

MEASURES OF BUSINESS CONDITIONS IN INDIANA

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MEASURES OF BUSINESS CONDITIONS

PREFACE

The Indiana University Bureau of Business Research presents in this bulletin for the first time a summary of the materials and methods used in constructing the Bureau's monthly index of business conditions in Indiana. The index was constructed for use in the Indiana Business Review, the monthly summary of business conditions in Indiana published by the Bureau.

Altho the index has been published monthly in the Indiana Business Review since its inauguration in 1926, in its present form it has been in use only since 1928. Each year the trend lines and seasonal indexes of the series composing the index have been recomputed, but no material changes have been made during the past five years, and the only reason for presenting the data on the composition and construction of the index at this time is the necessity of having the material in bulletin form to supply the requests for information on its construction.

No claim is made for the completeness of the series as a group contained in the index, nor is it believed that other series, were they available, might not be added with profit, or substituted for some now used. On the other hand, practically all the series now currently available for Indiana are being used, and the index appears to be a trustworthy measure of business conditions within the state. The purpose of the index is to reflect the trend of business conditions within the state, and not to forecast what conditions will be at some future time.

In presenting an index of business conditions in Indiana the Bureau staff recognizes that, with the ease with which goods and services may flow from one part of the country to another as the result of our excellent systems of transportation and communication, the business activities of one state cannot be separated from those of its neighbors. Thus, the amount of electricity produced within a state may not at all reflect the amount of business activity within its borders, but that of its neighbors. Nevertheless, business conditions in the United States do vary with the various regions, if not directly with states, and the business executive must supplement his general

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indexes which cover the United States as a whole, with more detailed analyses which reflect the changes in the volume of business activity in each region or locality.

The Bureau's index of business conditions gives recognition to the industries peculiar to the state, and at the same time furnishes a close-up view of the activities of industries which may not be peculiar to Indiana, but whose fluctuations differ from those of the same industries in neighboring states. It is with the purpose of furnishing this detailed close-up cross-section of business conditions in Indiana that the Bureau maintains its index.

The data presented are of three kinds: First, are those series which are obtainable for the entire state, and which may be obtained not later than the fifteenth of each month, for the month next preceding. The series which are obtainable for at least seven years are included in the business curve, or index. Secondly, are those data which are not available early enough each month to be included in the business curve, but are carried in the Business Review as of the latest month available. Lastly, are those data which are indicative of the activities of certain localities, and which are of entirely local interest. All three types of data are included with the thought that many who are interested in business conditions may wish to continue the series on the basis of the current figures which appear in the Indiana Business Review each month.

Bloomington, Indiana
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Chapter I

INTRODUCTION

A casual glance at the financial page of a metropolitan daily will likely show that "business is picking up" or that "business is falling off." These conclusions may be based on the reported activity of a single basic industry; the sales in certain lines of retail trade; the volume of check transactions; or a weighted average of all the above, or other similar items, as determined by some statistical organization; but in any event, the public accepts such conclusions as valid irrespective of their completeness, as measures of the mass of economic activities which we term "business." The almost endless number of business indexes which appear in the press each week, have made it all but impossible for anyone who has not an academic interest in statistics or business forecasting, to make anything but a cursory examination of the reliability of the indexes as they appear. Altho frequently statistically inaccurate, there is no dearth of business information. The smaller urban weeklies glean the financial and business news of the week for their readers, while the larger metropolitan dailies not only completely summarize the business news, but also either maintain their own indexes, or are clients of syndicated business services furnishing indexes of business conditions.

In fact, the business of forecasting and interpreting business conditions has become a sizeable industry in itself. Current business information which is both timely and accurate is not, however, so readily obtainable as the above statements would suggest. Many indexes which appear currently are compiled from data, which at the time of the publication of the indexes are from one to three months old. This is particularly true of too many of the monthly indexes published by the various Federal departments and bureaus. It is to be regretted that such practices of these departments, as withholding permission for publication by non-governmental organizations, of regional data, with proper credit, until the figures have been released for the United States as a whole; or refusing to release regional data, until the data are complete for the United

States as a whole, irrespective of the tardiness of some unimportant regional report, have made many otherwise important data, of value only as matters of historical interest.

In view of the unsatisfactory manner in which much regional business information is made available, both by reason of its tardy appearance and its inaccurate interpretation, the Bureau of Business Research has collected and compiled its own indexes of business conditions in Indiana. The nature of these data, their sources, and the statistical methods used in presenting the data as indexes of business activity in the state are presented in the following chapters.

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Chapter II

METHODS OF ANALYSIS

The Bureau's index of business conditions, like many of the well-known national indexes, is largely, but not wholly an index of the physical volume of production and distribution. The primary purpose of indexes of this kind is to furnish a single measure of what is loosely termed "general business," that is comparable for all periods within the range covered by the index, and which at the same time contains a sufficient number of representative series of data as to be a reliable index of the business activity of the region. The most useful data for the construction of regional business indexes appear in monthly form. Annual data are of almost no use in studying a current situation, and weekly data, except insofar as they may be used in estimating tardy monthly reports, do not give enough information over that furnished by monthly figures to warrant the additional labor of compilation. Many items are also available in monthly form only, and where a portion of the data are available in monthly form, there is no advantage in collecting the remainder on a weekly basis.

Before any data, particularly those compiled on a monthly basis, may be used as a part of a business index, they must be corrected for certain variations which are inherent in practically all business figures; otherwise comparisons among different periods of the index cannot be made. The fluctuations occurring in business data for which adjustments must frequently be made before the figures for different periods are directly comparable are: Long time growth, or decline, whichever the case may be; month to month changes, due to seasonal demand for the product or service; episodic movements, which produce pronounced changes in the volume of business, and which recur at frequent but irregular intervals, such as strikes in the coal mining industry, etc.; and accidental interruptions in business, such as, earthquakes, floods, droughts, etc., which may seriously affect the business activities of a region. Once business data are corrected where possible for the above variations, the activity of any industry or trade, for any number of periods under consideration, or the activities of

several different lines of industry or trade for a single period, may be compared with some degree of accuracy. The more common adjustments which are applied to business data are the corrections for trend, or long time growth, and for seasonal variation. These will be discussed next.

The Elimination of Trend.

Everyone is familiar in a general way with the growth of industry as a whole in the United States, and with the rise and decline of certain industries. The production figures of the Census of Manufactures furnish an illuminating example of the growth of manufacturing during the past century. The rapid expansion of the automobile industry in the early years of the present century, and the even more recent rise of the radio and air transport industries illustrate the rapid growth which often takes place in the formative period of an industry.

The introduction of new industries is not always a net gain, for with the appearance of new industries, old ones may be supplanted almost immediately, or their activities so impaired that the total output declines gradually with the growth of the newcomer. The rapid demise of the horse-drawn vehicle business with the coming of the automobile, and the almost automatic substitution of the radio for the phonograph, indicate how rapidly progress may affect the outlook of seemingly stable industries; while the gradual substitution of electric power for other forms of energy, and the more efficient use of coal thru the production of electrical energy, illustrates how changes in technology may gradually bring a decline in the output of a basic industry like coal, altho industrial production as a whole may be steadily expanding. Business remains static only momentarily; and every industry over a period of time is either increasing its production and adding to its facilities, or it is contracting its output, and dropping off some of the units of production. Whether these changes are rapid or gradual depends upon many factors, among which are the extent of the maturity of the particular industry, and its importance in the whole industrial system. Illustrative of these trends, the statistical measurements of the rise or decline of some major industries are presented in the paragraph below.

From 1901 to 1913 the average annual increase in the production of raw materials was slightly more than two per cent per annum, while that of manufactured goods was almost

four per cent. From 1922 to 1929 the annual rate of increase for raw materials was two and one-half per cent, and that of all manufactured goods, four and one-half per cent. Thus, if we disregard the violent gyrations caused by the war, the growth of raw material production has been slightly more than two per cent, and that of manufactures somewhat more than four per cent per year, for the first quarter of the present century. During the pre-war period of the present century, population increased about two per cent per annum, and in the post-war period the growth declined to less than one and one-half per cent per year.

With a constantly changing manufacturing technique, and an ever-shifting consumer preference, it is obvious that all industries do not grow at the same rate, nor does prosperity and depression treat all industries impartially. In the early years of the present century there was a substantial expansion of industrial output, and a majority of our industries made material gains, yet the growth was not uniform; some lines made rapid gains, while others were contracting their output during the period from 1901 to 1913. Motor vehicle production increased about forty-five per cent annually, while freight car and vessel construction receded one and four per cent respectively, per year. In the post-war period, automobile production slowed down to a gain of about six per cent per year while the production of locomotives declined almost fifteen per cent per year. In both the pre-war and the post-war periods of the present century, industry was forging ahead at a steady rate, but the rates of growth were widely divergent, and some industries actually made substantial annual declines. It is only by appraising these changes thru some process of statistical measurement that we are able to determine if industries are in a period of expansion, working toward stabilization, or have passed their zenith and are on the decline. It is necessary that we know the trend of each industry if we are to compare the production of the current year with that of any preceding period. In this bulletin are presented the trends for Indiana of those industries of importance in the state.

Seasonal Variation.

Few industries are unaffected by seasonal changes. Weather and climatic conditions which are characteristic of each season of the year affect both the production and con-

sumption of goods. Altho the peak of production of most lines of manufacture is some months in advance of the peak of consumption, nevertheless production follows the same relative variations as consumption. While seasonal variation is largely a matter of climatic conditions it is not wholly dependent upon climate; customs and habits of consumers are not wholly dictated by climatic conditions. Religious and civil customs such as the observation of the Christmas and Easter seasons, and the celebration of the anniversaries of national events, are responsible for the seasonal demands for certain types of merchandise.

Occasionally thru judicious and persistent advertising and selling methods the seasonal peaks in the sale or consumption of certain commodities can be changed. The demand for women's fur coats, which once had a mid-winter peak, thru the efforts of retail stores was moved to August, and once the August peak was established it was found to be unprofitable, and retailers have again united their efforts in trying to eliminate the August peak and reestablish the mid-winter demand. Seasonal demands may remain relatively stable over a period of years, or they may change to the extent that certain peaks may be entirely eliminated, or shifted to other months of the year. Refrigeration, rapid transit, and national advertising have greatly reduced the usual seasonal peaks in the consumption of certain food products, such as, cranberries, ice cream, etc. Improvements in the technology of manufacturing may often change the seasonal demand for products. The construction of hard surfaced highways and the enclosed type of automobile, along with the early emphasis upon winter sales of automobiles have completely changed the monthly distribution of automobile sales within the last two decades. Despite the gradual shifting of the seasonal demand for many commodities, few industries have no seasonal load, and practically every series pertaining to production, distribution or transportation must be corrected for the usual month to month variation, which is fairly persistent over a period of years. There are several recognized methods of correcting data for seasonal changes. The more common methods are shown in detail in the appendix to this study.

The Business Cycle.

A third characteristic movement of business is the business cycle. A casual examination of any series of business data, whether production, sales, or finance, over a period of time will show a wave like movement, which is made up of a more or less regular sequence of expansion, boom, recession and depression; the four periods covering a complete price movement consisting of a rapid upward movement, then a downward swing followed by a slight rise in prices. A minute study of the fluctuations of many series of business data shows that different lines are not always affected simultaneously by the alternate swings of the business cycle. While some lines are in acute depression, others may be in fair or even intense prosperity; altho the counter-movement of certain series may be almost wholly obscured by the trend of a majority of the series. The unsatisfactory condition of the coal industry in 1928-29 was almost lost sight of by a majority of our population who were watching the wild gyrations of the stock market and the expansion of industrial profits. There is a fair degree of regularity in the fluctuations of business, so that any chart of business activity covering a century or more will show about an equal amount of prosperity and depression. As a matter of fact in the United States from 1790 to the present we have had one and one-half years of prosperity for each year of depression. In England for the same period the rate has been about even, that is, one year of depression for each year of prosperity.

Even though most business series when examined over a considerable period of time, show a rather even wave-like movement, it must not be assumed that business is always in one of the orthodox stages of the business cycle; that each stage follows its predecessor in regular sequence, or that each complete cycle is an exact duplicate of the preceding one. A period of recovery may be followed by one of comparative stability, which is neither prosperity nor depression, but a period of what may be termed "economic equilibrium" about which business may oscillate for some time. Periods of this type followed the depressions of 1893, 1907, and 1921.

No two business cycles are exactly alike in constitution, intensity or duration, but practically all have been characterized by complete price movements, and all periods of rising

prices have ultimately come to an end. With the termination of each great upward price movement have come the elimination of profits, curtailment of production, the deflation of credit, unemployment, business failures, and other economic and social maladjustments which follow in the wake of a price collapse.

Impressed by the constant, though not regular recurrence of the wave-like movement of business, economists and business forecasters have sought to find the causes of business cycles. As in the study of any unsolved social or physical phenomena, there has been amassed a sizeable bulk of theory dealing with the causes and behavior of business cycles. Even though we grant that some theory is necessary in advance of any investigation of such a complex economic labyrinth as the behavior of business cycles, one may generalize that the principal weakness in the study of this branch of economics has been a maximum of theorizing and a minimum of statistical measuring, and a tendency to read into the measuring which has been done, a mathematical exactitude and regularity of sequence which does not exist. The practical business man need pay little heed to the many conflicting theories of the causes and control of business cycles, but he cannot disregard the statistical measures of business fluctuations, for the latter, stripped of the effects of seasonal influences and of long time growth or decline, enable him to ascertain the trend of business, and shape his policies accordingly. It is not the purpose of this study to present a theoretical analysis of the causes of the fluctuations in business, but to furnish the methods of measuring these fluctuations, along with suggestions for the utilization of these measures in estimating business conditions in Indiana. Inasmuch as many may not be interested in the mathematical processes involved in handling the data used in this bulletin, the formulæ are presented separately in an appendix.

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Chapter III

THE INDIANA BUSINESS CURVE

In its present state the Bureau's index of business conditions in Indiana comprises eleven series, weighted and combined so as to give a reliable cross-section of business activity in the state. Many of the series are compiled from figures obtained from private sources, and which in their original form are confidential. Thus all the data upon which the index is based cannot be presented in their original form, but a sufficient number of derivative figures will be given to support any conclusions which may be drawn in interpreting the data. Since the statistical treatment of all the series is practically uniform, most of the illustrations will be drawn from the data obtained from public sources.

A word of caution in the use of the indexes presented in this bulletin may be appropriate at this point. The Bureau staff believes that the indexes which comprise the business curve as published by the Bureau are reliable indicators of current business conditions in the state. No accurate appraisal of the future trend of business can be made without a thorough knowledge of past and present conditions, but these indexes furnish only this information, and it is not presumed that an extension into the future of the trends which have been applied to the series to date is any indication that future business volumes will follow these trends; they merely indicate the trend to date, which may be used as a guide in forecasting the future of business activity only after all other influences have been carefully analyzed.

1. Pig Iron Production

This series is based on the monthly output of pig iron in the Indiana-Illinois district as reported in the Iron Age. It is possible to segregate the output of the furnaces in Indiana from those in Illinois, but since a majority of the output is in Indiana, and the whole South Chicago-Calumet region is industrially an entity, no attempt has been made to separate the Indiana production from that which is produced just across the state line.

Pig iron production has long been used as one of the barometers of industrial activity. Its production like that of some other industrial products and raw materials has certain defects as an index. The swings of pig iron production are wider thru the various stages of the business cycle than those of industrial production as a whole. Also the increased use of scrap materials due to their alloy content has caused the trend of pig iron production to flatten out more during the past decade than the trend of steel production. Pig iron production fluctuates currently with the movement of the business cycle, and while the movements reflect the current tempo of business rather promptly, they do not anticipate the changes of the latter with sufficient regularity or accuracy to permit the use of pig iron production alone as a mechanical forecaster. Nevertheless, the use of steel products is so universal, and the figures upon pig iron production are so easily available that it continues to be a very usable index of current business activity. In the case of Indiana, pig iron production is of more than usual significance as an index of industrial activity within the state; for not only is the Indiana-Illinois district one of the major producing areas of the country, but almost half of the state is covered by an industrial region using steel as its chief raw material. In 1929 the value of all manufactures in Indiana was roughly two and one-half billion dollars, of which fully one-half represented manufactures made chiefly from iron and steel. The value of iron and steel production in the Calumet district was over \$400,000,000 in 1929.

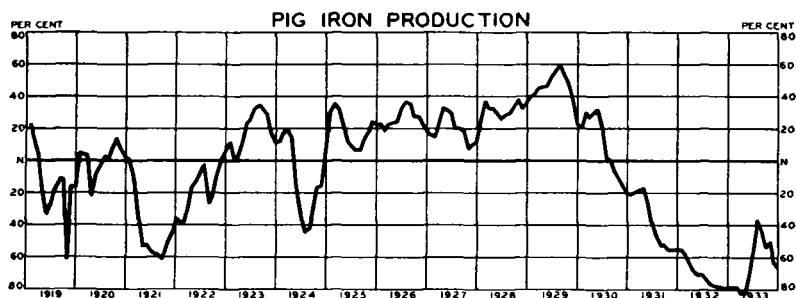
Pig iron production in the Indiana-Illinois district from 1919 to 1933 has had an average annual increase of slightly less than 30,000 tons. The seasonal movement has been as given in Table I below.

TABLE I
SEASONAL VARIATION OF PIG IRON PRODUCTION

Indiana-Illinois District 1919-1933			
Average Month=100			
January 97.9	April ..106.3	July .....100.5	October .....96.1
February .. 95.0	May ....109.6	August 97.8	November ..94.5
March .....109.9	June ....102.5	September . 92.2	December ....97.7

Figure 1 shows the cycles of pig iron production in the district after the figures have been adjusted to make allowances for seasonal fluctuations and long time growth.¹ The effects of the recessions in business in 1921, 1924, and since 1929 are shown very clearly in the cyclical fluctuations of this series. A comparison of Figure 1 with the Bureau's composite index of business in the state as given in Figure 12, page 43, shows that the cycles of pig iron production have followed very closely those of business as a whole in the state.

Figure 1



2. Building Construction

The construction of new capital equipment, new plants and new industrial buildings; the erection of skyscrapers, commercial and apartment buildings; and the building of new homes; is one of the major industries in the United States. No other major industry draws raw and finished products from so many varied sources, nor employs such a high proportion of hand labor. For these reasons the volume of building activity is a good current index of business activity, and a fairly good forecaster of future demand for certain household furnishings. The volume of residential building is normally a good forecaster of the demand for paint, since repairing and painting of existing structures follow closely the activity in new building construction.

¹ The curves shown in Figures 1 to 15, inclusive, are the percentage deviations from the estimated normal represented by N.

Building construction figures are reported currently in two principal forms; value and square feet. Construction figures which cover not only building but other forms of construction, such as, highway, street, sewer, hydraulic and electrical projects are given only in value. Building estimates are available from two sources; building permits issued, and building contracts awarded. Building permit figures represent contemplated construction in our larger cities, and are not a very satisfactory estimate of actual building construction, since many contemplated projects are never undertaken. Building contracts awarded, on the other hand, representing contracts actually awarded, are subject to less error in value than are permits, cover more cities, and as a whole are a very much more satisfactory measure of the activity in the industry. Both permits and contracts have one inherent weakness as current barometers of the industry; they are subject to wide fluctuations due to the awarding of large contracts, or a large number of contracts at irregular intervals, and the fact that there is no constant lag between the time of the awarding of the contracts, and that of the peak activity on the projects covered by the awards. Since the peak of building activity frequently follows from one to three months after the award of the contract, the original figures should be leveled by using the average figures over a three-month period. Applying a three month moving average not only eliminates a portion of the erratic fluctuation of the building contract figures, but also gives a figure which is more in accord with the actual activity in the industry.

The most reliable classified building figures available are those published by the F. W. Dodge Corporation for thirty-seven eastern states. As far as possible these figures are classified, and are shown both in value and square feet. The building figures used by the Bureau in the index of business activity in the state are the square feet figures for Indiana of the F. W. Dodge Company. Using square feet figures in lieu of value data may be open to some criticism, but it is desirable in presenting an index of the physical volume of business which minimizes price changes, to eliminate as many price factors as possible. In the long run it may be questioned whether square feet figures of building introduce as many errors as do the price changes which are reflected in the value figures.

In the years which have followed the World War the United States has experienced three waves of speculation. In order of their appearance these booms have been the agricultural land boom, the urban real estate boom, and lastly the stock market boom of 1929. The effect of the urban real estate boom is shown by the trend of contracts awarded in Indiana from 1919 to 1933. The two major peaks in building in Indiana were in 1919 and 1927, with minor peaks in 1922, 1925 and 1928-29. The trend over the whole period from 1919 to 1933 has been slightly downward with an average decrease of roughly 800,000 square feet per year. Statistically, building figures for Indiana require considerable adjustment for seasonal fluctuations even after the original figures have been smoothed by a three-month moving average centered on the current month. The seasonal distribution, with the average month as 100, is as indicated in Table II below.

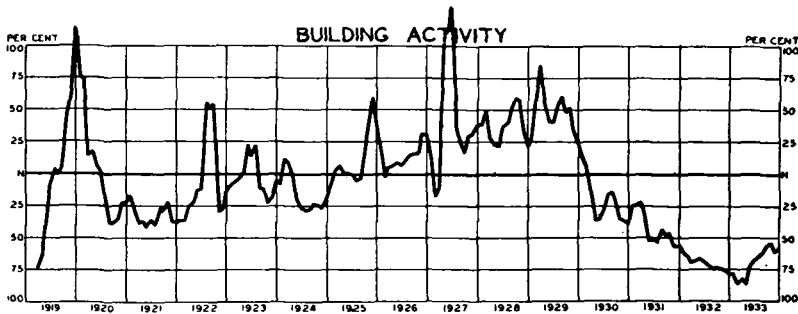
TABLE II

SEASONAL VARIATION OF BUILDING CONTRACTS AWARDED

Indiana 1919-1933			
Average Month=100			
January .....69.5	April ....109.6	July .....120.9	October ....100.3
February ....65.2	May .....125.6	August .....117.4	November .94.0
March .....81.5	June ....126.3	September..107.7	December ....82.0

In Figure 2 are shown the cyclical fluctuations of building contracts awarded in the state after a three-month moving average has been applied to the original data, and adjustments have been made for seasonal variation and long-time trend. It will be noted that despite this statistical treatment, building contracts are still highly erratic in their month to month fluctuation. Employment in the building industry, though highly seasonal, does not show the erratic movement characteristic of contracts awarded, indicating that a part of the fluctuation in the building series is inherent in the method of collecting the data. Altho not an entirely satisfactory index of building operations, building contracts awarded are nevertheless the best index of building construction available, and until a better index is devised, the best compromise seems to be the use of an average of building contracts awarded covering several months, rather than the figure for a single month.

Figure 2



3. Automobile Production

The automobile industry is essentially a mid-western institution. The industry obtained its early start in Ohio, Indiana and Michigan, and since has remained in the proximity of the two great steel producing centers; the Calumet region of Indiana, and the Pittsburgh-Mahoning Valley district. Indiana has always been in the forefront as a producer of automobiles. From 1910 to the present, the production of automobiles has been one of the ten leading industries of the state. In 1910 the industry ranked seventh among the manufacturing industries of the state; but since 1921 automobile production has been the state's second largest enterprise, with an annual product value frequently exceeding two hundred million dollars.

With the expansion of the automobile industry, the manufacture of automobile parts and accessories has become an increasingly important industry in the Middle West. In 1925 automobile parts and accessory manufacturing was the tenth leading industry in the state; in 1929 this industry was fifth in importance, with an annual product value close to one hundred million dollars. Over a period of years the production figures of both automobile and automobile accessory companies taken as a whole, are affected in the same manner by the rise and fall of business conditions, and an accurate index of the vicissitudes of one industry is also indicative of the fortunes of the other. Reliable figures which measure auto-

mobile production are available for Indiana, but no comprehensive current measure of accessory production can be readily obtained. For this reason, the Bureau has chosen to use the data on the production of automobiles in Indiana as its measure of the entire motor vehicle industry in the state. Automobile production in Indiana is no longer in its formative stage; it is represented by relatively few companies, most of whom were pioneers in the field, and consequently the data over the last decade or more have not been disturbed by the entrance and exit of numerous light car manufacturers. For this reason the number of units produced, rather than the value of the output has been taken as the measure of the industry's activity from month to month. Automobile production in the state like that of the industry as a whole over the last decade, shows a very rapid growth in the early years, with a marked deceleration in the rate in recent years. The Bureau's figures extend back to 1919, when the value of the industry's output in the state was in the neighborhood of one hundred million dollars. The last two years before the depression, that is 1928-29, were the best in the history of the industry in the state, both from the point of view of number of units produced, and in the value of total output. Since 1929 the industry has been affected by the reduction in consumer buying power, and the output has been reduced sufficiently to give an average annual decrease in the number of units produced of about one thousand cars per year for the entire period from 1919 to 1933.

The extension of hard surfaced highways within the past ten years until the national network now exceeds in mileage that of the railways, the construction of well insulated automobile bodies, improvements in the efficiency and convenience of automobile heating, and the perfection of anti-freezing compounds, have all but eliminated the seasonal factor in the use of the motor vehicle; but due to consumer buying habits, and production practices, the manufacture of automobiles has yet a wide seasonal variation. The seasonal movement of the production of motor vehicles in Indiana is shown in Table III.

TABLE III

SEASONAL VARIATION OF AUTOMOBILE PRODUCTION

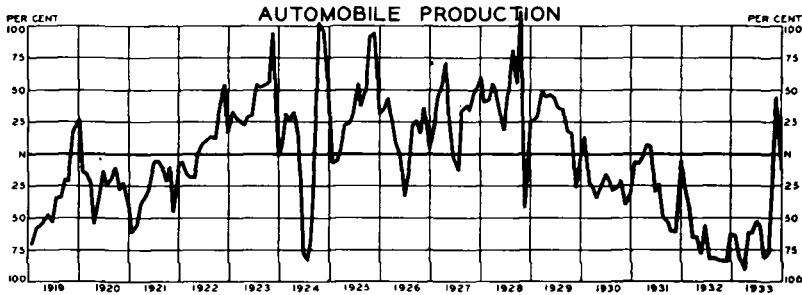
Indiana 1919-1933

Average Month=100

January 78.9	April ....130.1	July 99.8	October .....75.7
February ..101.8	May ....129.4	August .....109.8	November ..55.6
March .....135.7	June ....123.2	September.. 98.5	December ...61.5

The cycles of the activity of the industry after corrections have been made for seasonal fluctuations and trend for the period, are shown in Figure 3. A comparison of Figure 3 with Figure 1 on page 11, or Figure 12 on page 43 shows how widely the fluctuations of automobile production have deviated from the cycles of either business as a whole, or of the more stable industries like pig iron production. The erratic gyrations of the cycles of automobile production emphasize the difficulty of producing a consumer product with a large style factor and a high unit value. The history of automobile manufacture as a national industry has been one of two years of prosperity alternating with one of famine. Altho our largest single industry, it has been the most disorganized of all major manufacturing industries from the point of view of regulating output to consumer demand. A part of this condition has been due to the nature of the product, but a larger part has been caused by the organization of the industry. Automobile production in Indiana has suffered from the same disturbances which have affected industry as a whole, a fact which may be gathered from the curve in Figure 3. This chart shows that in some years, when the trend of business was plainly downward, production of automobiles in terms of units was on the upgrade, and at other times when business was distinctly improving, the automobile industry was curtailing its operations. Thruout the greater part of the period since 1919 production has alternately exceeded and fallen behind the retail demand for cars, resulting in alternate periods of expansion and contraction in the industry.

Figure 3



4. Coal Production

As a part of the Indiana-Illinois coal region, Indiana is an important producer of bituminous coal, and the welfare of a sizeable section of the state is dependent upon the prosperity of the bituminous coal industry. Nationally the coal industry has not shown the steady growth during the last decade which has characterized the development of many other heavy industries. The substitution of hydro-electric energy for coal, the expansion of the oil industry, and the more efficient use of coal in the generation of electric rather than steam power, have curtailed the output of the coal industry. Indiana coal operators as a group have felt the curtailment in the use of the commodity more than the industry as a whole, since the quality of the product, the cost of operation, and the cost of transportation have all been unfavorable to the Indiana producers. For these reasons the long time trend of coal production in the state has been downward. The Bureau's figures on Indiana coal production which extend back to 1910, show an average annual decline of slightly more than ninety-one thousand tons for the period from 1910 to 1933. Unless there should be a revival in industrial activity much in excess of any experienced since the war, it seems probable that the trend of coal production will continue to be downward for some time in the future.

Coal production has a distinct seasonal movement, since production due to the nature of the product must follow con-

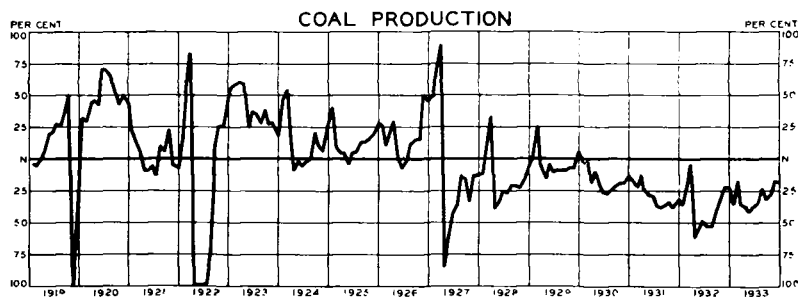
sumption rather closely, and the latter of course is highly seasonal. The seasonal movement of coal production in Indiana is shown in Table IV.

TABLE IV
SEASONAL VARIATION OF COAL PRODUCTION

Indiana 1917-1933			
Average Month=100			
January ....117.3	April .....83.8	July 88.4	October ....117.1
February .. 97.0	May .....87.9	August 96.1	November..108.6
March .....101.9	June .....85.0	September..102.2	December ..114.7

The cycles of coal production shown in Figure 4 are very erratic and do not follow the pattern of those of other basic commodities such as pig iron, etc. Some of the reasons for this behavior have already been explained; the coal industry did not participate in the 1925-29 industrial expansion, and production in the Indiana-Illinois district was even more depressed than in the nation as a whole. Another reason for some of the more pronounced fluctuations has been labor difficulties in the district. The declines shown in 1919, 1922, 1927, and in 1932 were caused by the suspension of the operations of either all or a part of the mines in the district pending the settlement of labor disputes. Operating agreements are ordinarily made for a definite period, and when such agreements are not renewed or extended prior to their expiration date, it has been customary for the operating companies to accelerate operations and accumulate stocks, and for large consumers to likewise anticipate their needs prior to the termination of the operating agreements. For this reason, each decline which has occurred by reason of an agreement termination has been preceded by a more than normal level of operation, making the decline more drastic than it would have been, had it started from a more normal level. Obviously no correction for labor difficulties can be applied with any degree of success to the original data, for not only are they accidental in their appearance, but they also continue for varying periods of time. The cycles of coal production as shown in Figure 4 emphasize the necessity of having barometers of business activity which reflect more than a national average of all industries. To be of the utmost value, indexes of business must not only reflect the activity of each major industry, but also its activity by regions.

Figure 4



5. Stone Production

In only a few restricted areas in the United States is the production of stone of sufficient economic importance to merit its inclusion in an index of industrial activity of the region. The Bloomington-Bedford Oolitic stone district is one of the areas which must be considered of primary importance to the welfare of its locale. Somewhat more than fifty per cent of all building stone used in the United States is limestone, and almost ninety-five per cent of all building limestone is produced in the Bloomington-Bedford district. The value of limestone production in Indiana is about two-thirds that of coal production, but the area covered by the industry is very much smaller than that of the coal region. The limestone district covers roughly two hundred and forty square miles, while the coal fields cover approximately forty-two hundred. The value of stone produced in the district is considerably greater than the value of all other manufactures in the district, and about ten times that of the agricultural products raised in this same area. The wage payments of the limestone industry when operating at normal capacity are about twelve million dollars annually. A twenty million dollar industry may be relatively unimportant in a state where the total manufactures are valued in excess of two billions, if the industry is decentralized and fairly well diffused thruout the state, but when it is centralized in one or two counties, and becomes the chief economic activity of even a restricted section of the state, its activities

become significant. Accordingly, stone production has been made one of the indicators of business activity in Indiana. The use of Oolitic limestone is confined almost wholly to the building industry, and the demand for limestone is affected principally by the demand for certain types of buildings; such as, commercial, public, educational, religious, fraternal, and memorial buildings, rather than by the activity in the industry in general. For this reason the volume of Indiana limestone consumption does not necessarily follow the shifts in building volume. When the building industry as a whole is affected by a building boom, such as that which occurred prior to the stock market boom, the activity is reflected in the limestone industry, but on the other hand, an increase in the building activities of governmental corporations at a time when residential and industrial building is at subnormal levels, also may introduce a period of considerable activity in the limestone industry. In part, this condition is shown by the long-time trends of the building and limestone industries. Over practically the same period of time, 1919 to 1933, the trend of the building industry has been downward while that of the stone industry has been upward. The Bureau's figures on Indiana limestone production which are based on the number of cubic feet of limestone produced in the district, show an average annual increase of over four hundred thousand cubic feet for the period from 1919 to 1933.

Climatic conditions and customs in the building industry have given the production of Indiana limestone a seasonal movement, altho the movement of the latter is less marked than that of the building industry. Table V indicates the month to month variation in limestone production.

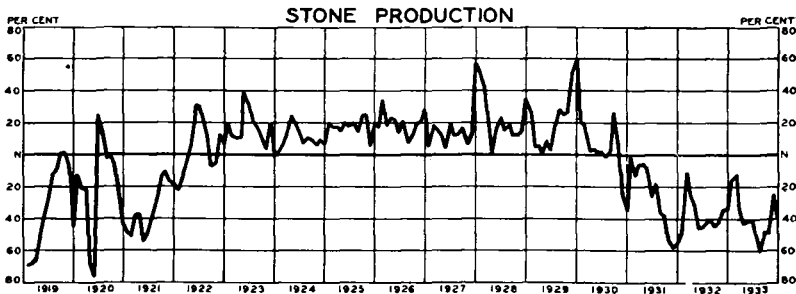
TABLE V
SEASONAL VARIATION OF LIMESTONE PRODUCTION

Indiana 1919-1933			
Average Month=100			
January .....79.4	April ....102.4	July .....106.9	October ....120.2
February ....73.0	May ....103.1	August .....121.8	November.. 98.4
March .....89.8	June ....108.6	September..107.7	December .. 88.7

As might be anticipated from the nature of the uses of building limestone, the output of the district when corrected for seasonal variation and long-time trend, has not followed

the erratic ups and downs of the building industry, nor have the cycles of stone production coincided with those of the business index for Indiana. The curve of the stone industry in Figure 5, shows that only the two major declines in business since the war have seriously affected the limestone industry. With the recovery in 1921 stone production in the district was remarkably steady until late in 1929. The fact that the plans of governmental departments, educational and other semi-public organizations are not seriously impaired by temporary fluctuations in industry and trade, is largely responsible for the relative stability of the stone demand.

Figure 5



6. Electricity Production

The Bureau's index of electricity production is based on the energy generation reports of the Edison Institute and the United States Geological Survey. Interconnections among large generating units make it impractical to use the figures for Indiana alone; consequently the figures for Ohio, Indiana, Michigan, and Illinois are used as an index of electrical energy consumption in this region. The purpose of the use of energy production figures also makes it impracticable to use Indiana figures separately, since the figures are used as an index of commercial and industry activity in the state and not solely as a measure of the activity of generating plants. Industrial activity by lines does not vary greatly at a given time thruout the industrial region formed by Indiana and several of the ad-

jacent states, but the reports on electrical energy production for the nation as a whole indicate that business activity in this industrial region often varies greatly from that of other regions of the United States. The increasing quantities of energy which are being used in new home appliances, new commercial uses, and new industrial processes—a trend which is not yet complete—has given electricity consumption a remarkable growth since the war. The average annual increase in the consumption of electrical energy in the region covered by the Bureau's figures has been over a billion kilowatt hours; a growth so rapid that it is difficult to estimate the future trend of the industry.

Electricity production has a very narrow seasonal movement, and as the use of energy becomes more universal and diversified it appears probable that the movement will continue to become less and less distinct. Table VI shows the average seasonal fluctuations of energy production in Ohio, Michigan, Indiana, and Illinois.

TABLE VI

SEASONAL VARIATION OF ELECTRIC PRODUCTION

Ohio, Michigan, Indiana, and Illinois 1919-1933

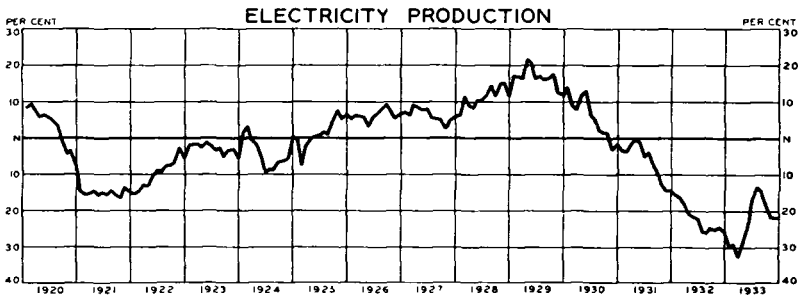
Average Month=100

January	107.2	April	96.7	July	94.3	October	105.0
February ..	97.1	May	96.1	August	97.5	November ..	102.6
March	103.6	June	94.3	September ..	97.7	December ..	107.9

Electric energy production is the most stable of all physical volume indexes. The large number of varying uses by which electric energy is consumed, many of which do not vary directly with either industrial production or consumer buying, have given this series a stability not present in many physical volume indexes. The unit operation of machines has made electric energy consumption fluctuate more directly with industrial output, but even unit operation does not entirely eliminate the discrepancies between industrial production and industrial energy consumption which occur with the varying load factors under which machines may be operated. Another steadying factor has been the domestic use of energy. Domestic consumers may curtail their use of current as the family income is diminished, but this curtailment is not automatic,

nor is it in direct proportion to the curtailment of the purchasing power of the consumer. Lastly, the rapid growth of the total consumption has had a tendency at some periods to obscure the curtailment in consumption of energy by certain groups of consumers. Figure 6 shows the cycles of electric energy consumption in the area covered by the Bureau's figures from 1920 to 1933.

Figure 6



7. Bank Debits

Debits to individual accounts are reported to the Federal Reserve Board by members banks in seven cities in Indiana; Indianapolis, Terre Haute, Gary, Muncie, Fort Wayne, South Bend, and Evansville. Clearings are available for other centres for varying periods of time, and altho these figures are used currently by the Bureau as one of the indicators of local business conditions, no index of clearings is included in the Bureau's business index. Beginning in 1919 debits to individual accounts were collected in four cities, Indianapolis, Fort Wayne, South Bend, and Evansville. In 1922 Gary was added to the group, in 1923, Terre Haute, and in 1924, Muncie. Trends and seasonal indexes have been calculated for the various centres grouped according to the length of the period for which the debit figures have been available. The deviations from normal of the debits of the different reporting groups have been combined on a percentage basis for the whole period from 1919 to 1933. For example, in the early portion of the

period the debits of Indianapolis, Fort Wayne, South Bend, and Evansville represent one hundred per cent of the index. After the addition of Gary, Terre Haute, and Muncie in the years following 1919, the debits of the original four centres represent slightly less than eighty-five per cent of the total. The percentage weights of each group of reporting centres has been based from year to year upon the proportion which the debits of a particular reporting centre were of the total debits reported during the year by all the cities.

Altho the Bureau's index of business activity is primarily a physical volume index, there has been no hesitancy in adding dollar series to the index where it was evident that such additions would improve the representativeness of the index. The utility and not the technique of the index has been the goal all thru its development. Thus, bank debits have been included without deflation or inflation for theoretical changes in the price level of all goods and services. Bank debits represent expenditures for food, clothing, luxuries, services, speculative ventures, rentals, wages, capital goods, and a host of other goods and services, not susceptible to classification, and for which there may be no recognized price. A cursory examination of the seasonal indexes of nearly twenty lines of activity in the state ranging from pig iron production to life insurance sales gives very strong evidence that bank debits in Indiana are influenced seasonally by the seasonal rise and decline in each of the twenty-odd lines of activity for which the seasonal movement has been carefully determined.

It appears that in one period of the year Indiana bank debits are influenced predominantly by the seasonal rise in the heavy industries; pig iron, steel, building, automobile and allied lines. At another period, distribution, largely other than retail trade is the major influence, while at a third period the seasonal rise in bank debits is caused by the expansion in retail trade. This changing character of bank debits may be less pronounced if spread over the nation as a whole, for sectional differences may offset each other, but the Bureau's index is concerned with Indiana and must be governed by local conditions. Where the composition of bank debits is changing markedly from month to month, or from quarter to quarter, any price index, even if reasonably accurate for the series which it represents, will not correctly deflate or inflate bank debits for

much more than a fourth of the time. There can be no reasonably accurate index of retail prices as a whole, and any index for the deflation or inflation of bank debits, purporting to compensate for changes in the prices of all commodities and services would be even more statistical fiction than some of our present price indexes. Even though it is impossible to deflate or inflate bank debits for all price changes, they are, nevertheless, in their unadjusted state, a valuable addition to any index of business conditions, for they furnish a wide sampling of the heterogeneous business activities of millions of people which may not be reflected currently in the physical volume indexes of our basic industries. For this reason bank debits are included in the Bureau's index of business conditions.

Trends of growth have been prepared for each of the four groups of cities, and for three of the groups the trend has been downward. In the fourth group, comprising the four larger cities, Indianapolis, Fort Wayne, South Bend, and Evansville, the rate of growth has been about two per cent per year for the period for which figures are available. The differences in the growth of bank debits in the different cities have been due in part to changes in business activity as a whole, and to differences in the severity of bank failures among the different centres during the past several years. Some cities for short intervals within the past two years had no banking facilities of any kind, while others were only slightly affected by the banking crisis.

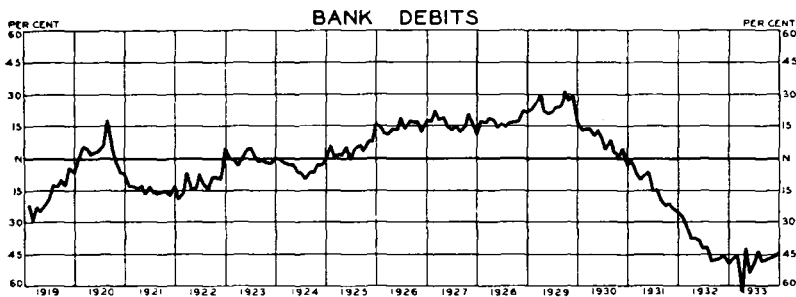
The seasonal movement of bank debits varies but slightly among the different reporting centres. In the main these differences can be traced to the differences in the prevailing types of industries found in these cities. Inasmuch as the seasonal differences are only slight, the composite index for the state rather than the seasonal indexes for all the centres will be given. Table VII shows the composite seasonal index for bank debits in Indiana.

TABLE VII
SEASONAL VARIATION OF BANK DEBITS

Indiana 1919-1933			
Average Month=100			
January ....102.4	April 97.4	July .....106.2	October ....103.3
February .. 88.5	May ....104.6	August 96.8	November.. 97.3
March .....100.5	June ....103.7	September.. 94.7	December ..104.6

A comparison of Figure 7 with the general business index, Figure 12, page 43, shows that the long-time swings of bank debits have about the same magnitude as those of the general business index, altho the month to month fluctuations of the latter are more pronounced than those of the bank debit index. Bank debits being a composite measurement of many diverse business transactions, all of which do not move concurrently in the same direction, would be expected to be much more stable over a short term than an index composed partially of series such as pig iron production, building, etc., having large month to month variations. It should also be observed that the month to month swings of the bank debit index usually follow rather than precede the similar movements of the business index. Here again we have evidence of the stabilizing influence of the many small consumer and other non-industrial transactions which influence the movement of bank debits, and which are not affected currently by changes in the tempo of industrial production.

Figure 7



8. Hog and Cattle Sales

Twenty per cent of the population of Indiana is engaged in some form of agricultural production, and the gross income of this important sector of the total population of the state is governed almost wholly by the crop yields and farm prices of the major products. In normal years the total gross cash farm income in Indiana exceeds three hundred million dollars, and

some current measure of this income is necessary in any index which is to reflect the trend of business in the state. Unfortunately adequate data on month to month changes in the income of the farmer are difficult to obtain. Current data on deliveries and prices of farm products are limited to those commodities which are handled regularly on the recognized commodity exchanges. Limiting the area for which agricultural incomes are to be obtained adds further difficulty to the problem, for rarely are the products which are handled on our organized commodity exchanges produced in the immediate locality of the market. This is true of grain receipts at certain central points in Indiana. Prices and car load receipts of grain are available for a few centres in Indiana, but the grain is frequently largely from neighboring states and is not a measure of agricultural income in Indiana. Prices for other commodities, such as poultry and dairy products are currently available, but there are no accurate data on deliveries. Prices alone are of little significance as a current measure of agricultural income, nor are data on physical deliveries of commodities alone of value, since high prices frequently indicate small deliveries, and the largest movement of agricultural products may come at the time when prices are close to the bottom. Taken alone, either prices or deliveries will frequently give an erroneous picture of agricultural incomes.

After considerable investigation of the possible sources of data on agricultural income, it was decided that the best indexes were cattle and hog receipts, corrected for changes in average prices. Receipts of cattle and hogs are obtainable each month for the four principal centres in the state. The average prices paid the farmer for these products are also available from the United States Department of Agriculture. About twenty-five per cent of the gross cash income of the farmer in Indiana is derived from the sale of live stock, and while live stock prices do not fluctuate directly with the farmer's total cash income, they furnish the only index that is available on a monthly basis for a restricted area such as the state of Indiana.

It being impossible to obtain live stock receipts in any measure other than numbers of animals, the price quotations cannot be applied directly to the receipts. However, with slight variations due to changes in the ratio between grain prices and live stock prices, it may be assumed that over a

period of years the average weight of the animals received at the stock yards is fairly constant, and for purposes of comparison the weight of the receipts may be ignored, and a composite index of receipts in units and average prices may be substituted for the value index which might be obtained by applying the average price to the total receipts in pounds, if the latter data were available. Accordingly, the Bureau's index of the value of cattle and hog receipts is derived from an index which is the product of the index of cattle and hog receipts and the index of average prices paid the farmer for each of the two kinds of live stock. Both live stock receipts and average prices are corrected for long time, and seasonal or month to month changes.

Hog receipts are available each month for four centres in the state; Indianapolis, Evansville, Lafayette and Muncie. All hogs marketed in Indiana are not received at these centres, but the geographical distribution of the four markets is such that the marketings are a reliable sample of hog marketings in the state, and undoubtedly constitute a very high percentage of the total deliveries. The Bureau's data on hog receipts, which extend back to 1915, show that hog production in the state increased during the period from 1915 to 1919, but has declined steadily since the later date. About one and three-fourths million hogs were marketed in the state in 1915; in 1919 almost three and one-half million; and in 1932 less than two million were received at the four markets; an average yearly decline for the period of about sixty-three thousand hogs. Hog marketings, like the movement of all agricultural commodities produced in the state have a distinct seasonal distribution; the period of heavy marketings being in the three winter months, November, December, and January. Table VIII gives the distribution of the movement within the year.

TABLE VIII

SEASONAL VARIATION OF HOG RECEIPTS

Indiana 1915-1933			
Average Month=100			
January ....115.3	April 86.8	July .....91.3	October ....102.9
February .. 81.8	May 99.1	August .....85.9	November ..124.5
March 76.1	June ....111.6	September ..86.6	December ..138.1

Hog Prices

The average monthly prices paid the farmer for hogs has been used as the price factor in determining the farmer's income from this source. The average price paid the farmer for a limited number of agricultural commodities is released monthly by the United States Department of Agriculture. In the Bureau's calculations average monthly prices from 1910 to 1932 were used. Hog prices, like hog production, reached their peak under the artificial stimulus of the war period, and have declined steadily since that time, until the average prices for recent years have been below those of the period immediately preceding the war. There have been numerous wide movements in the average prices paid the farmer in the twenty years covered by the Bureau's figures, but the trend of the prices over the period has been slightly downward. In 1910 prices averaged eight and one-half cents, and in 1915 less than seven cents; from which point they rose to the seventeen cent average for 1919. Since 1919 prices declined to an average of less than four cents for 1932. The average annual decline of the trend of prices from 1910 to 1932 has been about four-tenths of a cent per 100 pounds. The seasonal movement of hog prices, as would be anticipated, has been nearly the reverse of that of hog receipts, irrespective of the price level. Table IX shows the seasonal variation of hog prices from 1910 to 1933.

TABLE IX

SEASONAL VARIATION OF HOG PRICES

Indiana 1910-1933

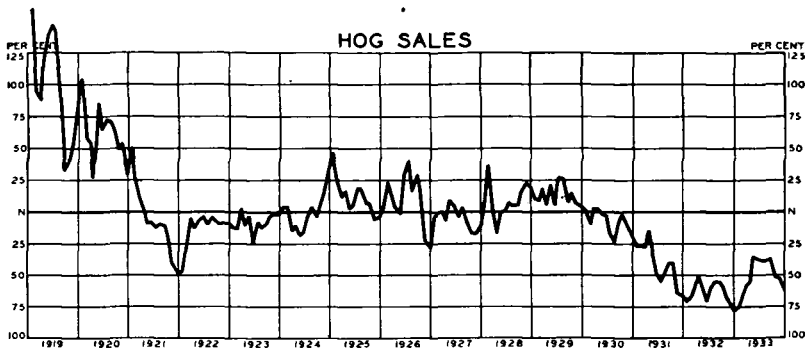
Average Month=100

January 95.0	April ....101.2	July .....103.2	October ....103.5
February .. 96.6	May 99.3	August .....107.2	November.. 94.7
March .....101.3	June 97.3	September..109.8	December .. 90.9

As shown by the above table hog prices over the twenty-four year period have been much higher during the months of August and September than in any other period of the year. Receipts on the other hand have been slightly lower in February and March than in August and September. Thus, so far as Indiana is concerned, a given quantity of hogs has brought much better prices in August and September than in February and March.

Figure 8 which is a composite of hog receipts and hog prices, reflects the trend of the monetary income of the farmer from this source after being corrected for seasonal fluctuations and long time changes in production and prices. What has happened to that portion of farm income derived from hog sales in the last decade is evident from the curve on the chart below. In 1919 hog receipts were close to three and one-half million, and prices averaged seventeen cents per pound. By 1932 receipts dropped under two million and prices under four cents. Thus, farm income from hog sales dropped from about one hundred and sixty per cent above normal in January, 1919, to roughly seventy-seven per cent below in December, 1932. The rather pronounced month to month fluctuations of the dollar value of hog sales is characteristic of the value figures for raw commodities; particularly raw commodities of which the production is dependent in part upon weather and crop conditions. The fluctuations are also due in part to the organization of the industry, which is characterized by a large number of small producers acting independently.

Figure 8



Cattle Receipts

The Bureau's index of cattle sales is derived in the same manner as for hog sales. Cattle receipts are collected from the same centres and at the same time as are hog receipts. The Bureau's data begin in 1916 on an annual basis, and have

been continued from 1919 to the present on a monthly basis. Due to the nature of the industry, cattle receipts did not respond to the war stimulus as did hog receipts. However, war-time restrictions on the slaughtering of immature cattle increased the quantity of beef reaching the market more rapidly than the number of animals, consequently the relative decline since the war in the number of cattle marketed has not been as great as that of hogs. In 1916 about two hundred and eighty-five thousand cattle were received at the four centres in Indiana; by 1920 marketings had increased to over three hundred and eighty-five thousand. Marketings then declined gradually from the 1920 peak, and in 1932 the total was some fifteen thousand under the 1916 figure. The average decline for the entire period from 1916 to 1932 was in the neighborhood of five thousand head per year. Cattle marketings in Indiana have a smaller seasonal variation than have hogs. The heavy seasonal movement of cattle precedes the hog movement by about three months. Table X shows the distribution of cattle marketings thruout the year.

TABLE X

SEASONAL VARIATION OF CATTLE RECEIPTS

Indiana 1915-1933

Average Month=100

January ....103.6	April .....98.8	July 97.8	October ....117.6
February .. 82.6	May .....95.1	August .....106.4	November.. 92.7
March 95.8	June .....99.5	September..109.2	December ..100.9

Cattle Prices

In determining the farmer's income from cattle marketings, the average monthly prices paid the farmer as reported by the United States Department of Agriculture have been used. Average monthly prices of cattle were obtained for the period from 1910 to 1932. Cattle prices, like those of hogs, reached their peak during the artificial demands of the war period, but unlike hog prices, they recovered partially from their post-war slump, and in 1928 and 1929 regained most of the ground lost in the decline from 1921 to 1927. In line with all wholesale commodity prices, cattle prices declined steadily from 1929 to 1933. The stability of cattle prices in

the post-war period has given them a long-time upward trend of about nine-tenths of a cent per one hundred pounds per year from 1910 to 1933. The seasonal movement has been much smaller and much more regular than that of hog prices. Table XI shows the seasonal movement of cattle prices in relation to the average month.

TABLE XI

SEASONAL VARIATION OF CATTLE PRICES

Indiana 1910-1933

Average Month=100

January	96.9	April	102.0	July	102.5	October	99.1
February	97.4	May	103.3	August	102.3	November	96.0
March	99.4	June	103.0	September	102.2	December	95.9

It will be noted in comparing Table XI above, with Table X, on page 31, that the seasonal indexes of cattle receipts and cattle prices are not reciprocals of each other, as they might be if cattle prices in Indiana were governed wholly by cattle receipts in the state. This discrepancy is due to the fact that cattle prices in Indiana are affected markedly by receipts at other primary markets such as Chicago, Kansas City, etc., for example, and are not wholly dependent upon receipts at certain Indiana centres. Cattle receipts in Indiana are seasonally the lowest in February, but prices are also close to the low of the year in this month. October marks the high point of cattle receipts in the state, but October prices are seasonally higher than those of the months from September to March when receipts are much lower.

Figure 9

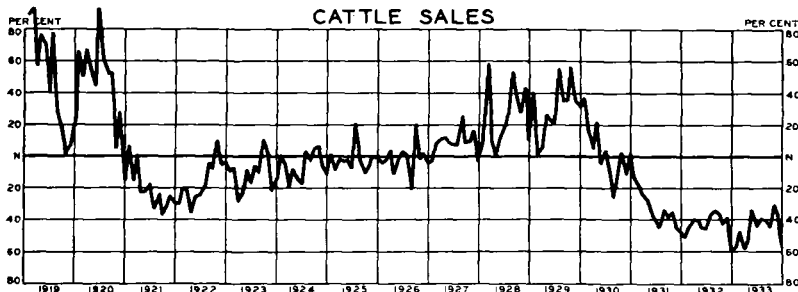


Figure 9 shows the trend of the monetary income which the Indiana farmers have received from cattle marketings from 1919 to 1933. This index does not include all the cattle marketed in the state for the period covered, nor does it include the income from marketings of calves, but the percentage of the total cattle marketings covered by the index is so large that it affords a good barometer of the farmer's income from this commodity.

A comparison of cattle sales with hog sales since 1919 shows that relatively, the gross income from cattle marketings in the state did not reach the extremely high levels reached by hog marketings in 1919 and 1920, nor did cattle sales recover as rapidly after the 1921 slump. On the other hand, the recovery in cattle, once it got under way, was more substantial in 1928 and 1929 than was that of hogs, for in the latter years both cattle receipts and prices were relatively higher than hog receipts and prices.

In determining the month to month variations in the gross income from live stock marketings, the variations from the long time trend of receipts in the form of index numbers were multiplied by the like variations of hog and cattle prices from their long time trends. The product of the indexes of prices and receipts was used as the monthly index of sales or gross income. It is recognized that due to changes in the supply and demand of animal feeds, there may be variations in the average weights of the cattle and hogs marketed each month, which would affect the gross income which farmers receive from this source, but in this index we are attempting to chart the relative changes in the farmers' incomes rather than to measure the total amount at any given time. Thus, any sample which varies directly with the total is just as useful for barometric purposes as the total itself.

In order to eliminate as many variables as possible in measuring the gross income of live stock sales; calves, sheep, and unusual quantities of pigs, resulting from governmental reduction programs, have been excluded from the live stock receipts considered in the index.

9. New Car Sales

In normal years the people of Indiana spend in the neighborhood of one hundred million dollars per year for new automobiles. As a current measure of retail trade items totalling a hundred million dollars per annum must be considered as worth while indicators, especially in a field where current all-inclusive data are difficult to obtain. New car sales are perhaps less barometric for forecasting the trend of the industry than are used car sales, but as current indexes of this branch of retail distribution they excell the latter. In Indiana automobile sales are available by months for the period since the passage of the registration law in 1923. The Bureau has developed estimates of sales from 1913 to 1923, but in the preparation of the index of new car sales only the data from 1919 to 1933 were used. New passenger car sales since 1923 have run as high as sixteen thousand and as low as seven hundred cars per month. In 1929, when new car sales reached their peak, over one hundred and twenty thousand cars were sold, and in 1932, the low point in car sales since 1923, less than thirty thousand were delivered. Even though the sales of new passenger cars have slumped since 1929, there has been an average annual gain for 1923 to 1933 of about five hundred and forty cars.

Altho passenger car use is no longer seasonal to any large degree, the majority of new car sales occur in the spring and early summer months. In Indiana almost half of the new car sales take place in the four months of March, April, May, and June. The distribution of sales for the entire year are shown in Table XII below.

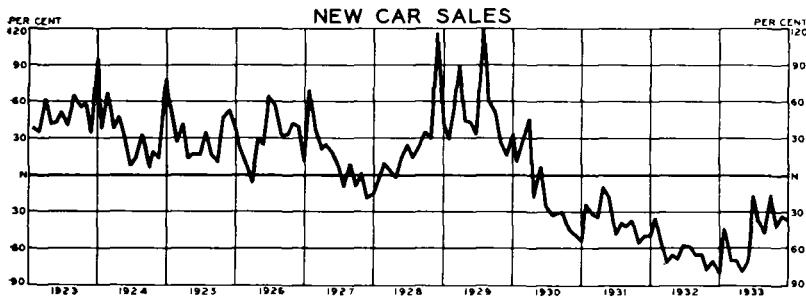
Table XII
SEASONAL VARIATION OF NEW CAR SALES

Indiana 1919-1933							
Average Month=100							
January	74.5	April	155.6	July	112.4	October	78.7
February ..	75.3	May	142.2	August	109.9	November....	43.0
March	133.6	June	123.8	September..	97.5	December ...	53.5

Figure 10 shows the fluctuations of new car sales from the estimated normal. New car sales in the state have shown a wider fluctuation than used car sales for the same period. From the nature of automobile consumption it would be ex-

pected that during a period of prosperity such as that which preceded 1930, and the subsequent period of business recession, used car sales would be more stable than new car sales. Likewise, during periods of recovery, particularly when such periods of recovery follow protracted periods of depression, the former should fluctuate more widely than new car sales. For this reason, if properly understood, used car sales should afford a better forecaster, but a less adequate current measure of retail trade in general, than new car sales. Thus, in the Bureau's index, which is essentially a current measure rather than a forecaster of business in the state, new car rather than used car sales have been used.

Figure 10



10. Newspaper Advertising

With certain limitations, newspaper advertising over a period of years is a reliable measure of local or regional volume of trade. Newspaper advertising, other than classified advertising, is not wholly a reflection of local conditions, since all daily papers carry some national advertising, and its reliability as a measure of local or regional business conditions is impaired somewhat by the extent to which national advertising lineage does not vary with local business conditions, and by the practice on the part of some advertisers of increasing rather than decreasing their advertising expenditures as the volume of business declines. On the other hand, advertising expenditures of many firms are limited to a certain per-

centage of sales, and consequently vary directly with the volume of trade. The shortcomings of newspaper advertising as an indicator of current business conditions are further modified by the accuracy and availability of the data. Advertising lineage is readily obtainable from practically all urban centres, and the lineage may be accurately determined for each locality.

At the present, the Bureau receives monthly figures on advertising lineage from all the newspapers in twelve Indiana cities: Indianapolis, Fort Wayne, Terre Haute, Gary, Richmond, Kokomo, South Bend, Elkhart, Evansville, Marion, Muncie and Hammond. These cities contain one-third of the total population of the state and more than half of the urban population. The data have been made available thru the courtesy and coöperation of the individual newspapers and Media Records, Inc.

Newspaper advertising has a seasonal movement which follows rather closely the movement of retail trade. Altho separate trends and seasonal indexes were determined for each of the twelve regions, a composite seasonal index has also been determined. The movement has been as indicated in Table XIII below. The separate trends are shown in Table XXV.

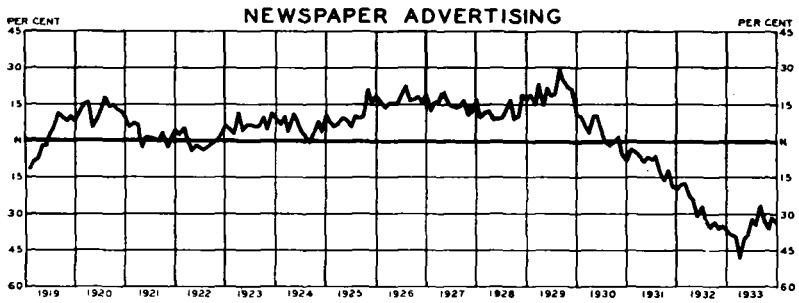
TABLE XIII

SEASONAL VARIATION OF NEWSPAPER ADVERTISING

Indiana 1919-1933			
Average Month=100			
January 93.3	April ....109.1	July .....87.5	October ....111.4
February .. 90.0	May ....108.7	August .....87.5	November 105.3
March .....105.4	June .....98.7	September ..94.5	December ..108.6

The high correlation between the fluctuations of newspaper advertising and bank debits as shown by Figures 11 and 7 indicates that if bank debits may be considered a good measure of distribution and trade, newspaper advertising must also be recognized as one of our better indexes of local retail trade. It is not to be presumed that newspaper advertising is a better index than bank debits and should be used in lieu of the latter, but that it affords an additional measure, which may often be obtained for localities for which bank debits are not available.

Figure 11



INDIANA STUDIES IN BUSINESS

Chapter IV

THE COMPOSITE CURVE

In the preceding chapter the eleven series which comprise the general business curve were explained in detail. In the present chapter the methods used in combining the eleven series into a composite curve will be discussed. The composite curve is composed of the weighted deviations from normal of the eleven series described in Chapter III. The deviations from the estimated normal of each of the eleven component parts of the curve have been weighted according to their importance in the industrial and commercial activities of the state, and to their stability, or freedom from erratic fluctuation in the period covered by each series. Technically each series has been weighted by its economic importance as shown by the Census of Manufacturers or other official sources and by an index of variability which measures the average range of the fluctuations of each series from its estimated normal. For purposes of identification these indexes will be designated as economic weights and indexes of variability. In determining the relative importance of such items, as pig iron production, automobile production, etc., the value added by manufacture has been taken as the measure.

In the case of stone and coal the value of the product rather than the value added by manufacture has been taken as the measure, since it is extremely difficult to determine the value added by manufacture of such raw materials as coal and stone. In the case of electricity production, bank debits, and advertising, which measure largely, but not entirely, distribution rather than production, arbitrary weights were assigned, based on the best information available on the relative importance of such items as measures of business activity. The procedure followed in constructing the index was, first, to determine the relative importance of distribution and retail trade in relation to industrial production as a current measure of business activity, and then, subdivide the weight assigned to each division among the various activities which composed that division. After having determined the various economic

weights independently, they were checked against the weights assigned to similar items in some of the well-known national indexes. The weights of the eleven series now used in the Indiana general business curve are as shown in Table XIV below.

TABLE XIV

ECONOMIC WEIGHTS OF THE COMPONENTS
OF THE INDIANA GENERAL BUSINESS CURVE

Item	Weight
Advertising	5
Automobile Production	7
Automobile Sales	10
Bank Debits	15
Building Construction	16
Cattle Sales	3
Coal Production	5
Electricity Production	15
Hog Sales	7
Pig Iron Production	15
Building Limestone Production	2
Total	100

The above weights may differ from those assigned to similar items in some of the well-known national indexes of business conditions, but it must be remembered that the principal reason for developing regional indexes of business conditions is that the importance and the composition of the chief items of production and consumption are not uniform thruout the nation but differ by regions, or even states, in some instances. In the above table the weighting represents as closely as it is possible to ascertain, the relative importance of the eleven items in the economic organization of the people of Indiana.

In combining a series of items as those shown in Table XIV so as to form a single index of business activity, cognizance must be taken of another characteristic which may be quite apart from the relative importance of the industry in the region; that is, the relative stability of each industry or activity included. To make a concrete illustration it may be assumed that automobile sales with a weight of ten, fluctuate but very little from the estimated normal, but that coal produc-

tion with a weight of five, fluctuates very erratically from normal. It may be further assumed that coal production over a period fluctuates just twice as widely as do automobile sales. If the above is generally true, then in an average month a combined index composed of automobile sales with a weight of ten, and coal production with a weight of five, might show no change if the two items fluctuated in opposite directions, even though automobile sales were twice as important in the state as coal production, since the latter usually fluctuates twice as much from its estimated normal as do automobile sales.

It is possible to measure the average fluctuations of each item from its normal and correct it for its erratic tendencies. This has been done for all the items in the Bureau's index. The exact statistical procedure is shown in the appendix to this bulletin, and it is sufficient for the present to indicate that the effect upon the composite index, of the fluctuations of each item is modified by its economic importance in the series and by its relative stability, measured by what may be termed an index of variability. If the economic importance of the items may be temporarily disregarded, then it is clear that a ten point change of an item which usually changes by twenty point jumps is not so significant as a five point change in an item which usually changes but one point. The Bureau's index of variability supplies the necessary correction to each item so as to make its influence upon the combined index almost wholly in accord with the importance of the industry or activity.

In combining the eleven items shown in Table XIV, to make a composite index of business activity in the state, the fluctuations of the items from their estimated normals have been multiplied by their respective economic weights, divided by the various respective indexes of variability, and the results added for each month from January, 1919, to the present. As additional figures become available each month they are used in determining the index for the current month. Those who are interested in the statistical methods employed in determining the composite index of business activity in the state may examine pages 52-69 in the appendix to this bulletin. The composite index of business activity in the state for the period from 1919 to 1933 is shown in Table XV below.

TABLE XV

COMPOSITE INDEX OF BUSINESS ACTIVITY IN INDIANA

1919-1933

In Percentage Deviations from Normal

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919....	+ 2.6	- 4.4	-15.0	-13.0	- 7.8	- 2.6	+ 6.4	+ 3.2	+ 3.2	- 1.0	+ 9.0	+20.0
1920....	+18.5	+17.9	+10.9	+ 2.2	+ 6.7	+11.7	+ 8.9	+ 8.5	+ 5.0	- 0.1	+ 0.4	- 5.1
1921....	- 9.3	-13.2	-16.5	-20.1	-22.0	-19.4	-21.3	-18.8	-19.8	-17.4	-21.2	-19.4
1922....	-19.5	-16.2	-10.3	-16.3	-11.8	- 8.8	- 3.1	- 5.3	- 1.0	- 6.4	- 2.2	+ 1.1
1923....	+ 4.9	+ 3.3	+ 5.4	+ 4.5	+10.2	+ 9.1	+10.2	+ 7.7	+ 7.1	+ 5.7	+ 6.1	+ 4.9
1924....	+ 4.5	+11.0	+ 4.5	+ 4.9	- 3.8	-13.6	-14.4	-11.5	- 7.4	0.0	- 0.7	+ 7.5
1925....	+10.1	+ 4.5	+ 7.3	+ 6.2	+ 5.9	+ 3.7	+ 8.6	+ 6.6	+10.0	+18.5	+19.7	+17.0
1926....	+13.7	+11.0	+10.6	+11.9	+ 9.6	+14.8	+15.7	+15.8	+17.3	+15.9	+15.1	+12.8
1927....	+15.2	+13.7	+15.2	+22.8	+20.4	+20.9	+ 9.1	+11.6	+ 9.4	+ 9.1	+10.4	+12.2
1928....	+15.1	+22.1	+17.3	+12.0	+13.3	+15.2	+17.0	+22.2	+21.1	+25.1	+22.7	+19.3
1929....	+22.3	+26.5	+32.1	+26.3	+26.3	+23.8	+31.9	+30.2	+27.6	+26.1	+19.5	+15.6
1930....	+12.6	+10.1	+ 7.7	+ 4.2	+ 5.6	+ 0.8	- 3.3	- 4.3	- 4.9	- 7.7	-11.5	-13.8
1931....	- 9.6	-12.1	-11.1	-10.2	-13.5	-22.2	-22.2	-25.7	-27.3	-29.4	-32.7	-30.9
1932....	-32.4	-34.3	-38.5	-41.2	-43.2	-42.9	-45.5	-47.8	-46.7	-47.9	-46.8	-48.5
1933....	-47.6	-49.0	-56.0	-49.0	-45.4	-37.5	-34.6	-37.1	-37.5	-36.9	-35.0	-38.2

Indiana and the Nation

As an economic entity Indiana is typically an average state. The state has slightly more than two and one-half per cent of the nation's population; does about three and one-half per cent of the total manufacturing, and two and one-half per cent of the total retail trade in the United States. Both the centre of population and the centre of manufacturing are located in the state. In agriculture, the state produces in commercial quantities most of the principal field and garden crops found in its latitude. The state is an important producer of coal and building stone, and while it produces no iron ore and only limited amounts of oil and gas, it is one of the principal centres of oil refining and iron and steel production. All in all, Indiana is a state which is typical of most of the industry and agriculture of the United States, and an accurate index of its business activity over a decade or more might be expected to follow very closely several of our better national indexes. If there are wide variations between the Indiana index and some of the principal national indexes, then it may be reasonable to presume that a national index, however accurate and timely, at best can not measure the numerous local conditions which are constantly at variance with the general trend as reflected in an index covering the whole nation.

TABLE XVI

THE ANNALIST INDEX OF BUSINESS ACTIVITY IN THE
UNITED STATES

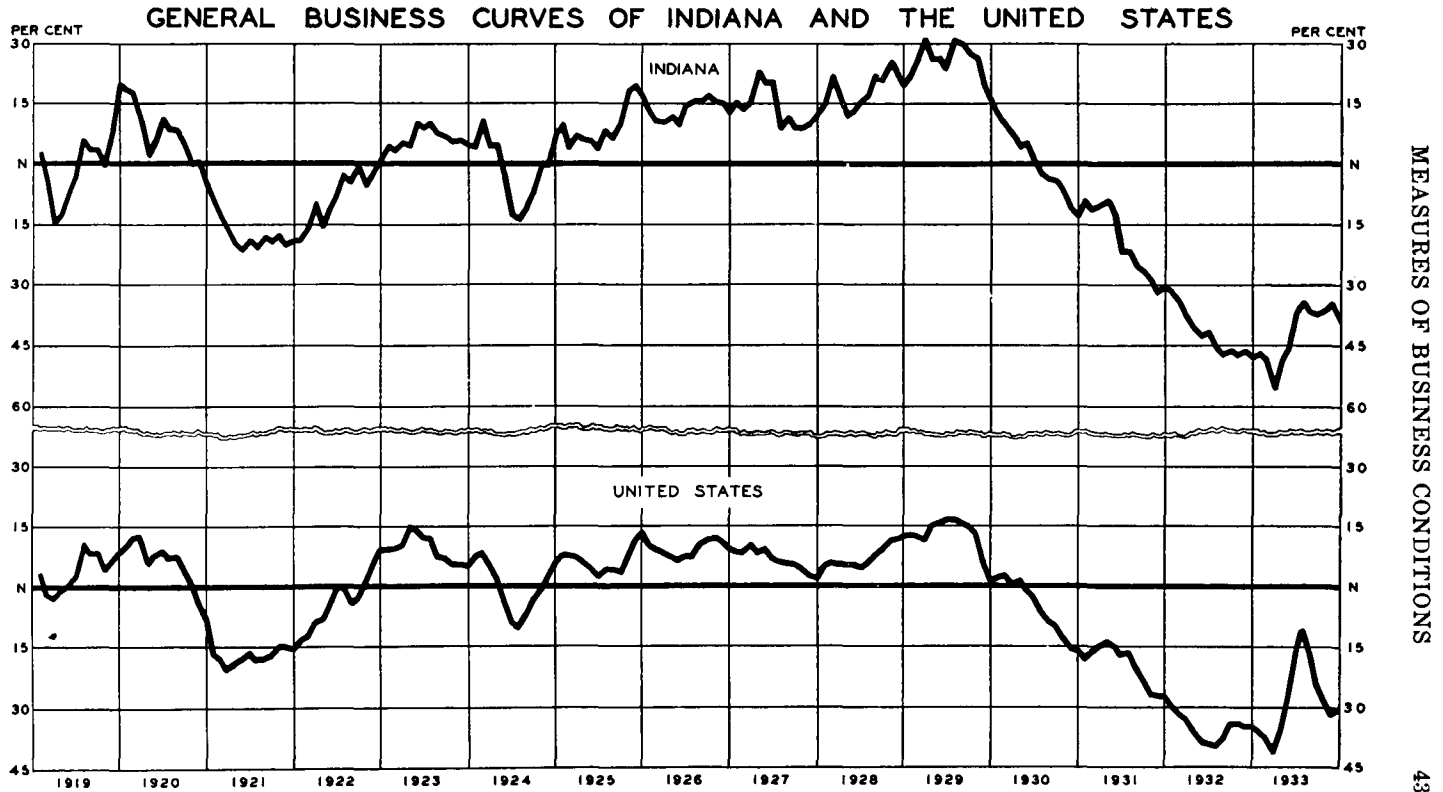
1919-1933

In Percentage Deviations from Normal

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919....	+ 3.4	- 2.1	- 3.1	- 1.1	+ 0.2	+ 3.0	+10.9	+ 8.3	+ 8.6	+ 4.2	+ 6.3	+ 8.4
1920....	+11.3	+12.4	+12.7	+ 5.9	+ 8.0	+ 9.0	+ 7.2	+ 7.8	+ 4.3	+ 0.6	- 4.4	- 8.9
1921....	-17.0	-18.4	-21.1	-19.6	-18.3	-17.0	-18.6	-18.2	-17.6	-14.9	-15.1	-15.4
1922....	-13.8	-13.1	- 9.8	- 8.9	- 5.5	- 0.9	- 0.6	- 4.5	- 3.1	+ 2.1	+ 6.7	+ 9.3
1923....	+ 9.3	+ 9.4	+10.4	+14.9	+14.0	+12.4	+12.2	+ 7.8	+ 7.1	+ 5.6	+ 5.3	+ 5.5
1924....	+ 8.0	+ 8.5	+ 6.0	+ 1.8	- 4.6	- 9.5	-10.8	- 7.3	- 3.3	- 0.8	+ 2.2	+ 6.0
1925....	+ 8.2	+ 8.0	+ 7.5	+ 6.5	+ 4.8	+ 2.6	+ 4.4	+ 4.1	+ 3.4	+ 7.5	+12.0	+13.2
1926....	+10.2	+ 9.3	+ 8.6	+ 7.4	+ 6.7	+ 7.5	+ 7.5	+10.1	+11.6	+12.0	+11.0	+ 9.2
1927....	+ 8.6	+ 8.4	+10.3	+ 8.3	+ 9.0	+ 7.0	+ 6.1	+ 5.6	+ 5.3	+ 4.1	+ 2.7	+ 2.2
1928....	+ 5.6	+ 6.1	+ 5.4	+ 5.5	+ 5.6	+ 4.8	+ 6.3	+ 8.1	+ 9.7	+11.8	+12.0	+12.5
1929....	+12.9	+12.4	+11.9	+15.0	+15.7	+16.6	+16.7	+15.6	+15.0	+13.4	+ 6.0	+ 1.2
1930....	+ 2.1	+ 2.5	+ 0.5	+ 1.8	- 1.5	- 2.9	- 6.9	- 9.2	-10.4	-13.2	-15.6	-16.1
1931....	-18.6	-16.9	-14.9	-13.6	-14.9	-17.4	-16.9	-21.1	-23.7	-27.4	-27.8	-27.9
1932....	-29.9	-31.9	-33.3	-36.8	-39.1	-39.6	-40.3	-38.7	-34.8	-34.6	-35.3	-35.2
1933....	-36.9	-38.3	-41.5	-35.9	-27.5	-16.6	-10.5	-16.4	-23.5	-27.6	-31.5	-30.4

The Annalist index of business conditions has been chosen as the best single measure of the business activity of the nation as a whole. This index was chosen because it is generally available to every one; the method of construction and the content have been presented from time to time by the publishers, thus making the index almost ideal for the purposes of comparison; and lastly, the Annalist index has been one of the few reliable national indexes which have been entirely revised in recent months and the data made comparable for the whole period covered by the Bureau index.

Figure 12



General Business Curve for the United States, adapted from *The Annalist* by permission.

The Annalist curve shown in Figure 12 is a composite of the following items with their respective weights: Freight car loadings, 20 per cent; electric power production, 15 per cent; steel ingot production, 15 per cent; pig iron production, 10 per cent; cotton consumption, 8 per cent; wool consumption, 2 per cent; boot and shoe production, 2 per cent; automobile production, 10 per cent; zinc production, 5 per cent; lumber production, 7 per cent; and cement production, 3 per cent. Of the above twelve items, only three, pig iron, electricity, and automobile production, are the same activities which are included in the Bureau's business curve for Indiana. Thus it would not be anticipated that the two indexes should show similar movements due to the inclusion of identical items. In general it may be said the Annalist index contains more items measuring industrial production and fewer measuring the volume of trade than does the Bureau index. The predominant proportion of industrial production measures rather than retail trade indicators should make the Annalist curve fluctuate more widely than the Bureau curve; since trade, particularly retail trade, is much more stable thru prosperity and depression than industrial production.

An examination of the two curves in Figure 12, however, shows that the Annalist curve over the last fifteen years has been more stable than the Indiana curve. Business activity in Indiana as measured by the Bureau's index rose to more than thirty per cent above normal in 1929 and then dropped to almost sixty per cent below in 1933. The Annalist curve, on the other hand, exceeded fifteen per cent above normal but fractionally for two brief periods since 1919, and was less than forty-five per cent below in 1933. Business in Indiana rose gradually, but very steadily, from 1925 to 1929. For the nation as a whole business remained fairly constant at about ten per cent above normal from 1925 to 1927 and then rose sharply in 1928-1929. The differences between the two indexes seem to be differences of quantity rather than quality. Both curves have roughly the same pattern, and the changes in the direction of neither curve seem to anticipate those of the other; they seem to move almost simultaneously. Many factors, some of which are not readily measurable, account for the differences in the extent of the fluctuations of the two

curves. Probably the most important factor responsible for the variation is the difference in the areas covered by the two curves.

As the size of the region covered by a business index is reduced, the wider may become the fluctuations. Where an index is national in scope, unfavorable conditions in an industry in one part of the country may frequently be offset by more favorable conditions in another part. The probability of an index being stabilized by the averaging of conditions within a region decreases with the size of the region represented. Indexes reflecting business conditions in a few of the larger Indiana cities are much less stable than the index for the state as a whole. An examination of numerous state and local indexes aside from those prepared for Indiana by the Bureau seems to warrant the conclusion that no adequate picture of the movement of American business will be available until our national indexes are more fully supplemented than at present by state or regional indexes.

INDIANA STUDIES IN BUSINESS

Chapter V

OTHER MEASURES OF BUSINESS ACTIVITY IN INDIANA

The Bureau of Business Research maintains a second group of indexes which for various reasons are not included in the general business index. In some cases the data are not available for a period of time sufficiently long to give an adequate picture of the trend. In other cases the data are not complete enough to furnish a satisfactory sample of the activities of the industry represented. In still other cases, and this classification contains the largest number of indexes, the data are not available early enough in the month succeeding the one to which they apply, to be included in the Bureau's index of business conditions. The Indiana Business Review is received by subscribers on the twentieth of each month, and information to be included in the index must be available by the fifteenth. Consequently, data which are not available by the fifteenth of the month following the one to which they apply, cannot be included in the index of general business conditions. The indexes described in this chapter are those, which for the reasons indicated, are not included in the business curve but which seem to be of sufficient importance to be kept up to date pending their ultimate inclusion in the general index. Only the more important of those which have more than local significance, will be considered.

Life Insurance Sales

Thru the coöperation of the Life Insurance Sales Research Bureau, sales of ordinary life insurance are available each month for a substantial number of companies doing business in Indiana. The sales reported by the Life Insurance Sales Bureau represent approximately eighty per cent of all ordinary life insurance business done in Indiana, and afford an excellent indicator of the trend of the business as a whole. Life insurance sales are a measure of consumer purchasing power and follow more closely the movement of retail trade than that of an index of industrial production, like pig iron for example. The Bureau's index of sales in Indiana of or-

dinary life insurance covers the period by months from 1921 to the present. The sales in Indiana for the period since 1921 have increased roughly six and one-half million dollars per year. Like other lines of retail distribution life insurance sales have a distinct seasonal movement. Altho December is seasonably the best month of the year, the bulk of insurance is sold from March to June. The distribution of sales by months thruout the year is shown in Table XVII below.

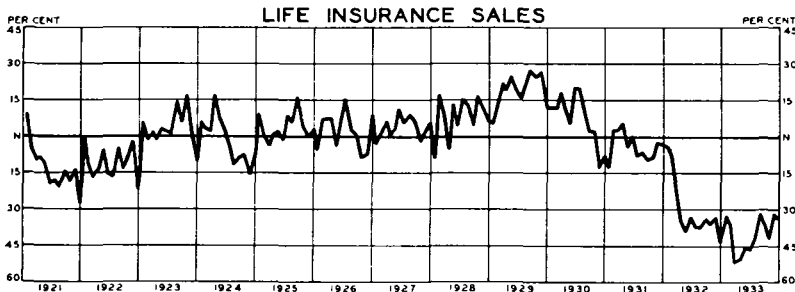
TABLE XVII
SEASONAL VARIATION OF LIFE INSURANCE SALES

Indiana 1921-1933
Average Month=100

January 91.8	April ....106.9	July .....99.5	October 95.4
February .. 94.4	May ....107.6	August .....93.4	November 90.7
March .....113.0	June ....106.7	September ..85.3	December ..115.3

Life insurance sales in Indiana since 1921 have shown about the same degree of variation as department store sales. It might be presumed that conditions in the security market might have a more direct influence upon life insurance sales than upon the retail distribution of commodities, but this has not been true in Indiana, for the movement of department store and life insurance sales have been quite uniform in both direction and degree. This does not imply that there is necessarily a close relationship between the two series, but it does seem to indicate that virtually the same factors have affected both lines of activity. When accurate indexes for lines of retail trade other than department store sales are available for Indiana, it will be possible to examine further the apparent similarity in the movement of retail trade and life insurance sales.

Figure 13



Gasoline Sales

Data on the sales of gasoline in Indiana are computed monthly by the Auditor of State. The rapid growth in automobile ownership from the end of the post-war depression to the collapse of incomes after 1930; the increase in automobile use fostered by the low gasoline prices; and an increasing number of hard-surfaced roads, with the tendency toward more powerful motors, have contributed to the steady rise in gasoline consumption in the last decade. In Indiana the trend of gasoline consumption since 1923 has increased more than a quarter of a million gallons per month, while actual consumption approximated fifty million gallons for the peak month of the period; July, 1931. Decreased consumption in 1932 and 1933 has retarded the rate of growth which existed prior to 1932, but the decline has not been sufficient to give a downward trend to the data for the entire period since 1923.

Notwithstanding the increase in gasoline consumption arising from the growth of truck transportation, passenger vehicles are still the largest consumers of gasoline, and the seasonal movement of gasoline consumption is largely that of passenger car operation. The variation in gasoline consumption in Indiana from 1925 to 1933 is shown in Table XVIII below.

TABLE XVIII
SEASONAL VARIATION OF GASOLINE SALES

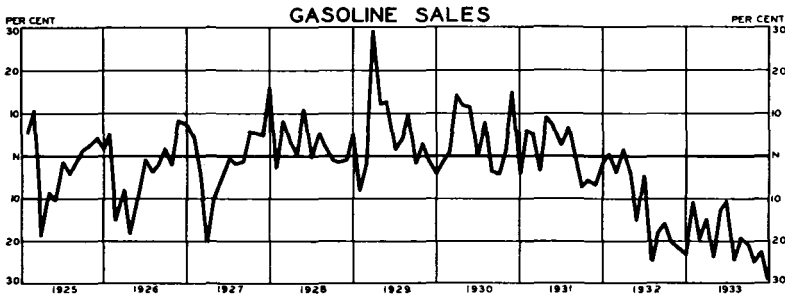
Indiana 1925-1933			
Average Month=100			
January .....78.3	April 98.4	July .....116.1	October ....110.9
February ....72.7	May ....102.8	August .....121.6	November 96.9
March .....86.7	June ....110.4	September 118.3	December .. 86.9

Altho the larger portion of our gasoline consumption may be attributed to the operation of the private automobile, the consumption of gasoline in the commercial operation of motor vehicles upon our highways is expanding at a rate which is having some influence upon both the seasonal movement and the trend of gasoline consumption. The effect of this increase in the commercial use of our highways is shown in the chart of gasoline consumption in Figure 14. The wide swings in the consumption of gasoline from 1925 to 1927

disappeared in the years following 1927. The effect upon gasoline consumption of the increased commercial use of our highways is two-fold. In the first place, truck operation increases in late autumn and early winter when passenger car operation decreases. This has the effect of reducing the seasonal swing of gasoline consumption. In the second place, truck operations increase relatively to the movement of goods by rail during periods of business declines.

During periods of minor recessions gasoline consumption should show less contraction than many other measures of business activity; for automobile ownership in the United States has not reached the saturation point, even though total registrations have declined since 1930. In a major depression such as has followed the recession in 1929, gasoline consumption may continue to decline even after many indexes of business activity have turned upward, due to the failure of automobile sales to keep up with retirements.

Figure 14



Used Car Sales

Monthly data on used car sales have been compiled for Indiana since 1923. In the main the fluctuations of used car sales are similar to those for new cars, since the same causes affect the demand for both. The supply of used cars being very much larger than that of new cars, the sales have also been larger, and the month to month variation somewhat smaller. The trend of used car sales has been decidedly up-

ward for the period covered by the data collected by the Bureau, having increased over six thousand cars per year. Actual sales have ranged from one hundred and sixty thousand in 1923 to almost three hundred thousand in the peak year of 1929. During normal periods the quantity of used cars increases, for new car sales exceed retirements, making the inventory of used cars constantly larger. As the stocks of used cars increase it may be anticipated that the sales will also increase.

Used car sales, like those of new cars, have a distinct seasonal movement. The low period comes in the last two months of the calendar year when the presentation of new models is impending. With the delivery of the new models to the dealers in January the movement in used car transactions accelerates, since only rarely does the buyer of a new car completely wear out his car before exchanging it as a partial payment for a new one, and out of each sale of a new car to a car owner grows a later sale of a used car. A comparison of the seasonal movement of new and used car sales shows that the seasonal movement of new car sales is very regular, moving downward from the April peak to the November bottom and then gradually back to the April peak, while the used car movement rises steadily from the November low to a March peak, declines to a mid-summer low in July, rises abruptly in August, and then declines until the bottom is again reached in November.

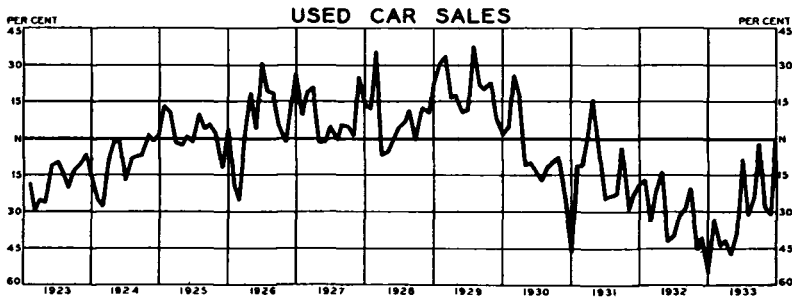
In Indiana the seasonal rise of used car sales is due principally to two causes. The first cause is the reduction in license costs on August first which causes July sales to be recorded as of August, or in other cases, the purchaser delays the transaction until after August first. A second factor is the tendency of used car owners to discard cars which are scarcely serviceable prior to the usual vacation period, when cars are subjected to more than usual mileage. The practice on the part of dealers of clearing their floors of used cars, or at least of making material reductions in their stocks of used cars before new car sales reach their seasonal peak, accounts for the used car seasonal peak in March, rather than April; the time of the seasonal peak for new car sales. The index of the seasonal movement of used car sales is shown in Table XIX below.

TABLE XIX
SEASONAL INDEX OF USED CAR SALES

Indiana 1923-1933
Average Month=100

January 85.6	April ....132.4	July 91.6	October .....79.4
February ..118.2	May ....124.0	August .....121.0	November ..42.2
March .....150.4	June ....114.3	September 98.4	December ....42.5

Figure 15



It should be noted that the curves in Figures 10 and 15 are not drawn on the same scale, and that while the month to month movements of used car sales appear to fluctuate more violently than those of new cars, in reality new car sales fluctuate much more than used car sales. The more erratic movement of new car sales is accounted for in part by the smaller volume of sales, and the higher unit values in comparison with used cars. In many cases, particularly on the upward movement, used car sales precede the recovery in new car sales. The data also seem to indicate that the average car has approximately four owners during its lifetime.

INDIANA STUDIES IN BUSINESS

Chapter VI

APPENDIX

Statistical Methods

This chapter covers, in the main, the statistical methods employed in analyzing the data presented in the preceding chapters. The methods used have been those employed in the Bureau of Business Research in analyzing the data which appear each month in the Indiana Business Review. In most cases the methods are neither new nor unique, but are well-known practices which have been found to be the most rapid and satisfactory methods of handling the data which are collected monthly by the Bureau. The methods are outlined in this section primarily for those who are particularly interested in the technique of the statistical analysis of time series and for the guidance of statisticians in industrial or commercial organizations who wish to make their own analysis of the data which appear monthly in the Indiana Business Review.

Most of the data presented in the earlier sections are from published sources and may be obtained by anyone interested in collecting the particular series, but in a few cases the data are obtained directly by the Bureau from private sources and may not be used in a manner which will disclose the original figures of the industry or association. Obviously, in the latter cases no original figures are shown in this chapter.

Where the data have been available, the Bureau has begun all time series with January, 1919, and has computed the secular trend by months since that time. In a few cases it seemed advisable to compute the trend by years over a longer period and then change the period since 1919 over to a monthly basis. Where business practices seemed to warrant the refinement, the data have been adjusted for the variation in the number of business days in the month. It has also been necessary occasionally, where the data have been subjected to large episodic fluctuations, to smooth the original figures with a three-month moving average before determining the seasonal

variation and the secular trend. No attempt has been made to deflate any of the value series by applying any theoretical price index, since it has been felt that the inconsistencies which would be introduced thru the use of either a deflation or inflation factor might be larger than those which an index of this character might be expected to remove.

Straight line trends based on the method of least squares have been applied to all series in measuring the secular trend of the data. In a few cases, where annual data have been available for a considerable period, the trends have been computed on an annual basis, but where the data have been available for a shorter period, the calculations have been made on a monthly basis. The generalized formula for a straight line trend by the method of least squares may be expressed as:

$$T = a + bx$$

where T equals the computed value of the trend, and x the years or months measured from the beginning of the period covered by the data. The constants, a and b , may be obtained by solving the equations below for a and b after the values for Σy and Σxy have been obtained from the data Y .

$$an + b\Sigma x = \Sigma y$$

$$a\Sigma x + b\Sigma x^2 = \Sigma xy$$

A more convenient formula may be obtained for fitting a straight line trend by substituting in the above equation $\frac{n(n+1)}{2}$ for Σx and $\frac{2n^3 + 3n^2 + n}{6}$ for Σx^2 .

The equations then become:

$$an + b \left[\frac{n(n+1)}{2} \right] = \Sigma(y)$$

$$a \left[\frac{n(n+1)}{2} \right] + b \left[\frac{2n^3 + 3n^2 + n}{6} \right] = \Sigma(xy)$$

Solving for a :

$$a \left[\frac{n(2n+1)}{3} \right] + b \left[\frac{2n^3 + 3n^2 + n}{6} \right] = \frac{(2n+1)}{3} \Sigma(y)$$

$$a \left[\frac{n(n+1)}{2} \right] + b \left[\frac{2n^3 + 3n^2 + n}{6} \right] = \Sigma(xy)$$

$$a \left[\frac{n(2n+1)}{3} - \frac{n(n+1)}{2} \right] = \frac{(2n+1)\Sigma(y)}{3} - \Sigma(xy)$$

$$a \left[\frac{2n(2n+1) - 3n(n+1)}{6} \right] = \frac{(2n+1)\Sigma(y) - 3\Sigma(xy)}{3}$$

$$a \left[\frac{4n^2 + 2n - 3n^2 - 3n}{6} \right] = \frac{(2n + 1)\Sigma(y) - 3\Sigma(xy)}{3}$$

$$a \left[\frac{n(n-1)}{6} \right] = \frac{(2n + 1)\Sigma(y) - 3\Sigma(xy)}{3}$$

$$a \left[\frac{n(n-1)}{2} \right] = (2n + 1)\Sigma(y) - 3\Sigma(xy)$$

$$a = \frac{(2n + 1)\Sigma(y) - 3\Sigma(xy)}{\frac{n(n-1)}{2}}$$

$$a = \frac{2}{n(n-1)} \left[(2n + 1)\Sigma(y) - 3\Sigma(xy) \right]$$

Solving for b :

$$a \left[\frac{n(n+1)}{2} \right] + b \left[\frac{n(n+1)(n+1)}{4} \right] = \frac{n+1}{2} \Sigma(y)$$

$$a \left[\frac{n(n+1)}{2} \right] + b \left[\frac{n(2n+1)(n+1)}{6} \right] = \Sigma(xy)$$

$$b \left[\frac{n(n+1)(n+1)}{4} - \frac{n(2n+1)(n+1)}{6} \right] = \frac{(n+1)}{2} \Sigma(y) - \Sigma(xy)$$

$$b \left[\frac{3n(n+1)(n+1) - 2n(2n+1)(n+1)}{12} \right] = \frac{(n+1)\Sigma(y) - 2\Sigma(xy)}{2}$$

$$b \left[\frac{3n^3 + 6n^2 + 3n - 4n^3 - 6n^2 - 2n}{12} \right] = \frac{(n+1)\Sigma(y) - 2\Sigma(xy)}{2}$$

$$b \left[-\frac{n(n^2-1)}{12} \right] = \frac{(n+1)\Sigma(y) - 2\Sigma(xy)}{2}$$

$$b \left[-\frac{n(n^2-1)}{6} \right] = (n+1)\Sigma(y) - 2\Sigma(xy)$$

$$b \left[\frac{n(n^2-1)}{6} \right] = -(n+1)\Sigma(y) + 2\Sigma(xy)$$

$$b = \frac{-(n+1)\Sigma(y) + 2\Sigma(xy)}{\frac{n(n^2-1)}{6}}$$

$$b = \frac{6}{n(n^2-1)} \left[-(n+1)\Sigma(y) + 2\Sigma(xy) \right]$$

The equation for a straight line with the origin of the x 's at the beginning of the data becomes:

$$a = \frac{2}{n(n-1)} \left[(2n + 1)\Sigma(y) - 3\Sigma(xy) \right]$$

$$b = \frac{6}{n(n^2-1)} \left[-(n+1)\Sigma(y) + 2\Sigma(xy) \right]$$

The values of n are usually comparatively small and errors in this part of the equation may be detected by inspection. As may be observed the fraction $\frac{2}{n(n-1)}$ is always equal to one over the sum of the consecutive numbers for $(n-1)$ terms, and the value for this portion of the equation may be obtained from any table of the sums of the powers of natural numbers for all the common values of n . Likewise, $\frac{6}{n(n^2-1)}$ is equal to $\frac{6}{(n^3-n)}$, and a table for all the usual values of n may be prepared from any table of cubes. One check of the accuracy in obtaining the constants for $\frac{6}{n(n^2-1)}$ may be obtained by dividing the denominator of the fraction by the numerator, since $n(n^2-1)$ is evenly divisible by six for all values of n .

Tables giving the decimal values for the above straight line equation for values of n from 1 to 240 have been prepared, making it necessary only to multiply the decimal values by the proper values for $\Sigma(y)$ and $\Sigma(xy)$.¹ Due to the large number of places necessary to insure accuracy in the decimal values, reaching sixteen places in some cases, for straight line trends it is usually more convenient to use only the fractional values for $\frac{n}{n(n-1)}$, $(2n+1)$, $\frac{6}{n(n^2-1)}$, and $-(n+1)$. Tables of fractional values for each of the above combinations may be computed very readily for all the necessary values of n .

Where data are available over a considerable period of time it is often more convenient to fit trends to annual rather than to monthly data. When trends are computed on an annual basis, July 1 is presumed to be the center of the yearly totals. Likewise, when trends are computed on a monthly basis, the monthly totals are presumed to be centered on the fifteenth of the month. Any annual trend may be converted to a monthly basis by dividing the T value or the y intercept by twelve and the slope, or annual increment, by 144. For example the annual trend

$$T = 1728 + 576x$$

may be converted to a monthly basis by dividing 1728 by 12, and 576x by 144. The trend then becomes $T = 144 + 4x$ with

¹ See Davis, H. T. and Latshaw, V. V. in *Annals of Mathematics*, Second Series, Vol. 31, pp. 52-78. (January, 1930).

the origin at July 1. The origin may be moved to July 15 by adding $.5x$ to the y intercept, making the trend on a monthly basis

$$T = 146 + 4x$$

with the origin at July 15. From this point the origin of the trend may be shifted to any point by adding or subtracting the necessary values of x .

Where trends are computed on a monthly basis for data covering long periods of time, the most difficult task is the accurate computation of $\Sigma(xy)$, particularly when the monthly values of y are large. Keying each monthly value of y with the proper x and $\Sigma(x)$ value will afford a running check where the $\Sigma(xy)$ is calculated by machine methods. Once the $\Sigma(y)$ and $\Sigma(xy)$ are determined for any period, additional years or months may be added ahead of the original origin without recalculating the value of $\Sigma(xy)$ over the whole period. The value of $\Sigma(xy)$ may be computed in the usual manner for the additional months added ahead of the original origin, and the original $\Sigma(y)$ may be multiplied by the number of months added to the trend. The above two quantities may then be added to the original $\Sigma(xy)$. After the original $\Sigma(y)$ has been increased by the sum of the new y values, the trend may be computed for the new period. The reverse treatment of $\Sigma(y)$ and $\Sigma(xy)$ may be used in dropping off periods adjacent to the origin of a series.

Straight line trends computed on the basis of least squares have been fitted to all the series used in the Indiana Business Review. At one time the Pearl-Reed curve was used as the trend for automobile production in Indiana, but recent changes in the output of the industry have changed the data to the extent that a straight line affords a better fit than the Pearl-Reed curve. The decline since 1929 in the physical volume of many industries has changed materially the data to which trend lines must be applied, and since the normal of each year is measured by the ordinate of the line of trend for that year, every trend line may produce a different normal. Obviously, the number of constants in a trend equation may be increased until in simple cases the trend line may be made to pass thru every value of y , but closeness of fit within the limits of the observed data may not be the best trend from which to determ-

ine a statistical normal for the immediate future. A trend should be a regular smooth tendency whose projection into the immediate future may be logical and consistent with the past behavior of the series. Parabolas, cubics and logistic trends in some cases have given a better fit to the existing data than some of the more simple trends, but the extrapolation of the more complex trends gave statistical normals so far from reasonable on the basis of the past movement of the series that they had to be discarded. Next to the straight line trend the simple parabola is perhaps the most valuable for interpolation of data, and in some cases in the extrapolation of data. Some of the more convenient methods of fitting a second degree parabola are given below.

Fitting Second Degree Parabolas

The usual normal equations for a simple parabola for the generalized form $T = a + bx + cx^2$ are so well known that they are shown here only to serve as a point of departure in arriving at more convenient forms of the equation. When the origin of the x 's is taken at the beginning of the series the usual normal equations

$$\begin{aligned} an + b\Sigma x + c\Sigma x^2 &= \Sigma y \\ a\Sigma x + b\Sigma x^2 + c\Sigma x^3 &= \Sigma xy \\ a\Sigma x^2 + b\Sigma x^3 + c\Sigma x^4 &= \Sigma x^2y \end{aligned}$$

may be changed into a more convenient form by the same method employed in deriving the straight line formula on page 53. The new equations then become

$$\begin{aligned} a &= \frac{3}{n(n-1)(n-2)} \left[(3n^2 + n + 2)\Sigma y - 6(2n+1)\Sigma xy - 10\Sigma x^2y \right] \\ b &= \frac{6}{n(n-1)(n-2)} \left[-3(2n+1)\Sigma y + \frac{2(2n+1)(8n+1)}{(n+1)(n+2)}\Sigma xy - \right. \\ &\quad \left. \frac{30}{(n+2)}\Sigma x^2y \right] \\ c &= \frac{30}{n(n-1)(n-2)} \left[\Sigma y - \frac{6}{(n+2)}\Sigma xy + \frac{6}{(n+1)(n+2)}\Sigma x^2y \right] \end{aligned}$$

Decimal values for the various fractions containing n have been prepared for the values of n from two to sixty, and the use of the prepared tables shortens somewhat the work involved in securing the values of the constants, a , b and c .¹

¹ See Davis, H. T. and Latshaw, V. V. in *Annals of Mathematics*, Second Series, Vol. 31, pp. 52-78 (January, 1930).

Much labor may be saved in solving parabolas if the origin of the x 's is taken at the mid-point rather than at the beginning of the time series. The sums of the odd powers of x become zero, and the normal equations become

$$\begin{aligned}an + c\Sigma x^2 &= \Sigma y \\b\Sigma x^2 &= \Sigma xy \\a\Sigma x^2 + c\Sigma x^4 &= \Sigma x^2y.\end{aligned}$$

It may be readily seen that the equation

$$an + c\Sigma x^2 = \Sigma y,$$

may be written

$$a = \frac{\Sigma y - c\Sigma x^2}{n}$$

Likewise, the equation

$$b\Sigma x^2 = \Sigma xy,$$

may be written

$$b = \frac{\Sigma xy}{\Sigma x^2}$$

The equation

$$a\Sigma x^2 + c\Sigma x^4 = \Sigma x^2y$$

may also be simplified by the following method:

$$c = \frac{\Sigma x^2y - a\Sigma x^2}{\Sigma x^4}$$

Substituting the value

$$a = \frac{\Sigma y - c\Sigma x^2}{n}$$

we have

$$c = \Sigma x^2y - \frac{(\Sigma y - c\Sigma x^2)}{n} \Sigma x^2$$

Simplifying the fraction:

$$c = \frac{n\Sigma x^2y - (\Sigma y - c\Sigma x^2) \Sigma x^2}{n\Sigma x^4}$$

$$c = \frac{n\Sigma x^2y - \Sigma x^2\Sigma y + c\Sigma x^2\Sigma x^2}{n\Sigma x^4}$$

$$cn\Sigma x^4 = n\Sigma x^2y - \Sigma x^2\Sigma y + c\Sigma x^2\Sigma x^2$$

$$c(n\Sigma x^4 - \Sigma x^2\Sigma x^2) = n\Sigma x^2y - \Sigma x^2\Sigma y$$

$$c = \frac{n\Sigma x^2y - \Sigma x^2\Sigma y}{n\Sigma x^4 - \Sigma x^2\Sigma x^2}$$

Collecting the various equations we have:

$$a = \frac{\Sigma y - c \Sigma x^2}{n}$$

$$b = \frac{\Sigma xy}{\Sigma x^2}$$

$$c = \frac{n \Sigma x^2 y - \Sigma x^2 \Sigma y}{n \Sigma x^4 - \Sigma x^2 \Sigma x^2}$$

Values for the denominators of the fractions in the above equations may be computed from any of the published tables of the sums of powers. Thus a table may be prepared for all the values of x commonly used in fitting parabolas to time series.

Seasonal Variation

Adjustments for seasonal variation have been made by the Persons' link-relative method. Next to the link-relative method, the method of first differences of the ratios to trend is perhaps the most satisfactory, when both the accuracy of the index and ease of computation are considered. Differences in seasonal indexes computed by the two methods were not sufficiently great to warrant the expenditure of the additional time necessary to use the first differences of ratios to trend. The seasonal index of pig iron production for the Indiana-Illinois district, computed by the two methods is shown in Tables XX and XXI.

TABLE XX
SEASONAL INDEX OF PIG IRON PRODUCTION
 1919-1933
Link-Relative Method

Month	Median Link Relatives ¹	Chain Relatives	Correction Factor	Corrected Chain Relatives	Indexes of Seasonal Variation
January	100.3	100.0	1.00000	100.0	97.5
February	96.4	96.4	.99687	96.7	94.3
March	114.7	110.6	.99375	111.3	108.6
April	97.2	107.5	.99064	108.5	105.8
May	103.2	110.9	.98754	112.3	109.5
June	93.7	103.9	.98444	105.5	102.9
July	98.8	102.7	.98135	104.7	102.1
August	96.6	99.2	.97827	101.4	98.9
September	93.3	92.6	.97520	95.0	92.7
October	104.3	96.6	.97214	99.3	96.9
November	96.5	93.2	.96909	96.2	93.8
December	103.0	96.0	.96605	99.4	97.0
Totals				1230.3	1200.0
Averages				102.5	100.0

¹ The arithmetic mean of the middle three relatives in the frequency table.

The link-relatives were obtained by dividing pig iron production for each month by the production figure for the preceding month. Thus, the January figure for each month, save for January, 1919, was divided by the production of the preceding December. The February figure for each year was divided by the January total for that year, and in this manner the production figure of each month was obtained as a percentage of the figure for the preceding month. The link relatives obtained by the above computations were then arranged in order of magnitude for each of the twelve months. Thus, in the particular example, the link-relatives for the fourteen January items, the fifteen February items, etc., were arranged in order of magnitude for their respective months. The arithmetic mean of the middle three items in the monthly arrays were then used as the data for the column in Table XX headed "Median Link-Relatives."

In order to get the link-relatives on a common base, they have been chained by using January as a base, and each link relative multiplied by the chain relative of the preceding month. In this manner the February chain becomes 96.4,

since the January chain relative of 100, times the February link relative of 96.4 gives a chain relative of 96.4.

Inasmuch as the link relatives have been computed from the original data, before the trend has been removed, they are affected by the trend of the data, which in the present case is downward. Were there no trend, the December chain relative times the January link relative would be 100. Actually the product of the two relatives in Table XX is 96.3. This discrepancy is the result of an error which has been compounded twelve times in multiplying the median link relatives by the chain relatives, and may be removed by dividing the February chain relative by $(1+r)$, the March chain relative by $(1+r)^2$, etc., until the December chain has been divided by $(1+r)^{11}$. The value of r is obtained from the following equation:

$$r = \sqrt[12]{\frac{P_n}{P_o}} - 1,$$

when P_n is the product of the December chain relative times the January link relative, and P_o is the theoretical value of the frequency product, or 100. For the data in Table XX the value of r becomes

$$\begin{aligned} r &= \sqrt[12]{\frac{96.3}{100.0}} - 1 \\ &= .99687 - 1 \\ &= -.00313 \end{aligned}$$

The value of r for all the months of the year is shown in the fourth column of Table XX. In order that the final index may be based on the average month, rather than on January, the items in the fifth column of Table XX have been divided by the arithmetic mean of the column, or 102.5. The final indexes in the last column have been adjusted so that their sum is 1200.

Table XXI below shows the index of seasonal variation for pig iron production in the Indiana-Illinois district calculated by the method of first differences of ratios to trend.¹ The method of first differences may be outlined as indicated below:

1. A suitable trend line is fitted to the original data.
2. The monthly data are divided by the corresponding monthly trend values.

¹ See Carmichael, F. L. *Journal of American Statistical Association*, September, 1927, pp. 69-83.

3. The first differences of the ratio to trend are obtained by subtracting from the ratio of a given month, that of the preceding month.
4. The first differences for the monthly items are arranged in order of magnitude for each of the twelve months; in the present example, fourteen January items, fifteen February items, etc.
5. The arithmetic mean of the three central items has been taken as the median first difference in Table XXI.

TABLE XXI

PIG IRON PRODUCTION INDIANA-ILLINOIS DISTRICT
Index of Seasonal Variation
First Differences of Ratios to Trend

Month	\triangle Median ¹	\triangle Adjusted	\triangle Chained	Seasonal Index
January	+ .4	+ .117	100.000	96.7
February	- 2.8	- 3.083	96.917	93.7
March	+17.0	+16.716	113.633	109.9
April	- 4.3	- 4.584	109.149	105.6
May	+ 3.7	+ 3.417	112.466	108.8
June	- 6.2	- 6.484	105.982	102.5
July	- .6	- .883	105.099	101.7
August	- 3.5	- 3.783	101.316	98.0
September ..	- 4.1	- 4.383	96.933	93.8
October	+ 4.3	+ 4.016	100.949	97.6
November	- 2.3	- 2.583	98.366	95.1
December	+ 1.8	+ 1.517	99.883	96.6
Totals	+ 3.4	00.000	1240.693	1200.0
Averages	+ .2833		103.391	100.0

The figures in the second column of Table XXI have been adjusted in the third column so that their algebraic sum is zero, by adding the average of the second column, +.2833, to the negative items, and subtracting it from the positive items in the third column. The January item has been chosen as a base and the first differences of the other months chained to it, by cumulating the items algebraically. Normally the chained items will not average exactly 100, and in the present example each item has been divided by the arithmetic mean of the items, or 103.391, to give the seasonal indices in the last column. The usual method of correcting the chained first differences is to add or subtract from each item the differ-

¹ Arithmetic mean of the three central items.

ence between the arithmetic mean of the twelve items and 100, but this method changes each chained difference by a constant amount rather than by a relative amount, and it seems more reasonable to adjust each item relatively than by a constant factor, where such adjustment is merely for the purpose of making the arithmetic mean 100. Where there is no wide variation within the seasonal index, the two methods of adjustment will give approximately the same result, but where the range is wide, the final adjustment by dividing by the arithmetic mean will give a seasonal index with a much smaller range than the addition and subtraction method.

The Composite Curve

The Bureau's monthly index is a weighted aggregate of the deviations from normal of eleven series. The index covers the period from 1919 to the present, altho the trends of some of the series have been computed with origins earlier than 1919. A few series are composites of the deviations from normal of several component parts. This is true of bank debits, cattle and hog sales, and advertising.

Bank Debits

The index of bank debits has been derived from the weighted deviations from normal of the several parts of the index. Bank debits for Indianapolis, Fort Wayne, South Bend and Evansville have been combined and a trend fitted to the total debits for the four cities. Separate trends have been applied to the debits in Terre Haute, Muncie and Gary. The trend values are given in Table XXV. The deviations from normal of the four bank debit trends have been weighted on the the following percentage basis for the period from 1919-1933.

TABLE XXII

WEIGHTS APPLIED TO BANK DEBITS
IN SEVEN INDIANA CENTERS

1919-1933

	1919	'20	'21	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31	'32	'33
Indianapolis															
Fort Wayne															
South Bend	100	100	100	85	79	76	77	78	79	80	81	82	83	84	84
Evansville															
Gary				15	13	12	12	11	11	10	9	9	9	8	8
Terre Haute					8	8	7	7	6	6	6	6	5	5	5
Muncie						4	4	4	4	4	4	3	3	3	3
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Cattle and Hog Sales

Live stock receipts are collected by the Bureau from the three principal receiving centers in the state, Evansville, Indianapolis, and Lafayette. A trend has been fitted to the total receipts of the three centres, and the deviations from normal, expressed as index numbers, have been multiplied by the deviations from normal of their respective monthly prices also expressed as index numbers. The example shown below illustrates the method applied to cattle sales during the first half of 1919.

TABLE XXIII

INDIANA CATTLE SALES
First Six Months of 1919

	Price Index	Receipts Index	Sales Index	Deviations from Normal
January	155.5	122.7	190.8	+90.8
February	161.8	120.3	194.6	+94.6
March	161.2	98.0	158.0	+58.0
April	166.7	106.8	178.0	+78.0
May	167.3	103.1	172.5	+72.5
June	154.0	92.0	141.7	+41.7

The deviations from normal as shown in the last column of Table XXIII computed separately for both cattle and hogs have been used to represent live stock sales in the Bureau's index of business conditions. The prices used are the average prices paid the farmer as reported by the United States Department of Agriculture.

Advertising

Newspaper advertising is received monthly from the newspapers in twelve Indiana cities. The deviations from normal for newspaper advertising in each city have been weighted each year as indicated below.

WEIGHTS APPLIED TO NEWSPAPER ADVERTISING
IN TWELVE INDIANA CITIES
1919-1933

	'1919	'20	'21	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31	'32	'33
Indianapolis ..	36.3	36.4	36.5	28.7	24.2	22.8	21.3	21.3	21.4	20.4	20.4	20.5	20.6	20.7	20.8
Fort Wayne	21.8	21.8	21.7	17.0	14.3	13.4	12.4	12.4	12.4	11.8	11.8	11.8	11.8	11.7	11.7
Terre Haute ..	18.7	18.5	18.4	14.3	12.0	11.1	10.3	10.2	10.2	9.6	9.5	9.4	9.4	9.3	9.3
Gary	7.6	7.8	8.0	6.5	5.6	5.4	5.1	5.3	5.4	5.2	5.4	5.5	5.6	5.8	5.9
Richmond	9.8	9.7	9.7	7.6	6.4	5.9	5.5	5.5	5.5	5.2	5.2	5.2	5.2	5.2	5.1
Kokomo	5.8	5.8	5.7	4.4	3.7	3.4	3.1	3.1	3.0	2.8	2.8	2.8	2.7	2.7	2.7
South Bend				17.2	14.5	13.6	12.7	12.7	12.7	12.1	12.1	12.1	12.1	12.1	12.1
Elkhart				4.3	3.6	3.4	3.2	3.2	3.2	3.0	3.0	3.0	3.0	3.0	3.0
Evansville					15.7	14.7	13.7	13.7	13.7	13.1	13.1	13.1	13.1	13.1	13.1
Marion						6.3	5.9	5.9	5.9	5.6	5.6	5.6	5.6	5.6	5.6
Muncie							6.8	6.7	6.6	6.1	6.0	5.9	5.8	5.7	5.6
Hammond										5.1	5.1	5.1	5.1	5.1	5.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Bank debits, cattle and hog sales, and newspaper advertising are the only series in the composite index of business conditions in Indiana of which the state total is composed of more than one part. The data from which the series other than those indicated above have been derived, are available only as state totals. The trend values for the series shown in Figures 1 to 15 are given in Table XXV. Where a series is composed of more than one part the trend value is given for each part.

TABLE XXV

TREND EQUATIONS OF COMPONENT PARTS
OF THE INDIANA GENERAL BUSINESS INDEX

Series	Trend	Period	Origin	Unit	Basis
Automobile Production	$y=10,857.6-6.70x$	Jan., 1919—Nov., 1932	Dec., 1918	Number of Cars	Monthly
Bank Debits					
Evansville					
Fort Wayne	$y=226,380.0+488x$	Jan., 1919—Nov., 1932	Dec., 1918	\$1,000	Monthly
Indianapolis					
South Bend					
Muncie					
Gary	$y=22,285.7-52.94x$	Jan., 1924—Oct., 1932	Dec., 1923	\$1,000	Monthly
Terre Haute	$y=26,828.2-76.60x$	Feb., 1922—Nov., 1933	Jan., 1922	\$1,000	Monthly
Building Contracts	$y=17,135.1-55.89x$	Jan., 1923—Nov., 1932	Dec., 1922	\$1,000	Monthly
Cattle Prices	$y=77.3+9384x$	Mar., 1919—Oct., 1932	Feb., 1919	100 sq. ft.	Monthly
Cattle Receipts	$y=365,208.1-4,994.50x$	1910—1932	July 1, 1909	Dollars per 100 lbs.	Annual
Coal Production	$y=20,735.9+91.18x$	1916—1932	July 1, 1915	Number of animals	Annual
Electricity Production	$y=6,841.9+70.71x$	1910—1932	July 1, 1909	1,000 tons	Annual
Hog Prices	$y=120.1-3526x$	Jan., 1920—Oct., 1932	Dec., 1919	100,000 kwh	Monthly
Hog Receipts	$y=3,254,324.4-62,479.57x$	1910—1932	July 1, 1909	Dollars per 100 lbs.	Annual
Limestone Production	$y=919.9+4.64x$	1915—1932	July 1, 1914	Number of animals	Annual
New Car Sales	$y=919.9+4.64x$	Jan., 1919—Dec., 1932	Dec., 1918	Standard car load	Monthly
Newspaper Advertising	$y=72,649.3+541.14x$	1919—1932	July 1, 1918	Number of Cars	Annual
Elkhart	$y=3,947.7+1.17x$	Jan., 1922—Dec., 1932	Dec., 1921	100 lines	Monthly
Evansville	Arithmetic mean=1,714	Jan., 1923—Nov., 1933	Arithmetic mean	1,000 lines	Monthly
Fort Wayne	$y=1,571.7-2,084x$	Jan., 1918—Oct., 1933	Dec., 1917	1,000 lines	Monthly
Gary	$y=5350.4+13.26x$	Jan., 1919—Oct., 1933	Dec., 1918	100 lines	Monthly
Hammond	Arithmetic mean=6,685	Jan., 1927—Oct., 1933	Arithmetic mean	100 lines	Monthly
Indianapolis	$y=2,582.7+6184x$	Jan., 1916—Oct., 1933	Dec., 1915	1,000 lines	Monthly
Kokomo	$y=4,314.2-4.41x$	July, 1917—Sept., 1933	June, 1917	100 lines	Monthly
Marion	Arithmetic mean=7,301	Jan., 1924—Oct., 1933	Arithmetic mean	100 lines	Monthly
Muncie	$y=11,244.2-175.38x$	1921—1932	July 1, 1920	1,000 lines	Annual
Richmond	$y=7051.5-1.82x$	Jan., 1918—Oct., 1933	Dec., 1917	100 lines	Monthly
South Bend	Arithmetic mean=1,584	Aug., 1922—Oct., 1933	Arithmetic mean	1,000 lines	Monthly
Terre Haute	$y=1,375.9-.80x$	Jan., 1916—Sept., 1933	Dec., 1918	1,000 lines	Monthly
Pig Iron Production	$y=4,669.5+2.05x$	Jan., 1919—Oct., 1932	Dec., 1918	1,000 tons	Monthly

As indicated in Chapter IV the economic weights assigned to the various parts of the general business index at the present time are:

Item	Economic Weight
Automobile Production .....	.07
Bank Debits .....	.15
Building Construction .....	.16
Cattle Sales .....	.03
Coal Production .....	.05
Electricity Production .....	.15
Hog Sales .....	.07
New Car Sales .....	.10
Newspaper Advertising .....	.05
Pig Iron Production .....	.15
Stone Production .....	.02
	1.00

The above weighting is perhaps a fairly reliable appraisal of the importance of the various series in the state as measures of economic activity, but it fails to take into consideration the stability or instability of each series. A study of the behavior of each series since 1919 indicates that a few, such as electricity production and bank debits, are very stable while others, such as building construction and automobile production, have a very large standard deviation. The factor of relative stability has been recognized by dividing the economic weight of each series by the standard deviation of the percentage deviations from normal of the series. The weight resulting from the division has been used in weighting the percentage deviations from normal of each series before all the series are combined in the final index. The procedure is shown in Table XXVI.

TABLE XXVI

PERCENTAGE WEIGHTS OF SERIES
COMPRISING THE GENERAL BUSINESS INDEX

1919-1933

Series	Economic Weight	σ	$\frac{E W}{\sigma}$	Percentage Weight
Automobile Production .....	.07	.4291	.1631	4
Bank Debits .....	.15	.1740	.8621	21
Building Construction .....	.16	.4166	.3841	9
Cattle Sales .....	.03	.3142	.0955	2
Coal Production .....	.05	.3640	.1374	3
Electricity Production .....	.15	.1103	1.3599	32
Hog Sales .....	.07	.4182	.1674	4
New Car Sales .....	.10	.4415	.2265	5
Newspaper Advertising .....	.05	.1498	.3338	8
Pig Iron Production .....	.15	.3447	.4352	10
Stone Production .....	.02	.2773	.0721	2
Totals	1.00		4.2371	100

TABLE XXVII
TREND EQUATIONS FOR LIFE INSURANCE, GASOLINE,
AND USED CAR SALES

Series	Trend	Period	Origin	Unit	Basis
Life Insurance Sales	$y = 9,677.91 + 45.03x$	Jan., 1921—Oct., 1932	Dec., 1920	\$1,000	Monthly
Gasoline Sales	$y = 21,958.3 + 226.44x$	Jan., 1925—Oct., 1932	Dec., 1924	1,000 gal.	Monthly
Used Car Sales	$y = 16,787.1 + 42.98x$	Jan., 1923—Dec., 1932	Dec., 1922	Number of cars	Monthly