the like.

It is now proposed largely to abandon the older cross-tabulation analysis, and to substitute multiple correlation analysis, using either the older method which assumes linear relationships between the variables, or a modified method permitting the use of curvilinear relationships. There can be no question that the methods of multiple correlation properly applied may yield much information which cannot be obtained by the cross-tabulation method. In particular, it permits a simultaneous determination of the separate effects of several related factors where the cross-tabulation method, like a simple correlation, attributes to a single factor the effects of that factor plus a part of the effects of all other factors that happen to be correlated with it.

But questions may well be raised regarding the usefulness of the partial or multiple correlation analysis to serve the general purpose of farm management research. This purpose is not merely to explain last year's profits on a specified group of farms, but also to lay down generalizations valid over periods of years concerning the relationship between profits and the factors affecting profits, and further to point out specifically to farmers what they ought to do to secure higher profits. The last is the true or ulti-

mate objective. Obviously it cannot be attained unless the first two steps in the analytical process are successfully undertaken.

Little has been written in criticism of the proposal to employ the partial correlation analysis in farm business analysis surveys. The literature on the subject has thus far dealt largely with exposition of the method and development and testing of the device, and it has emanated chiefly from advocates of the method. Yet there are certain significant limitations on the general procedure which might well be more clearly recognized, especially since farm management is a field of investigation wherein standardization of analytical methods proceeds rapidly through the influence of the United States Department of Agriculture. The adoption of the partial correlation analysis in farm management research has been urged by influential members of the Department. But in the judgment of the present writer it is a device at once too complicated, expensive, and uncertain to justify its adoption generally throughout the various research agencies, though it may well prove to be the most satisfactory of available methods in the hands of a few qualified investigators working on a mass of really adequate data. It seems desirable here to point out certain of the more obvious difficulties in applying the partial correlation analysis to farm management data.

II

Although the systematic collection and analysis of farm cost data began in 1902, correlation analysis was not proposed until 1917. In that year Tolley¹ urged its adoption in a publication explaining, with illustrations, the methods of computing both gross and net coefficients (linear). For several years the proposal seems to have received little attention, but, beginning with 1923, discussion and use of the correlation method became more common. Taylor,² in a journal article, discussed a partial correlation analysis of data from 965 farms in Iowa, and stressed the importance of employing partial rather than gross correlation because of the inter-relationship usually existing between the factors affecting farm profits. A few months later Ezekiel³ discussed rather

¹ H. R. Tolley, *The Theory of Correlation as Applied to Farm-Survey Data on Fattening Baby Beef* (U.S. Department of Agriculture Bulletin 504), May 1917.

² C. C. Taylor, "A Statistical Analysis of Farm Management Data," *Journal of Farm Economics*, July 1923, V, 153-62.

³ M. Ezekiel, "The Use of Partial Correlation in the Analysis of Farm Management Data," *Journal of Farm Economics*, October 1923, V, 198-213.

thoroughly, on the basis of the same data employed by Taylor, the general problems of farm profits analysis by the correlation method. He showed its superiority to the customary "grouping and averaging" or "cross-tabulation" method, endorsed Taylor's contention that partial correlation was necessary, demonstrated the need for careful definition of the variables, laid down general rules for the use of the method, and indicated the need for some means of handling partial correlations when relationships were known to be not rectilinear, but curvilinear—a situation to be expected in agriculture, where the law of diminishing returns operates. Ezekiel and Tolley¹ toward the end of 1923 explained in a technical paper a short method for computing the coefficients of net correlation and the multiple correlation coefficient, thus lessening the labor of computation to such a degree that the handling of many variables became feasible. Linear relationships were assumed.

Early in 1924 Ezekiel published a preliminary report on an analysis of farm management data from a dairying region in Pennsylvania; but although the author employed correlation analysis, this preliminary statement made no reference to the method. A few months later Tolley and Mendum again explained the use of simple rectilinear correlation, laying particular stress upon scatter-diagrams, lines of regression, and regression coefficients.² In September Tolley, Black, and Ezekiel outlined, in an important bulletin, the uses to which partial correlation analysis, both rectilinear and curvilinear, might be put and illustrated the methods to be employed.³ Particular stress was laid upon the use of regression coefficients as forecasting devices, useful in the problem of aiding the farmer to achieve the highest possible future profits. In December Ezekiel⁴ developed (independently of Mills) the index of correlation, and, employing it, demonstrated a method for handling partial curvilinear correlation.

¹ H. R. Tolley and M. J. B. Ezekiel, "A Method of Handling Multiple Correlation Problems," *Journal of the American Statistical Association*, December 1923, XVIII, 993-1003.

² H. R. Tolley and S. W. Mendum, *A Method of Testing Farm-Management and Cost-of-Production Data for Validity of Conclusions* (U.S. Department of Agriculture Circular 307), March 1924.

³ H. R. Tolley, J. D. Black, and M. J. B. Ezekiel, *Input as Related to Output in Farm Organization and Cost-of-Production Studies* (U.S. Department of Agriculture Bulletin 1277), September 1924.

⁴ M. Ezekiel, "A Method of Handling Curvilinear Correlation for Any Number of Variables," *Journal of the American Statistical Association*, December 1924, XIX, 431-53.

Up to this point the development had been chiefly in the perfection of a technique which permitted the application of correlation analysis to a multiple-variable problem wherein the relationships were curvilinear as well as rectilinear, and in the explanation of statistical methodology, illustrated from farm management data. In 1925 direct applications of the method began to appear. In June, Crickman¹ published a study of farm organization and management in Warren County, Iowa, basing it upon surveys taken in 1916 (832 farms), 1919 (477 farms), and 1922 (231 farms). Partial rectilinear correlation was employed, but the details of its use were not made clear until November, in a separate bulletin.² In October Hitchcock³ applied simple linear correlation to survey data obtained chiefly from 189 farms in Vermont for the year 1922-23. In November Taylor and Hurd⁴ employed rectilinear partial correlation in analyzing survey data from farms in Tama County, Iowa (965 farms 1913, 237 farms 1921; correlation was not applied to 210 records obtained for 1918). In the same month Vernon and Ezekiel,⁵ using both rectilinear and curvilinear partial correlation, presented an analysis of records from 258 tobacco farms in Virginia for the year 1922-23, but omitted any detailed explanation of their analytical methods. In October Ezekiel, touching upon a different problem, had employed multiple correlation to demonstrate that operator's earnings constituted a figure more suitable as an index of financial success than labor income or per cent of return on investment.⁶ In April 1926, Ezekiel published in final form the results of an analysis of 422 records obtained from

¹ C. W. Crickman, *Farm Organization and Management Studies in Warren County, Iowa* (Iowa Agricultural Experiment Station Bulletin 229), June 1925.

² C. W. Crickman, *A Partial Correlation Analysis of Farm Organization and Management Data from Warren County, Iowa* (Iowa Agricultural Experiment Station Research Bulletin 89), November 1925.

³ J. A. Hitchcock, *A Study in Vermont Dairy Farming* (Vermont Agricultural Experiment Station Research Bulletin 88), November 1925.

⁴ C. C. Taylor and E. B. Hurd, *Farm Organization and Farm Profits in Tama County, Iowa* (Iowa Agricultural Experiment Station Research Bulletin 88), November 1925.

⁵ J. J. Vernon and M. J. B. Ezekiel, *Causes of Profit or Loss on Virginia Tobacco Farms* (Virginia Agricultural Experiment Station Bulletin 241), November 1925.

⁶ M. Ezekiel, "A Statistical Test of Measures of Farmers' Financial Success," *Journal of Farm Economics*, October 1925, VII, 399-413.

farms in southeastern Pennsylvania.¹ In all these publications there appears only one thoroughgoing attempt (Ezekiel, 1926) to employ the partial curvilinear correlation analysis. The literature consists chiefly of either (1) explanations and illustrations of some form of correlation analysis, intended to show what can be done with the various methods, or (2) thorough analyses, like Taylor's and Hurd's or Crickman's, which employ only rectilinear partial correlation. But curvilinear correlation differs from rectilinear only in so far as it accounts for relationships not rectilinear in nature between variables (indisputably often the case in agriculture); the logical processes underlying the analysis, and the interpretation of correlation coefficients, are essentially subject to the same principles. Since we are here concerned with some of these fundamental principles, we may proceed without special reference to the type of correlation employed. It is to be noted that the correlation analysis, as employed in farm management inquiry, is applied to data for one year only. No attempt has thus far been made to correlate time series.

III

The difficulties in the use of the partial correlation analysis in farm management research may be considered under four heads: (1) The securing of adequate data; (2) The choice of variables; (3) The imputation of causal relationships between variables; and (4) The interpretation of low-value coefficients.

Adequacy of Data.—The partial correlation analysis is one of the most intricate, detailed, and refined methods of statistical procedure, a device which may well be reserved for application only to basic data which may be accepted as reasonably accurate. Questions may be raised regarding the accuracy of the data which are available to farm management investigators.

The first requirement is an adequate number of records, since, broadly speaking, the validity of conclusions drawn from correlation coefficients depends upon the size of the probable errors of the coefficients and probable errors are larger as the number of records is smaller. Even within a relatively restricted and fairly homogeneous area farms vary widely in size, volume and type of production, and natural endowments. On general principles it may therefore be assumed that data from several hundred farms, probably from 400 to 1,000, are required if one is to be assured

¹ Mordecai Ezekiel, *Factors Affecting Farmers' Earnings in Southeastern Pennsylvania* (U.S. Department of Agriculture Bulletin 1400), April 1926.

that a representative sampling has been secured. Investigators who have employed correlation analysis have for the most part secured an adequate number of records. Nevertheless the requirement imposes a significant limitation on the use of the device.

This limitation arises from the fact that so large a number of records must be obtained either by a method yielding unduly inaccurate data, or by a method involving prohibitive expense—at least under present conditions.¹

In order to obtain really accurate data on quantitative expenditures the route method must be used, but it is likely that one year's data from as many as fifty farms would cost \$2,000 or \$3,000 at a minimum. The expense of obtaining route data from 500 farms would be prohibitive. Consequently the survey method is the only practicable one. This method is accurate in so far as the farmer's memory is dependable and the field agent's skill is great in checking the farmer's answers, one against the other. Merely because of the number and kind of items which must be remembered and checked, there is reason to believe that a good deal of error must occur in the estimates given by individual farmers. These errors are not so significant as entirely to discredit the use of the survey method, but the likelihood of their presence is sufficiently great to give rise to the contention that correlation coefficients calculated from survey data probably need to be accepted with considerable reserve. The data are by no means strictly comparable with "errors of observation" in physical measurements, or even with enumerations. Under the survey method, of course, certain items are more trustworthy than others: areas and numbers of live stock, for example, are likely to be reported more accurately than values or quantitative expenditures. Even under the route method significant errors may occur. One would suppose that it ought to be possible to account for the disposition of wheat on farms with real accuracy. But Table 1A (p. 272), compiled from route cost records obtained from five farms in Jackson County, Kansas, in 1920, gives reason to question the accuracy even of the route method. Discrepancies in the recorded disposition of quantities of wheat produced are large, and one cannot ascertain precisely where the errors of recording occurred. This table, of course, is not presented as typical of the data obtained from route cost investigation; it is intended merely to show that the route method does not preclude errors, even

¹ Expense of gathering data would not be so serious a problem if more farmers kept accurate records under a uniform system, or if the co-operative service now operating in Illinois should come into common use.

272. FARM COST STUDIES IN THE UNITED STATES

when conducted with care, as the investigation yielding these data appears to have been.

If records err, memory may err also. The inexact quality of survey data ought to be remembered by investigators employing the correlation analysis. The danger is that refinement of the analytical procedures will create a disposition to ignore the matter; statements regarding inaccuracies of data have always been too uncommon in published studies.

TABLE 1A.—DISPOSITION OF WHEAT ON FIVE FARMS IN JACKSON COUNTY, KANSAS, 1920*
(Bushels)

| Farm No. | Opening inventory | Pro-duced | Pur-chased | Total supply | Closing inventory | Sales | Con-sumed on farm | Total disposition | Discrep-ancies |
|----------|-------------------|-----------|------------|--------------|-------------------|-------|-------------------|-------------------|----------------|
| 2..... | 45 | 909 | | 954 | | 1,188 | | 1,188 | +234 |
| 10..... | 8 | 385 | 29 | 422 | 10 | 176 | 28 | 214 | -208 |
| 11..... | | 875 | | 875 | | 874 | 120 | 944 | +119 |
| 12..... | 70 | 680 | | 750 | 455 | 146 | 46 | 647 | -103 |
| 16..... | | 604 | | 604 | 245 | 250 | 21 | 516 | -88 |

* Compiled from original route cost data furnished the Food Research Institute by the Kansas State Agricultural College.

Even if accurate data could be secured by the route method, the propriety of basing conclusions upon one year's data may be questioned. Farmers within a given area do not tend to maintain their rank in labor income from year to year, but fluctuate widely from high to low positions on the curve of incomes. The same can probably be said with respect to other income figures—the dependent variables in the correlation analysis—such as “operator's earnings.” Now if investigators are seeking to develop permanently valid generalizations, it is clear that this inconsistency of farmers in maintaining their rank in income gives rise to the necessity of employing data for more than one year. Size of farms, for example, would not show considerable change from one year to the next, while labor income would change. Thus in one year a high correlation might be found between labor income and size of farms, while in the next year it might prove low. Similar difficulties might appear in correlating acres in corn with labor income, for, though acreage might remain constant, yield on some farms might be high in one year, low in the next, on account of soil conditions; and changes in yield might affect labor incomes

so that the correlation of acreage in corn with labor income proved quite different in the two years.

It would appear that a thoroughgoing correlation analysis ought to be based on data for several years, at least if investigators seek to develop general principles of farm management. Thus far no such analysis has been attempted, for investigators have apparently been inclined to believe that farmers consistently maintain their positions on the income curve. Until correlation analyses have been run on three or four years' data from the same area, we shall have only an inadequate notion of the factors usually significant in their bearing on profits in that area. In the judgment of the present writer, two or three such analyses (using one year's data at a time, with the same variables each year but not necessarily data from the same farms; and comparing the correlation coefficients so as to determine whether or not the same factors are significant each year) ought to be undertaken in preference to many analyses of one year's data. Such analyses of data obtained in carefully selected areas would probably contribute more definite and dependable knowledge of the factors affecting farm profits than we now possess despite 25 years of farm management research. But only a few such inquiries ought to be conducted in view of their expense and of the paucity of capable statisticians.

Choice of Variables.—The correlation analysis involves at the outset a set of definitions of variables. Hypotheses must be formed respecting the form of farm income which is to be analyzed, and the factors which may reasonably be supposed to affect it. Summary figures representing each factor must be compiled from the raw data. Table 2A (p. 274) displays the summary figures which have actually been employed in the more extensive correlation analyses. The table emphasizes the fact that the problem of explaining farm profits is a multiple-variable problem; the most elaborate analysis includes 20 variables.

An analysis including variables defined as those of Table 2A, however, constitutes scarcely more than an approach to the problem in hand. Even after correlation coefficients or coefficients of determination have been calculated, all that one knows is that, roughly speaking, certain of the defined factors apparently bore a closer relationship to profits than certain others. Most of the variables are not simple, but complex. Thus "receipts" variables are composites of volumes of produce sold and prices received. Volume of sales may depend on acreage and yield; yield on soil,

TABLE 2A.—VARIABLES EMPLOYED IN SELECTED CORRELATION ANALYSES OF FACTORS AFFECTING FARM PROFITS*

| Ezekiel, Taylor, Hurd (1913 data) | Crickman (1921 data) | Taylor, Hurd (1921 data) | Ezekiel (1922-23 data) |
|---------------------------------------|------------------------------------|--|------------------------------------|
| Labor income | Profits | Profits | Operator's earnings |
| Acres operated | Acres operated | Acres operated | |
| Crop acres per horse | Acres pasture per animal unit | | |
| Acres in crops | Acres of corn | Percentage of area in corn | Acres in crops |
| Percentage of area in corn | Acres of hay and pasture | Percentage of area in hay | Acres in pasture |
| Percentage of area in hay and pasture | Acres of small grains | Percentage of area in pasture | |
| Percentage of area in small grains | Productive animal units | Percentage of area in oats | |
| Productive animal units | Crop index | Corn yield per A. | Number of cows |
| Crop index | Live stock index | Oat yield per A. | Crop index |
| Live stock index | Percentage of receipts from dairy | Lbs. pork produced | |
| Percentage of receipts from dairy | Percentage of receipts from hogs | Lbs. beef produced | Receipts from dairy herd |
| Percentage of receipts from hogs | Percentage of receipts from cattle | Receipts from live stock per 100 acres | Receipts from hogs |
| Percentage of receipts from cattle | | | Receipts from beef cattle |
| | Percentage of receipts from crops | Receipts from corn per 100 A. | Receipts from sheep |
| Percentage of receipts from crops | Months of man labor | Receipts from oats per 100 A. | Receipts from poultry |
| Months of man labor | Value of real estate per A. | | Receipts from crops |
| Total capital | | Rent charge per A. | Labor index |
| Percentage of working capital | | Building charge per A. | |
| is percentage of total capital | | Machinery value per A. | Percentage of dairy feed purchased |
| | | Hog price per pound | |
| | | Cattle price per pound | |
| | | Pounds of dead hogs | |

* Sources: For Column 1, M. Ezekiel, "The Use of Partial Correlation in the Analysis of Farm Cost Data," *Journal of Farm Economics*, V, 202; and C. C. Taylor and E. B. Hurd, *Farm Organization and Farm Profits in Tama County, Iowa* (Iowa Agricultural Experiment Station Research Bulletin 88), November 1925, p. 321. For Column 2, C. W. Crickman, *A Partial Correlation Analysis of Farm Organization and Management Data from Warren County, Iowa* (Iowa Agricultural Experiment Station Research Bulletin 89), November 1925, p. 12. For Column 3, Taylor and Hurd, *loc. cit.* For Column 4, Mordecai Ezekiel, *Factors Affecting Earnings in Southeastern Pennsylvania* (U.S. Department of Agriculture Bulletin 1400), April 1926, p. 55.

fertilization, precipitation, or cultivation, and others; while price (aside from general influences) must be affected more or less by time of marketing and quality, perhaps by bargaining ability. That a high correlation is found between profits and receipts from one source or another is therefore not a finding of great significance in itself; the analysis must be pushed farther if one is to point out specifically what factors affect receipts, and in addition indicate to farmers what they both ought and can do to increase receipts.

When this stage of the analysis is reached (in the published studies only those by Ezekiel have pressed so far) difficulties are certain to arise in two directions: securing sufficiently accurate data on details, and distinguishing controllable from uncontrollable factors. As a practical matter it is not feasible by any method to obtain data on soil quality, precipitation, and temperature on each of a large group of farms; and accurate data on feeding practices and labor utilization are probably not to be had by the survey method. Consequently the correlation analysis must remain to some degree an inadequate analysis. It must remain so unless very heavy expenditures are to be made in securing data adequate to explain all that farm management investigators seek to explain. Such expenditures ought not to be incurred in more than a few instances, especially in view of cheaper alternative methods of attacking the same problem. Hence the multiple correlation analysis ought not to be regarded as an analytical device suitable for general adoption in the agricultural experiment stations.

If the correlation analysis is to render to farmers the sort of services which investigators apparently contemplate, the definition of variables ought to be such that measurement is possible of the extent to which factors that farmers can control influence profits. To establish the proposition that yield as summarized in "crop indexes" or "live-stock indexes" influences income to such and such a degree is doubtless a useful contribution to knowledge; but it is not a proposition of major interest to individual farmers. The analysis must be carried farther in order merely to explain yield, and farther still if farmers are to be informed precisely how to increase yields and increase profits at the same time. Broadly speaking, one might suppose that yield is dependent not only upon largely controllable factors like seed selection, date and depth of planting, fertilizing, closeness of rows, and methods of cultivation, but also upon uncontrollable factors like precipitation,

temperature, and chemical composition and texture of soils. Suppose hours of labor per acre appears not to be correlated with yield. Does this demonstrate that intensity of cultivation has no noticeable effect; or does it mean that an hour of one man's labor is not the same as another's for reasons of differences in physical constitution and that this is the only cause of variation in hours of labor per acre; or does it mean that farmers with low-lying fields were forced to spend more time in soil preparation than others of the group because of heavy rainfall, and yet secured the same yields on the average? It is clear that what investigators seek is to indicate procedures whereby farmers can increase their profits if they will. But it is equally clear that only the most detailed records will provide data adequate to permit the requisite separation of controllable from uncontrollable influences; and one may doubt if thoroughly adequate data could be obtained by any means whatsoever.

Imputation of Causal Relationship.—Most writers on the theory of correlation recognize that the process does nothing more than to measure, more precisely than is otherwise possible, the degree to which two variables vary with each other. The correlation coefficient enables us to say with some precision how far high, medium, and low orders of one variable are associated with high, medium, and low orders of the other. Nothing but the presence or absence of association is measured. No light whatever is thrown upon the nature of the association; it may be directly causal and compulsory, or wholly incidental, or a mixture of the two. Suppose farm profits were to be correlated with length of farmers' fingers, and a coefficient of $+0.4$ emerged. Nothing in the theory of correlation compels us to infer that the one is the cause of the other; we are assured merely that, for the data in hand, long fingers were associated somehow or other with high profits. And if a high correlation is found between yield and profits, nothing is proved but that a high degree of association exists; it need not be a causal relation. That the relation is in fact causal must be established on quite different grounds.

Yet to assume that high correlation proves high causal relationship is a tempting procedure in economic analysis, simply because economic inquiry is largely directed toward explanation of effects by causes. This is, as we have seen, the chief object in farm cost inquiry. We wish to determine what factors influenced profits. We meditate upon the possible causal influences and fix upon a list, say of twenty. Some of these we regard as more im-

portant than others, but on account of the complexities of their relationship, we are uncertain which to choose. On carrying through a partial correlation analysis, we reach coefficients measuring the net association of each independent variable with the dependent variable. We scan the list; and at this point the chief danger of the process arises. For, observing that certain coefficients are of higher value than the others, we argue that causal importance is shown by the rank of the coefficients; yet no such thing is proved. We merely know that various degrees of association exist. It might still be true that the factor with, say, the third highest coefficient was in fact the one most important in its causal influence on profits. The process of correlation provides no dependable means for separating association of a causal nature from association of an accidental nature.

The literature of correlation analysis of farm management data is not free from this fallacy; and no writer seems to have given specific warning against it. Vernon and Ezekiel list receipts per acre of tobacco, area in tobacco, and receipts from other crops as important in the order named for their causal influence on earnings, and the conclusion is apparently based on the relative size of the coefficients.¹ Crickman, clearly arguing from the size of coefficients, says, "it is found that the most important factors, in order of importance, are the production per animal unit, efficiency in the use of man labor, value of the real estate per acre, . . . crop yields, and the amount of pasture used to carry one animal unit."² Hitchcock, presenting a tabular statement of correlation coefficients, says: ". . . the relative size of the several coefficients indicates the relative importance of the several factors."³ Almost every writer speaks of the independent variables as causal, the dependent as resultant.

Correlation is in this respect a dangerous tool. It should not be employed as an infallible means of discovering and measuring the relative importance of causal relationship, for it leads easily to what may be called the fallacious argument from association. It is a particularly insidious method in a problem where the object is largely to disentangle many obscure causal relationships; and farm cost investigation is a problem of this sort. To attack farm

¹ Vernon and Ezekiel, *op. cit.*, p. 45.

² Crickman, *A Partial Correlation Analysis of . . . Data from Warren County, Iowa* (Iowa Agricultural Experiment Station Research Bulletin 89), November 1925, p. 2.

³ Hitchcock, *op. cit.*, p. 46.

cost analysis by guessing at factors likely to influence profits, correlating these by any method whatever, and gauging the causal importance of the factors by reference to the relative sizes of the correlation coefficients is theoretically unsound, but tempting because it seems decisive. There is real danger that such a rule-of-thumb procedure should gain adherents in a field where standardization of analytical methods is customary. Correlation is not a mechanical substitute for logic. In the end it provides only a statistical description. As Keynes says, ". . . not unnaturally, the more complicated and technical investigations become, the more prone enquirers are to mistake the statistical description for an inductive generalization."¹ The evidence indicates that advocates of correlation analysis of farm cost data have fallen into this error.

From another point of view, however, correlation bids fair to perform a service not otherwise available. Tolley and Mendum regard it as essentially a check "on the validity of data under study . . ."² In the light of our earlier remarks, it is clear that hypotheses regarding causal relationships are not infallibly verified by the device. But it may nevertheless be argued that although the presence of high correlation by no means constitutes certain proof of causal relationships, its absence may be employed to disprove hypotheses. Thus if very great causal relationship is expected, and practically no correlation is found, there is good reason to question the hypothesis. Use has been made of this method of arguing to show that size of farm has less influence on profits than has commonly been supposed. In this respect correlation seems serviceable in curtailing the number of erroneous conclusions which without it might gain acceptance. But it is unwise, and indeed impossible, to press this use of the device very far. If one expected a coefficient of $+0.8$ and obtained no correlation, then it could properly be said that a hypothesis was disproved. But the same could not be said where coefficients in the middle and lower ranges were expected, and only slightly lower coefficients were obtained. The disproof of the hypothesis would here be no more certain than the proof of a hypothesis would be when "some" causal relationship was predicted, and "some" correlation was obtained.

Interpretation of Low-Value Coefficients.—We have already seen that the problem of explaining farm profits by correlation analysis is a multi-variable problem. In such a problem we have

¹ J. M. Keynes, *A Treatise on Probability*, p. 329.

² Tolley and Mendum, *op. cit.*, p. 13.

every reason to expect that most of the coefficients obtained in the analysis will be of low value. It is impossible that each of, say, 20 variables should show a large effect on farm profits. From what evidence we have, it is clear that farm management investigators must grapple with the problem of interpreting coefficients of low value, or at least the problem of determining which coefficients to dismiss from discussion as unimportant. Table 3A (p. 280) displays the most elaborate published list of net coefficients of correlation,¹ together with their probable errors.

Accepted statistical practice calls for the exercise of judgment in determining when a coefficient of correlation is sufficiently high to warrant the inference that it indicates a relationship of real importance. This is true of any form of coefficient, whether simple, multiple, partial, rectilinear, or curvilinear; and it is equally true of the "coefficient of determination."² Customarily judgment is guided by calculating the probable error and by ascertaining whether or not the coefficient is appreciably larger than its probable error. There appears to be some divergence of opinion among authorities regarding the proper method of calculating the probable error of a coefficient of partial correlation, much less of a coefficient of determination, though the formula

$$PE = \frac{.6745 (1-r^2)}{N}$$
 is accepted for application to coefficients of gross correlation. Apparently farm management investigators, when they have calculated probable errors at all, have employed this formula. But it is a further query, with respect to the relation of the coefficient to its probable error however calculated, which concerns us here.

Writers on statistics, when they discuss what size of coefficient may properly be regarded as significant, are inclined to say vaguely that relationship is established when the coefficient is "appreciably greater" or "three or four times larger" or "at least four times larger" than its probable error. It is true that they are speaking of gross, not net, coefficients. Discussion of the significance of partial coefficients as tested by their probable errors is not to be encountered in any but the more technical statistical textbooks. But presumably authorities would follow much the same line of reasoning in adjudging the significance of a net

¹ In *U.S. Department of Agriculture Bulletin 1400*, Ezekiel presents list of coefficients of determination; the coefficients of correlation are not shown, and hence cannot be presented in Table 3A.

² The coefficient of simple correlation multiplied by the partial regression coefficient when expressed in standard deviations.

280 FARM COST STUDIES IN THE UNITED STATES

coefficient or correlation or a coefficient of determination as they follow when speaking of gross coefficients of correlation; and we may properly assume that if there is no generally accepted test of

TABLE 3A.—NET COEFFICIENTS OF CORRELATION (RECTILINEAR) AND THEIR PROBABLE ERRORS, OBTAINED IN SELECTED FARM COST CORRELATION ANALYSES*

| Variables (965 farms in Iowa, 1913) | r | PE | Variables (281 farms in Iowa, 1921) | r | PE |
|---|--------|--|--|---------|---------|
| LABOR INCOME ^a | | | PROFITS ^a | | |
| Acres in crops..... | + .319 | Where r=0, the probable error is 1.022 | Total acres | + .1194 | ± .0437 |
| Acres not in crops..... | + .044 | | Productive animal units | + .1479 | ± .0434 |
| Productive animal units | -.089 | | Months of man labor.... | -.4031 | ± .0368 |
| Months of man labor.... | -.275 | | Value of land per acre... | -.2655 | ± .0412 |
| Total capital | -.188 | | Acres in corn..... | -.0375 | ± .0443 |
| Percentage working capital is of total..... | + .141 | | Acres in small grains.... | -.0656 | ± .0442 |
| Percentage of area in corn | + .186 | | Acres in hay and pasture | -.1569 | ± .0433 |
| Percentage of area in small grains | + .154 | | Percentage of receipts from dairy | -.1919 | ± .0427 |
| Percentage of area in hay and pasture..... | + .152 | | Percentage of receipts from cattle | -.0836 | ± .0440 |
| Percentage of receipts from dairy | -.091 | | Percentage of receipts from swine | -.0074 | ± .0444 |
| Percentage of receipts from cattle | -.167 | | Percentage of receipts from crops | -.0620 | ± .0442 |
| Percentage of receipts from swine | -.188 | | Acres of pasture per animal unit | -.1973 | ± .0426 |
| Percentage of receipts from crops | -.047 | | Live stock index..... | + .5257 | ± .0321 |
| Crop acres per horse.... | -.085 | | Crop index | + .2433 | ± .0417 |
| Live stock index..... | + .528 | | | | |
| Crop index | + .300 | | | | |

* Sources: For Column 1, C. C. Taylor and E. B. Hurd, *Farm Organization and Farm Profits in Tama County, Iowa* (Iowa Agricultural Experiment Station Research Bulletin 88), November 1925, p. 321; for Column 2, C. W. Crickman, *A Partial Correlation Analysis of Farm Organization and Management Data from Warren County, Iowa* (Iowa Agricultural Experiment Station Research Bulletin 89), November 1925, p. 12.

^a Dependent variables.

the significance of a gross coefficient, such a test for a net coefficient is also lacking.

Some authorities (notably King, Jerome, and Day) following Bowley, say that a coefficient of correlation ought to be "six times

larger" than its probable error before significance can be attached to it—not "appreciably larger," or "three or four times larger," or "at least four times as large." There is in fact no precise rule-of-thumb method of testing the significance of a coefficient, either simple or partial, by comparing it with its probable error. There is rather a considerable difference of opinion. What one authority might regard as a significant coefficient would presumably be discarded as unworthy of attention by others. Day voices the opinion that "coefficients under 30 give very little indication of any definite connection between the variables."¹

Now it is notable that out of 30 coefficients, only two run above .5, only three above .4, only four above .3; only four out of these thirty coefficients can be said to indicate an association really worth considering. If four times the probable error is to be the test, thirteen (or perhaps twelve) out of the sixteen in the first column may be regarded as significant, and six out of the fourteen in the second column—a total of nineteen out of thirty. If six times the probable error be the proper test, the number of trustworthy coefficients is reduced to fourteen.

Evidently, then, the lack of a dependable rule-of-thumb test is of some importance to farm cost investigators. There is always danger of perceiving relationships, and discussing them, where their very existence is doubtful and can be disputed. The danger is particularly prevalent in farm cost analysis, not only because the probable error test is often applied too blindly, but also because the emergence of so few high-value coefficients tempts one to seek for significance in those of lower and more doubtful values. It is easy, in the search for significant conclusions, to lean too heavily upon the tangible coefficients so laboriously computed, meanwhile forgetting the inherent inaccuracies of the original data, and the uncertain nature of the probable error tests.

IV

It is clear, then, that limitations partly of a practical and partly of a theoretical nature must be encountered in any attempt to establish the partial correlation analysis as the standard ana-

¹ E. E. Day, *Statistical Analysis*, p. 209. Dr. Day is speaking here of gross coefficients of correlation, and it may be unfair to assume that he would say the same thing of net coefficients. He also suggests that the probable error test is not properly applicable where the data do not constitute a random sample. In the judgment of the present writer, farm survey data cannot strictly be regarded as random samples; but it is unnecessary to consider the matter here.

282 *FARM COST STUDIES IN THE UNITED STATES*

lytical device in farm management research among the agricultural experiment stations. In view of these limitations of the partial correlation analysis, it seems proper to urge that it should be employed only by skilled investigators working with adequate accumulations of data. The device is not a magical machine, which, once set up, will turn out significant conclusions regardless of its operation, and at moderate expense. It is a better device than the cross-tabulation analysis; but the co-operative farm management service is also a better device. This service widely used, and supplemented by partial correlation analyses sparingly used, would in the judgment of the present writer constitute a more fruitful approach to the farm management problem than any general procedures which have hitherto been employed. But no method of analysis ought to be regarded in and of itself as the road to solution of farm management problems.

INDEX

- Account-keeping by farmers, vii, 170
- Accounting principles, as cause of variation in costs, 114 f.; as source of difficulties in price fixing, 220-24
- Accuracy of cost data, 270-73
- Adams, R. L., milk cost investigation by, 53-64
- Agencies compiling cost statistics, 5 f.
- Agricultural colleges, 6
- Agricultural depression, influence of, on cost study, 17, 26; on price fixing, 214
- Agricultural experiment stations, 5
- Agricultural journals, 6
- Agricultural surveys, relation of, to cost surveys, 24
- Alfalfa hay, labor requirements of, 135
- Allocation of overhead costs, uncertain principles of, 47-49
- Alsberg, C. L., ix
- American Agriculturist*, cost investigation by, 14
- American Farm Economic Association, 21
- Array, defined, 10 n.
- Associationship in correlation analysis, *see* Causality
- Assumptions in price theory, 200 ff.
- Averages, different forms of, 78; doubtful significance of, to farmers, 126 f.; difficulties of choosing appropriate, in tariff making, 251-53
- Barley, cost of production of, 15, 73
- Beans, labor requirements of, 135
- Beef, cost investigation of, 239
- Beef production, calculation of least-cost combination for, 143-47
- Bias in cost investigation, 2, 44
- Bibliographical notes and references, 6 f., 40, 64 f., 181 f., 205, 229-31, 257-59
- Black, J. D., 3, 268
- "Bulk-line theory," weaknesses of, 224-28; use of in determining tariff duties, 255
- Bureau of Agricultural Economics, 5, 21
- Bureau of the Census, 5
- Bureau of Crop Estimates, 5 n.
- Bureau of Crop and Live Stock Estimates, 21
- Bureau of Markets, 5 n., 21
- Bureau of Plant Industry, 24
- Bureau of Statistics, 21
- Business expenditures, farm, in relation to farm cost statistics, 1, 7; classification of, 7-10; unallocated, 9
- Butter, cost investigation of, 243, 247 f.
- California, costs of milk production in, 54-63
- Canada, cost investigation in, 4
- Cattle, cost of production of, 14
- Causality and associationship in correlation analysis, 276-78

- Causes of growth of cost inquiry, 22-28
- Causes of variation in costs, 99-117; difficulties in determining, 107-17
- Changes in costs, defined, 68; illustrated with respect to average money costs, 85-87; with respect to individual money costs, 87-90; with respect to quantitative costs, 91; significance of, 85
- Cheap money in relation to price regulation, 207
- Cheese, Swiss, cost investigation of, 232
- Cherries, cost investigation of, 232
- Coefficients of correlation, difficulties of interpreting low-value, 278-81; list of, from selected studies, 280; probable error of, 279
- Coefficient of variation, 75
- Clover seed, labor requirements of, 135
- Collection of cost data, *see* Farmers' record, Questionnaire, Route, and Survey
- "Competitive" tariff, 33
- Completeness of cost data in different methods of collection, 42 f.
- Controllable and uncontrollable causes of variation in costs, 99-117; difficulty of separating as a limitation on farm management investigation, 127; neglect of problems raised by, 105
- Co-operation between agencies conducting cost investigations, 5, 18
- Co-operative farm management service as a type of farm management investigation, 121, 163-67, 170-72
- Corn, cost of production of, 14, 15, 77 f., 85 f.; seasonal distribution of labor on, 136
- Correlation analysis, application to quantitative data, 141-49; general limitations of, 267-82; recent popularity of, 119 f.; use in farm business analysis, 156; usefulness of, in separating controllable from uncontrollable causes of variation in costs, 111 f.
- Cost equalization doctrine, stated, 233 f.; practical difficulties in employing, 248-57; theoretical fallacies of, 244-48
- Cost-and-price disputes, history of, 207-15; influence of, on growth of cost study, 26
- Cost - and - price relationships, misconceptions of, 188-96; qualifications of, 200-204; theory of, stated, 183-88
- Cost curves, statistical, not comparable with theoretical curves, 196-200
- Cotton, cost of production of, 14, 76, 80; seasonal distribution of labor on, 136
- Country Life Commission, 24
- Country life movement, 23 f.
- County agents, 5
- Crickman, C. W., 269, 277
- Cross-tabulation analysis, 154-56; compared with correlation analysis, 267 f.
- Cultural practices, statistical description of, 137

- Davies, Joseph, 208
- Davis, J. S., acknowledgment to, viii
- Denmark, cost investigation in, 4
- Department of Agriculture, early cost investigations by, 14, 15, 16
- Differences in costs, between countries, 251-53; defined, 68; illustrated with respect to average money costs, 69-72; with respect to average quantitative costs, 72-75; with respect to individual money costs, 75-81; with respect to individual quantitative costs, 81-84
- Diminishing returns, 193, 197 f.
- Dingley Tariff of 1897, 235
- Dispersion, in relation to representative quality of averages, 66 ff., 79, 126 f.
- Efficiency expert, function of, 102-7; maintenance from private rather than public funds, 124 f.; wider opportunity for, in manufacturing, 103 f.
- Efficiency, farm, increase of, as objective in cost study, 33-36; not necessarily demonstrated by varying costs, 127; not furthered by the cost equalization doctrine of tariff making, 247 f.
- Efficiency, labor, measurement of, 139 f.
- Efficiency movement in industry and agriculture, 22 f.
- Elasticity of supply, differences in, for various agricultural products, 201 f.; expansion of, more rapid than contraction, 202-4
- Elements of cost, 45-47, 186 f.
- Emergency Tariff Act of 1921, 240
- England, cost investigation in, 4
- Equalization of labor costs between countries as a basis for tariff making, 25
- Erdman, H. E., acknowledgment to, viii
- Expense of cost investigation, 21, 116 f., 124, 162 f., 167
- Experimental farms, cost data from, 3
- Extension of economic investigation, 22
- Extension services, 5, 164
- Extension work in agricultural education, 24
- Ezekiel, M. J. B., 267, 268, 269, 275, 277
- Factors affecting profits, analysis of as a type of farm management investigation, 120, 152-58; desirability of employing correlation analysis in study of, 178 f.
- "Fair price," common view of, as identical with cost price, 214-16; concept of, in theoretical discussions, 188 f.
- "Farm bureau—farm management service," *see* Co-operative farm management service
- Farm Bureau Federations, 5
- Farm business analysis, *see* Factors affecting profits
- Farm management demonstration, 5, 24

- Farm management investigation, criteria for evaluating, 121-25; fundamental limitations on, 125-32; types of, 120 f.
- Farmers' institutes, 24
- Farmers' record plan of gathering data, 16, 42, 134, 141
- Farmers, value of cost study to practicing and prospective, 122 f.
- Federal Trade Commission, 5
- Feeding experiments, 13
- Fertilizer experiments, 13
- "Flexible provision" of Tariff Act of 1922, 25, 241 f.
- Food Administration, 209
- Food Control (Lever) Act of 1917, 209
- Forecasting, difficulty of, as a limitation on farm management cost inquiry, 128-32, 147; as an objection to price fixing, 216-19
- "Forecasting farm management," 129, 131
- Frequency series and time series of cost statistics, 9, 198
- Fuel Administration, 209
- Germany, cost investigation in, 4
- "Greatest-profit combination," 141
- Growth of cost inquiry, 18-28
- Guaranteed wheat prices, 27
- Haley, B. F., acknowledgment to, ix
- Hays, Willet M., 18, 23
- History of cost inquiry, 12-28
- Hitchcock, J. A., 269, 277
- Hogs, cost investigation of, 209
- Hurd, E. B., 269
- Income-tax legislation, influence of, on cost study, 27
- Increasing costs, *see* Diminishing returns
- Individual costs, *see* Differences in costs, Changes in costs
- Inflation of costs, 60 ff., 223, 261
- Interest on investment as an element of cost, 47
- Interstate Commerce Commission, use of cost data in testimony before, 32
- Journal of Farm Economics*, 6
- Kansas State Board of Agriculture, cost investigations by, 14, 16
- Kentucky Bureau of Agriculture, Labor, and Statistics, cost investigation by, 15
- Keynes, J. M., 278
- King, D. L., acknowledgement to, ix
- Labor income, changes in on identical farms, 92-98; defined, 89; as evidence on slow contraction of supply, 203 f.
- Labor requirements, 134-41, 172-73
- Land rent, *see* Rent of land
- "Least-cost combination," 141 f., 149
- "Local market" survey as a desirable type of research, 179-81
- Localities, differences in costs between, 73
- Long-time in relation to short-time theory of prices, 190-94, 196, 215

- McKinley Tariff of 1890, 235
 McNary-Haugen Bill, 217
 Management, effects of in causing differences in costs, 100-117
 Manufacturing, causes of differences in costs in, 101 f.
 Marginal producer and product, 187, 194 f.
 Mendum, S. W., 268
 Methods of collecting data, relative accuracy of, primary data obtained from various, 41-45
 Milk, cost of production of, 26, 54-63, 81, 87; fixed prices of, 211 f.
 Money costs, abandonment of, 133 f.; computed, 9; per operation, 8; per productive unit, 8, 71; per unit of product, 8, 69 f., 75-81; *see also* Differences in costs, Changes in costs
 Multiple correlation, *see* Correlation analysis
 Natural conditions, effects of, in causing differences in costs, 100-117
 New crops, use of cost data in introducing, 12 f.
 New Jersey Agricultural Experiment Station, cost investigations of, 14, 16
 Nourse, E. G., 207
 Oats, cost of production of, 15, 73, 84; seasonal distribution of labor on, 136
 Objectives in farm cost investigation, 29-40
 Office of Experiment Stations, 119
 Office of Farm Management, 5 n., 18
 Opportunity cost, in relation to principles of valuation, 50-54
Orange Judd Farmer, cost investigation by, 14 f., 16
 Overhead costs, *see* Allocation
 Page, T. W., 242, 246
 Partial correlation, *see* Correlation analysis
 Pond, G. A., ix, 35
 Populist Party, use of cost data by, 17
 Potatoes, cost of production of, 76, 84; labor requirements of, 135
 Price control, objects in cost inquiry directed toward, 31-33
 Price fixing, history of, 207-15; concrete difficulties of, 220-28; general objections to, 216-20
 Price, relation of, to cost, *see* Cost-and-price relationships
 Prices, "equilibrium," 184, 187; "market," 184; "normal," 184, 187
 Production problem of the farmer, divergent views on, 37 ff.; fourfold division of, 33, 36
 Production standards, erection of, as a type of farm management investigation, 120, 133-49
 Program for farm management investigation, 168-81
 Projects in farm management investigation, classified, 20 f.
 Prosperity, farm, reasons for excluding bearing of cost statistics on, viii

- Purnell Act, increase in cost investigation due to, 21
- Quail, line bob-white, cost investigation of, 232, 243
- Quantitative costs, per operation, 8, 74, 83 f.; per productive unit, 9, 73, 82; uses of, 133-49; *see also* Differences in costs, Changes in costs
- Questionnaire method of gathering cost data, 14, 16, 20, 140, 150
- "Ratio" basis for price fixing, 211
- Regions, geographical, differences in costs between, 69-71
- Rent, theory of, 100 f., 191-94
- Rent of land as an element of cost, 45 f., 186 f., 253 f.
- Replanning farms for profit as a type of farm management investigation, 120, 158-64
- Roosevelt, President, interest of, in rural problems, 24
- Route method of gathering cost data, 18 f., 134, 140, 150, 152, 172 f.
- Rye, cost of production of, 15
- Sampling problems in cost study, 43 f., 270 f.
- "Scientific tariff" movement, influence of, on growth of cost inquiry, 22, 25 f.
- Seasonal distribution of labor, 134, 136
- Simple correlation, *see* Correlation analysis
- Smith-Lever Act, influence on cost investigations, 25
- Sorghum, cost of production, 14
- Standard requirements, *see* Labor requirements
- Standardization of types of research; 119
- State boards of agriculture, 5
- Statements, cost, from single farms, 3, 13
- States, differences in costs between, 70 f.
- Statistical description, impossibility of determining usefulness of, 121 f.
- Success in farming, measures of, 154 f.
- Sugar, cost of production of, 25, 239; use of cost data to encourage domestic production of, 13
- Sugar beets, cost of production of, 74, 80, 239; labor requirements of, 135
- Supply, different conditions of in agriculture and manufacturing, 102; relation of to price and cost, 185 f.
- Surface, F. M., 210
- Surpluses, disposition of, 217 f.
- Survey method of gathering cost data, 18 ff., 134, 140, 150, 152, 173 f.
- Switzerland, cost study in, 4
- Tariff Act of 1909, 236
- Tariff Act of 1922, 25, 232, 240-42
- Tariff Board, 5, 25, 238 f.
- Tariff Commission, 5, 21, 25, 239
- Tariff duties on selected agricultural products, 237
- Tariff making by cost determination, history of, 232-42; objections to, 245-57

- Taussig, F. W., 101, 184, 233, 245
- Taylor, A. E., acknowledgment to, ix
- Taylor, C. C., 267
- Taylor, H. C., view of objectives in cost study, 36
- Taylor, Frederick W., 22
- Teachers, value of farm cost studies to, 122 n.
- Temporary and permanent as related to controllable and uncontrollable causes of variation in costs, 101 f.
- Texas Agricultural Experiment Station, cost investigations, 14
- Time series, *see* Frequency series
- Tobacco, cost of production, 81
- Tolley, H. R., 267, 268
- Transportation costs, 3
- Trends, usefulness of, to farmers in restricted areas, 131
- "True principle" of protection, 232 f.
- Types of cost data, 1-11; diversity in, 10
- Types of farming, need for further knowledge of, 175
- Unfamiliar machinery and methods, description of as a type of farm management investigation, 120, 149-52; investigation of as a desirable type of research, 178
- Uniformity in costs, fallacious notions of, 67
- Utilization of cost data by farmers, impossibility of ascertaining extent of, 123
- Utility, diminishing, 185; marginal, 185
- Value, theory of, extent to which differences in costs are uncontrollable in, 100 ff.
- Valuation of non-cash costs, uncertain methods of, 50, 54, 114 f.
- Variables, difficulties of defining in partial correlation analysis, 273-76; list of in selected analyses, 274
- Variations in costs, illustrated, 66-98; significance of to practicing farmers, 126 f.
- Varying cost, meaning of in theoretical discussion, 186 f.
- Vernon, J. J., 269, 277
- "Vexed question" of farm prosperity, early use of cost data in discussing, 16
- Wage rates in different countries in relation to costs of production, 241
- War Industries Board, Pricing Committee of, 209
- Warren, G. F., 19
- Wheat, cost of production of, 14, 69 f., 73, 77, 80, 85 f., 109, 232; fixed price of, 209 ff.; labor requirements of, 135
- Wheat flour, cost investigation of, 232
- Wheat millfeed, cost investigation of, 232
- Wisconsin Bureau of Labor, cost investigation by, 15 f.
- Wool, costs of production of, 25, 238 f.
- Working, H., acknowledgment to, ix
- Yield per acre, influence on cost per unit, 108 ff.

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