PRODUCTIVITY

Gauge of Economic Performance

Economic Policy Division Series

No. 53
September, 1952

14 WEST 49TH STREET, NEW YORK 20, N. Y.

PRODUCTIVITY:

GAUGE OF ECONOMIC PERFORMANCE

Prepared by
Research Department
National Association of Manufacturers
14 West 49th Street
New York 20, New York

August 1952

(Economic policy division series, no. 53)

PRODUCTIVITY AND PROGRESS

CONTENTS

PRODUCTIVITY*

Gauge of Economic Performance

INTRODUCTION

Our national economy may be conceived as a gigantic mechanism for satisfying our material wants. At one end it absorbs the services of labor, capital and other factors of production. At the other end it turns out the food, clothing, housing, and other goods and services which are the ultimate objectives of our economic activities.

The welfare of us all depends on the performance of this conceptual mechanism. Our monetary incomes are after all only means to an end. What we are really interested in is what we can buy with them, and we can buy only the goods and services that are produced. The food we eat, the clothes we wear, the tools we work with, the weapons we defend ourselves with, all must be provided by our national productive machine.

Economic progress, or at least one of its important aspects, may be defined as an improvement in the efficiency of the economic mechanism. But what criterion shall we use to rate this efficiency? How shall we determine how much progress has been made in the past? How shall we determine whether we are making any progress in the present?

It is clear that in rating the efficiency of the economic mechanism we must take account of the total supply of goods and services it turns out. Our national welfare, our national strength, our national standards of living, depend on the supply of economic values at our disposal. We cannot have more except by producing more.

But this is not the whole story. In appraising the performance of the economy account must also be taken of the input of human effort and other forms of sacrifice. If we were to produce twice as much goods by applying twice as much effort, this might be progress of a sort. But the performance of the economic machine, in at least one important sense, must mean an increase in the final output of goods and services without a proportionate increase in the input of human effort or of the other factors of production. The performance of the economy, in this sense, must be assessed in terms of changes in the output of goods and services per unit of input of the factors of production. This concept of output per unit of input is what economists mean by the term **productivity.** It is one of the most important single indicators of our national well-being.

In discussing productivity it is essential to identify all the elements of input. This must be done in our thinking, even though it is not always possible to do so in our statistical analyses. Without such a careful identification we may mistake for progress what is merely a substitution of one type of input for another.

* *Prepared by George G. Hagedorn, Research Department, National Association of Manufacturers.*

In studying the "input," of a single business establishment -- or even of a whole industry -- we should have to include the goods and services it purchases from other producers. An increase in the gross output of the establishment, per man-hour of labor or per unit of capital employed within that establishment, may simply reflect the fact that it is receiving its raw materials in a higher state of fabrication than formerly, or that it is purchasing services from outsiders which were previously performed within its own plant.

But for the economy as a whole, purchased materials and services do not form part of the input in any true sense. Such interchanges take place within the mechanism and should not be counted either as part of the original input or as part of the final output. What we are looking for is the ultimate factors of input. These may be identified as the three classical factors of production: labor, capital, and land. A brief word on the nature of each is appropriate here.

Obviously in studying the input of labor we must take into the reckoning not only the number of workers, but their hours of work. The quantity of labor input then is measured in terms of total man-hours. Ideally, at least, input of labor should also take account of the quality of the man-hours. It is somewhat absurd to equate one hour of a graduate engineer's time with one hour of the services of an untrained apprentice. A change in any process which substitutes one unskilled man-hour for one professional man-hour ought, by all realistic standards, to be considered a labor-saving innovation.

The nature of capital as a factor of input is somewhat more difficult to analyze. The capital used by producers is embodied in the form of buildings, machinery, stocks of goods, accounts receivable, and similar assets. But we must not imagine that the input of capital is to be measured in terms of the current consumption of such values in the form of wear and tear and obsolescence. This is the problem of depreciation and it is an entirely different matter. The consumption of capital values may be considered an intermediate stage in the productive process, in the same way as the consumption of materials. Such consumption is not one of the ultimate factors of input.

But there is an ultimate contribution of input in the provision of capital for productive purposes aside from the actual deterioration of the physical objects in which capital is embodied. The provision of capital involves a sacrifice which human beings are reluctant to make and for which they usually insist on compensation. The sacrifice is in the form of waiting. Someone must be willing to postpone the consumption of what he has produced, so that it may be made available to those who wish to use it to assist in future production. This sacrifice in the form of waiting must be considered as one of the ultimate factors of input in measuring the productivity of the economy.

Finally, land must also be included as one of the items of input. This term is used by economists in a broad sense to include everything that is provided by nature without man's assistance. The soil on which we grow our crops, the metals in the ground, the water in our streams, all these things -- except insofar as they have been modified by man -- may be comprehended under the title of land. These resources are limited in quantity, and their use for one purpose may entail the sacrifice of other uses to which

they might be put. The extent to which they are used in the productive process must be considered as a factor of input.

Having led the reader this far we must now disappoint him. Labor, capital, and land are all factors of input and there is no reason for emphasizing one of them to the exclusion of the others. But the fact is that a systematic analysis of productivity -- in the sense of the ratio of output to the **input of all factors** -- is still beyond the capabilities of economic science. Such an analysis would necessitate devising a means of measuring inputs of "waiting" and of the consumption of natural resources in units commensurable with man-hours of labor input. Theoretical methods for doing this have been suggested but various practical difficulties have blocked any satisfactory application of them. Since the general problem has not been completely solved the present discussion will be limited to labor productivity; that is, the amount of goods and services produced per man-hour of labor. The reader is asked to remember, however, both in reading this discussion and in applying its ideas, that the facets omitted from the analysis are of great importance. For example a change of process which saves man-hours of labor may represent no real gain if it results in wasteful consumption of natural resources. In cutting timber it is possible to save labor by cutting over an entire area, instead of cutting only the older trees from a larger tract. A discussion in terms of labor productivity alone runs the risk of failing to reckon with the real cost of such procedures.

Thus the present paper will be confined to a discussion of labor productivity; that is, the ratio of total output to **labor** input. Lest there be any misunderstanding at the start, it should be stated explicitly that labor productivity is **not** a measure of the performance of the workers. It is a measure of the performance of the entire economy in utilizing the services of workers. An improvement in labor productivity may or may not be due to a change in the behavior or attitude of employees. It may, for example, be the result of employers learning to apply labor with greater effectiveness.

A useful distinction may be made between "technical" and "economic" productivity.1/ Technical productivity means the efficiency with which man-hours of labor are used **in particular processes.** An increase in technical productivity means that we have learned to do some particular job with fewer man-hours of labor. Economic productivity, on the other hand, means the efficiency with which the manpower of the nation is allocated to the jobs in which it is most effective. For example, a movement of workers from the farms to the factories leads to an increase in economic productivity, since one hour's work in a factory produces more market value (on the average) than one hour's work on a farm.

It is well to keep this distinction in mind. The influences which affect the two types of productivity are entirely different: technical productivity depends largely on technological developments, while economic productivity depends on broader sociological factors. The results of the two types of

1/ These terms are suggested by John W. Kendrick in his paper on "National Productivity and Its Long Term Projection". It is not clear however, whether his use of the two terms would coincide precisely with the use of them in this report.

productivity are also usually different: an improvement in economic productivity may be self-compensating since the more productive jobs in the economy are in general the better paid jobs, whereas an increase in technical productivity does not have the same automatic effect on wages.

Recognition of the difference between the two types of productivity is also essential in interpreting statistics on the subject. Some of the extant statistical measurements of productivity include the effects of changing "economic" productivity and some are confined to changes in "technical" productivity.

It should not be thought that gains in economic productivity are in any sense less "real" than gains in technical productivity. The improvements of national welfare resulting from allocation of labor to the tasks in which it is most productive represent economic progress just as much as do improvements in the technique of performing specific tasks. Nevertheless the two types of productivity depend on different background causes and it is essential to remember the difference between them.

Finally, in order to avoid any suspicion that we are misleading the reader it should be said candidly that the whole story of national progress cannot be told in terms of labor productivity. Maintaining a high level of employment is probably just as important as increasing the productivity of those who are employed. Furthermore, there are non-material values which the concept of productivity cannot take into account. Movement from farms to factories may improve productivity but only at the sacrifice of a way of life which is precious to those who lead it. There are positive values to be derived from labor, or at least from certain types of labor, but they are of a non-material kind which are rarely counted in the statistics.

One other form of progress which is not comprehended in the concept of productivity is the gradual change in the character of the jobs which have to be done. It is a matter of common observation that there has been a shift from the back-breaking man-destroying types of work which were fairly common a half century ago to the type of job which may require close attention but not much in the way of brute effort. There has been a "humanization" of our daily bread-winning activities. This is an important form of progress but it does not figure in measurements of productivity, which equate all man-hours of work, whether they entail carrying a hod or repairing watches.

Despite these reservations labor productivity is an important criterion of national welfare and national progress. The proof lies in the eagerness with which European nations study the industrial methods by which the United States has achieved a much higher level of productivity than their own.

The present report is an objective study of this important subject, which it is hoped, will increase the reader's basic knowledge and understanding of it.

I

THE DETERMINANTS OF PRODUCTIVITY

Productivity is the rate at which the economy converts human exertion into want-satisfying goods and services. It is a measurement of the over-all efficiency of the economy, in much the same way as miles-per-gallon is a measurement of the over-all performance of a passenger automobile. Since the whole economy is involved, the actions of all economic groups have their effect on productivity.

Some of the more obvious factors which determine the rate at which productivity increases -- if it does -- are listed in the outline appended to this section (page 15). The list is neither exhaustive nor completely logical. No list could be exhaustive, since almost every significant economic event has its effect on productivity. The list is not wholly logical in that the factors listed overlap each other and each of them could be further analyzed as the results of still more basic economic forces.

However, the outline, and the discussion of it which follows, will be helpful if only in conveying a realization of the complexity of the problem.

INNOVATIONS

Despite the fact that we live in a changing world, the innate characteristics and potentialities of human beings remain effectively constant. We must not expect that progress can be achieved through greater individual strength or cleverness or effort being applied in doing the same old things by the same old methods. Significant gains in productivity depend on finding and using better ways of accomplishing the ends we set for ourselves. In this context a "better" way is to be understood as a method which attains the same result with less labor.

Labor-saving innovations must first originate in the mind of some imaginative person. He may be an engineer, a laboratory scientist, a businessman, a workman, or simply an average citizen who happens to get an idea. "He" is most likely to be a team comprising men of varied points of view.

The innovation may be the introduction of a new tool or a new machine. Historically labor-saving innovations have, for the most part, taken the form of a transfer to power equipment of duties formerly performed by human hands. Between 1899 and 1939 the machine horsepower available to each American factory worker increased by about three-fold and the output per man-hour in factories increased in almost exactly the same proportion.

But an innovation need not take the form of a new device. It may be simply a better method of handling the job with existing equipment. The development of the "line" method of production was a powerful force in increasing labor's

productivity. It permitted the worker to stand still with his tools and machinery, while the work came to him at a convenient height for working. True, this necessitated certain new devices, but these were the result rather than the cause of this new conception of the work process.

The layout of the factory and the use of auxiliary handling equipment can be just as important as the type of production machinery in use. The American boot and shoe industry turns out twice as much product per man-hour as the corresponding British industry, although both use the same production equipment.2/ The explanation lies in the greater use of mechanical conveyors by the Americans, and their practice of leaving more space in the factory for storage, packing, supervision, etc.

Innovations may be in the form of new materials or supplies which make the worker's job easier and permit him to turn out more product in an hour's labor. Replacement of metals by plastics, which are easier to mold and cut, has saved labor in many processes.

The essential fact is that labor-saving innovations must originate in the mind of some person or group of persons. Unless we have technically-trained, informed, alert and imaginative persons -- imbued with the idea that current ways of doing things are not necessarily the best ways -- we will be sadly handicapped in improving our productivity.

Innovation should not be thought of exclusively in terms of the occasional spectacular revolution in industrial methods. Such instances occur but, more commonly, improved efficiency results from the gradual accumulation of many changes, each one of which is minor by itself. The process of innovation is so gradual and so continuous that we either forget that it goes on or else take it for granted. We forget that in many human societies ways of doing things remain unchanged for centuries and departures from established procedures are either forbidden by law or impeded by a superstitious adherence to custom. An attitude which accepts the desirability and the practicality of technological change is an essential prerequisite to progress. This is not an attitude which can be taken for granted.

MANAGEMENT FACTORS

The original conception is only a first step in any technological innovation. A whole series of interests must cooperate to bring the idea to fruition.

The first of these interests is industrial management. Management has the responsibility for making the decision as to whether or not to adopt the innovation in question. This is not always easy, since careful calculation is necessary to determine whether an innovation is really an improvement. All the ramifying effects of the change must be considered, even if they are not

2/ See "Technological Stagnation in Great Britain" Machinery and Allied Products Institute, pp. 24 & 29.

precisely predictable. Substitution of a machine for a hand process involves no real labor saving if the man-hours required to construct the machine, prorated over the product it will turn out during its useful life, prove to be greater than the man-hours used to turn out the same product by hand. The sagacity of businessmen in rejecting innovations which ought to be rejected is just as important to progress as their progressiveness in adopting those which ought to be adopted.

Competition furnishes one of the most impelling stimuli toward higher efficiency. Competition forces the businessman to adopt the latest and most efficient methods, and to improve on them if possible. Competition punishes him if he fails to keep up with the procession, and eventually eliminates him if he lags behind for any long period. Competition, like the law of the jungle, permits the survival of only the most efficient. The superior productivity of American industry is due largely to the fact that competition has always been accepted as our way of business life, whereas many foreign nations have preferred to temper the competitive wind by cartels or by a general attitude of "live and let live."

In order to compete successfully, business managers must be willing to assume the risks involved in adopting innovations. This does not mean that risk is a good thing in itself or that all innovations should be accepted without question. The pros and cons of all proposed changes must be carefully considered. But, when all is said and done, businessmen must not retain established methods simply through lethargy or an instinctive preference for the familiar.

The supreme importance of the competitive spirit in fostering industrial progress is best appreciated by contrasting the American record with the course of events in countries which have preferred cartels and industrial "rationalisation" to competition. The following remarks are written by a Canadian who has had extensive experience with both American and British industry:

"Great Britain was very wealthy in 1880. She had so much money that she had grave difficulties in investing it all. Hundreds of millions of pounds had to be sent abroad each year to find profitable employment. There was no lack of British money with which to buy better equipment. The leaders of British industry were fully aware that better industrial equipment had been the foundation of their leadership in the past, and of their greater wealth. In spite of all this, those in charge of British industry allowed the equipment of American industry to draw ahead of them by leaps and bounds between 1880 and 1914, in both the quantity of this equipment and in its quality.

"Sharp and effective competition was the only means that the American Government has ever used to ensure that the equipment of their industries was kept fully up to date, and the industries themselves fully efficient. The results achieved are ample testimony to the soundness of this policy.

"The British Government held the same view up to 1880. From that time onwards, they swung slowly but increasingly to the opposite view. It was about 1880 that the heads of British businesses began to form trade associations, price rings and cartels, with the idea of reducing the sharpness of competition, or even of eliminating it entirely. At first the British Government

looked the other way. Certainly they took no action to prevent the formation of these organisations. In later years, however, they encouraged the formation and the extension of the activities of these associations."3/

Businessmen can accelerate the growth in productivity through actively supporting the search for labor-saving innovations. Most large concerns maintain research and development departments which specialize in this type of activity. Progress is likely to be more rapid when the search is carried on systematically than when management simply waits for an idea to be brought to its attention.

Of course, productivity is affected not only by businessmen's behavior and attitude toward innovations but by their day-to-day performance of normal duties. Efficient plant layout, efficient scheduling of work, efficient assignment of specific tasks to specific persons, efficient purchasing, all help to determine the output which one man-hour will yield.

The aggressive expansion of markets often helps to increase productivity. In many processes, large-scale production is more efficient than small-scale production. But if large plants are to operate continuously at their optimum rates management must find a dependable market for their output.

Finally, productivity is influenced by management's ability to get along with its employees. Employment practices and policies which promote a spirit of cooperation cannot fail to increase the yield in goods and services from each man-hour of work.

FINANCIAL FACTORS

When an inventor has devised a new industrial method, and when management has accepted it as desirable, still another condition must be met before it can be effective in increasing productivity: capital must be found for financing the innovation.

When venture capital is plentiful and can be obtained on reasonable terms management will be encouraged to install new types of labor-saving equipment which it would otherwise reject.

Of course, new equipment may be installed even without any new capital being contributed. This would occur as old equipment was retired and the funds would be provided by depreciation allowances. But the process is accelerated when new capital is plentiful and the resulting improvement in productivity is that much more rapid.

The contribution of new capital to the improvement in productivity should not be overemphasized. It should not be thought that new business investment somehow automatically increases productivity. Investment is only a part of the process and many other conditions must be met for the productivity gains to be realized. If the state of the industrial arts in a country

3/ *"Politics and Poverty" by Lewis C. Ord, pp 40 and 41.*

is such that foundations are dug by laborers with shovels, their productivity will not be increased if the necessary funds are invested to give each laborer two shovels. Where a worker already has all the equipment he can use, mere investment cannot improve his performance. On the other hand, where an industrial improvement has been devised new funds may be needed to make it effective.

It must be remembered that in a dynamic economy the average performance of industry is usually well below the best performance possible with the latest tools and machines. This is inevitable, since everyone cannot have the latest model. An industry cannot scrap its existing equipment every time an innovation occurs. But the width of the gap between actual performance and potentially best performance is importantly influenced by the availability of capital.

LABOR FACTORS

Obviously the characteristics of the labor force will have a considerable influence on productivity. It is hardly necessary to mention that the employees skill, training, and experience is all-important in determining the rate of their output. A skilled paper-hanger can decorate a living room in a fraction of the time the average home-owner can do it himself (not to speak of the difference in the quality of the finished job). This relationship would be true even if the average home-owner had all the tools of the trade at his disposal. There are very few jobs at which "know-how" does not make some degree of difference in efficiency.

The health and morale of the labor force are also important in determining its performance. Everyone knows from his own experience that when he is sick, or weary, or worried, or discontented, or oppressed with a feeling that he is being treated unfairly, his output suffers.

The health and morale of the population are dependent on a myriad of economic, political, and sociological factors which cannot be traced in detail here. One factor which should be mentioned specifically is the hours of work. If the worker is required to spend excessively long hours at his job each day or each week, his output per hour will very likely be reduced. This results not only from physical weariness but from staleness, boredom, or lack of a feeling that life is rewarding. There is some evidence that when -- during the early part of this century -- the standard factory work day was reduced from 12 to 10 hours the daily output per worker was not reduced at all.[4/] (This might have been due to the resulting incentive for management to find ways of saving labor, as much as it was due to the improved performance of labor itself.)

In a dynamic economy such as our own, productivity depends not only on the efficiency of the employee at the particular job he is doing, but on his ability to change along with the times. With changing technology acquired skills can quickly become obsolete. The employee must have the adaptability and initiative to learn new methods or he will be a drag on progress. His

4/ "Employment in Manufacturing, 1899 - 1939", National Bureau of Economic Research, p. 13.

general education will be a factor in determining his ability to adapt. Even more important are such intangibles as the general spirit of the population and its attitude toward industrial progress. The American people are used to constant changes in productive methods. They accept and even welcome these changes. In some foreign countries this is not so and people look with suspicion on any alteration in traditional ways of doing things.

The trait of adaptability is especially helpful in improving what we have called "economic productivity." Increases in economic productivity are defined as shifts of the labor force from the less productive to the more productive occupations, without necessarily any increase in the productivity of any particular occupation. Such shifts are encouraged when the labor force is flexible and adaptable. Geographic mobility is also important since it permits the employee to move to locations where his labor can be more effective. The Atomic Energy plant at Oak Ridge could not have been built or operated if large numbers of specialists and skilled workers had not been willing to assemble on a spot almost uninhabited previously.

The potential productivity of an industry can be seriously depressed if organized labor imposes make-work rules. Featherbedding -- that is, the practice of requiring the employment of persons whose labor is not needed -- dilutes the productivity of the labor force. Very often such rules result from the feeling that a worker has a vested interest in his job and that when technological advances eliminate the need for his services he ought to be kept on in a stand-by capacity. Such an attitude can be a serious drag on progress since it destroys management's incentives for installing labor-saving changes.

A very important factor in determining labor productivity is the manner in which employees are compensated. The form of compensation can sometimes act as an incentive for the employee to increase his hourly output. If he is paid on a piece-work basis he knows that he will benefit from any added exertion or closer attention to the job. But pay systems based on the individual worker's output must be flexible, and the rate per unit of output must be subject to change when a substantial change in the process occurs. Rigid piece-work rates would destroy management's incentive to adopt innovations which increase output per man-hour, since the benefit would go to the employees in greater earnings per hour rather than to ownership in lower wage costs or to customers in lower prices.

THE ECONOMIC CLIMATE

The discussion thus far has indicated various ways in which the behavior of inventors, management, employees, and financiers may affect the growth of productivity. In addition to actions of this type which can be ascribed to specific persons, productivity is influenced by certain broad background conditions which are the responsibility of everyone in general but no one in particular.

The Rate of Business Operations

The first aspect of the economic climate which is likely to exert an important effect on productivity is the general rate of operations. Is the

economic mechanism operating well below capacity as in 1932? Is it operating approximately at normal speed as in, for example, 1929 or 1948? Or is it operating under such pressure as to put a severe strain on our national economic strength as in the peak World War II years?

In a depressed period when industry operates well below capacity there may be a tendency for productivity to decline, or to grow less rapidly than usual. The lower scale of production reduces the efficiency of labor. Division of labor cannot be carried as far and labor for maintenance and for general overhead purposes imposes a greater burden per unit of product. Business is reluctant to make new investments for modernizing its plant and equipment.

However, in such a depressed period there are other forces making for an improved level of productivity. A certain part of the available production facilities is put aside, and this is likely to include the least efficient plant and equipment. A part of the labor force is unemployed and the employees who are kept on are quite likely to be more efficient than the average. In addition, profits suffer severely at such a time and the pressure of competition forces businessmen to search carefully for all possible methods of improving efficiency.

Thus a depression creates two opposing sets of forces, one tending to increase productivity and the other tending to decrease it. As business conditions improve and the nation moves from depression to prosperity the opposite sets of opposing forces come into play. The greater scale of operations permits more economical and more efficient use of labor. Investment funds become more plentiful and businessmen become more willing to modernize their facilities. On the other side of the coin, as prosperity returns the less efficient plant and machinery comes back into service and the less efficient employees are hired back and business ceases to feel so strongly the necessity for cutting waste and improving efficiency.

When the economy moves from a state of normal prosperity into a period of forced draft -- such as during World War II -- the factors tending to reduce efficiency come into the ascendant. Equipment that is badly out of date is brought back into service. The labor force is augmented by unskilled schoolboys and housewives. Haste and confusion prevail in industry. Unsatisfactory materials and supplies have to be substituted for those usually employed. Shortages of metals prevent business from modernizing its plant and equipment at the usual rate. Sellers' markets prevail and inefficient producers in some measure are protected from the consequences of their inefficiency.

In the present general discussion it is impossible to strike the balance and say which set of forces is likely to predominate at any given time. In the later examination of the statistical record some tentative conclusions of this nature will be drawn. (See page 19.)

Changes in the Composition of Output

Our economy is more efficient in producing some types of goods than it is in producing others. Therefore, any shift in output from one type to another will affect our over-all level of productivity.

An example which will make this clear, although it is not too significant economically, is provided by the tobacco industry. We are able to create one dollar of value with much less labor in manufacturing cigarettes than in manufacturing cigars. During the last half century cigarettes have become a much larger fraction of the total output of the tobacco industry. This development, by itself and without regard for the changes in the productivity of the cigarette and cigar manufacturing processes considered separately, has led to an increase in the productivity of the tobacco industry as a whole.

A similar, and far more important, economic development has occurred through the long-term shift of our entire economy from agriculture to industry. An hour's labor in manufacturing or in transportation produces far more dollar value than an hour's labor in agriculture. The decline in the relative importance of agriculture thus creates an automatic increase in the general productivity of the economy.

The effects of changes in the composition of our national product extend only to what we have called "economic productivity."

Other Background
Economic Factors

So many factors in the economic climate affect productivity that it is impossible to do more than mention some of the outstanding influences. An efficient system of transportation is important since it permits geographic specialization which in turn promotes productive efficiency. Steel production could not be concentrated in the large efficient mills without an elaborate system for carrying the raw materials to them and for delivering their product to its consumers.

The willingness of the public to save and to invest its savings in industry affects the rate at which innovations can be adopted and thus in turn influences the growth in productivity.

The willingness of the public, as consumers, to accept new products is helpful since it permits industry to make labor-saving changes in the character of its output.

GOVERNMENT POLICIES

The government cannot be omitted from a discussion of the factors which determine the level of productivity. However, its role is chiefly a secondary one; it can either dampen or accentuate the effects of the other factors which have already been mentioned.

The government's action in the anti-trust field is of considerable importance in determining the trend of productivity. Competition is one of our most important stimuli to increasing efficiency. One of the basic reasons for the superiority of American productivity over productivity in other countries is that our laws protect and encourage competition, and forbid monopolies or actions in restraint of trade. The cartels or schemes of "rationalization" in various foreign countries are often merely schemes for protecting the inefficient against the consequences of his inefficiency.

However, anti-trust policy may have adverse effects on productivity if it degenerates into a policy of harassment of large concerns merely because they are large. Large scale production is often, although not always, essential to the attainment of maximum potential efficiency. The productivity of the economy will undoubtedly suffer if our industrial giants are ever forced to break up into smaller units.

The government may alter the allocation of our productive resources, to the detriment of "economic" productivity, by its taxation, tariff, and subsidy policies. High corporate income taxes may discourage investment in undertakings involving high risk, since the government claims a lion's share of any profits but does not share in any losses which may develop. The innovations which lead to the most spectacular increases in productivity almost inevitably involve a high degree of risk.

NATURAL FACTORS

Finally, nature itself plays a role in determining the productivity of our labor. The productivity of agriculture (whether measured on a per acre or per man-hour basis) depends heavily on the weather. Recent improvements in yield may be due as much to good luck with the weather as to increased human efficiency.

The quality, location, and depth of our mineral deposits determines to a large degree the productivity of labor in the mining industry. Comparisons of productivity of British coal miners with the productivity of American coal miners are somewhat unfair, since the British miner must work at a much greater depth.

Many other examples of natural factors affecting productivity will occur to the reader. Some of these may be altered by human action: the natural fertility of the soil may be improved by chemicals, low-quality ores may be beneficiated, perhaps even the weather may be altered under human direction. But there is always a residuum of unalterable and uncontrollable natural factors which must be taken as given. These exert an influence on productivity which is of very great importance.

SOME BROAD CONCLUSIONS

This description of the forces which affect the productivity of our economic mechanism could be spun out almost indefinitely. But, since a halt must be called somewhere, this is perhaps the spot to pause and draw some broad general conclusions.

The first of these is that productivity depends on a large number of interacting influences and any tendency to emphasize a particular factor gives a false picture. It is true that between 1899 and 1939 the output per man-hour in manufacturing increased three-fold and the horsepower per worker also increased three-fold. But it would be highly misleading to assign the increase in horsepower as the "cause" of the increase in productivity.

Probably the worker in 1899 had all, or nearly all, the horsepower he could use in the existing state of technology and nothing would have been gained by putting more prime movers at his disposal. It would be truer to the facts to regard the increase in horsepower and the increase in productivity as different aspects of the change in technology which has occurred. Many conditions had to be met to make this change in technology possible. Ingenious people had to devise new ways of substituting machine power for hand labor, management had to appraise these developments carefully and decide for or against them, employees had to learn the new skills involved, government had to maintain the competition which acts as a spur to progress, financial markets had to supply the necessary funds. Attempts to decide which of these necessary conditions is most important are like attempts to decide which leg of a three-legged stool is most essential to its support.

A second conclusion, along the same lines, is that productivity gains are a social phenomenon. It is impossible as well as undesirable to assign the "credit" for particular advances in productivity to particular persons, particular industries, or particular economic groups. The origin of a change which brings greater productivity may be so remote from the industry in which the gain occurs that persons engaged in that industry may be unaware of its real source. None of the determining factors which have been mentioned is in any sense "ultimate" -- in fact it is questionable whether any such ultimate explanatory causes exist. For example, even if we were able to identify improved employee morale as the "cause" of an observed improvement of productivity in a particular process, we could never be sure to what extent the improved morale should be credited to the employees themselves and to what extent it is due to the behavior of management. This conclusion holds, a **fortiori**, with respect to attempts to assign the credit for increases in the productivity of the economy as a whole.

A third conclusion is that we must expect increases in productivity to be gradual rather than abrupt. Improvements in technique are for the most part minor in nature and it is their accumulation over a long period which creates substantial gains. Such improvements are not adopted instantaneously; they spread through an industry one plant at a time. Even where a spectacular change in technology is developed suddenly it is seldom installed immediately. It takes time for people to learn about it and to become convinced of its superiority. Then the new method comes into use gradually as old equipment wears out and is replaced by the new models. It is even more inevitable that the productivity of the economy as a whole can increase only gradually, since the improvements in different industries occur at different times.

A final and perhaps most important conclusion is that we must not regard the growth of productivity at some fixed secular rate as inevitable and predestined. For productivity to grow continuously many conditions must be fulfilled and many interests must cooperate. If any one of these should fail progress will be stalled or at least seriously impeded. There were periods of history when productivity remained unchanged for centuries, and wisdom and foresight are needed to keep us from lapsing again into stagnation.

The factors which determine the growth of productivity are numerous and complex and indistinguishable from the factors which determine our economic health in general. Probably it is as pointless to inquire: "What policies shall we follow to encourage the growth of productivity?" as to ask "How shall I keep my arm or my leg healthy?" The answer is that the health of an arm or leg is a reflection of the health of the entire body. So the growth of productivity is an outcome of an economy which is sound in all respects.

A PARTIAL OUTLINE OF THE FACTORS WHICH DETERMINE LABOR PRODUCTIVITY

I Technological factors
- Ingenuity of engineers and others in devising innovations:
  - A. In tools and equipment
  - B. In productive methods
  - C. In materials

II Management factors
- Attitude and behavior of businessmen with respect to:
  - A. Competitive spirit
  - B. Willingness to assume risks
  - C. Willingness to adopt innovations
  - D. Efficient scheduling of work (including division of labor and plant layout)
  - E. Efficient purchasing of materials
  - F. Aggressive expansion of markets
  - G. Efficient handling of labor relations
  - H. Active support of search for new and better methods
  - I. Standardization of products

III Financial factors
- Availability of capital for financing innovations:
  - A. In existing industries
  - B. In setting up brand new Industries

IV Labor factors
- The characteristics of the labor force with respect to:
  - A. Degree of skill
  - B. General Education
  - C. Health
  - D. Morale
  - E. Hours of work
  - F. Adaptability
  - G. Geographic mobility
  - H. Willingness to accept innovations
  - I. Attitude toward "featherbedding"
  - J. Manner of compensation

V Government factors
- Government policies dealing with:
  - A. Competition
  - B. Business size
  - C. Taxation
  - D. Subsidization
  - E. Tariffs

VI Economic factors
- The general background economic climate. In particular:
  - A. The rate of operations
  - B. The allocation of population as between farming and industry
  - C. The availability of transportation
  - D. Willingness of the public to save and invest
  - E. Willingness of consumers to accept new products

VII Natural factors
- The state of such uncontrollable factors as:
  - A. The weather
  - B. The presence or absence of mineral deposits
  - C. The condition of the soil

II

THE RECORD OF PRODUCTIVITY GROWTH

At this point we turn from a discussion of productivity in the abstract to an examination of the factual record of productivity growth in this country. Important questions are to be answered: How rapidly has productivity grown? Has its growth been steady or have there been spurts and lulls? Has growth been uniform in all economic sectors? What have been the effects of business cycles? Of wars and defense programs?

A great deal of highly skilled research has been done on the subject of productivity. It is not our purpose to present a comprehensive review of all of this data, but only to examine a few of the outstanding contributions which will be helpful in conveying an understanding of the broad aspects of the record. The studies to be discussed will be classified under three headings:

1. **The National Bureau Studies.** A series of works on productivity prepared by the National Bureau of Economic Research, for the most part under the direction of Solomon Fabricant.

2. **The Kendrick Study.** A paper by John W. Kendrick of the U.S. Department of Commerce, but not an official document of the Commerce Department.

3. **The BLS Studies.** Studies on productivity in certain industries, prepared by the U.S. Bureau of Labor Statistics.

Before presenting the conclusions of these several statistical inquiries, it will be well to consider certain problems involved in the measurement of productivity. These problems have an importance not only for statistical technicians but for those who are concerned with a correct interpretation of the record.

SOME PROBLEMS IN MEASURING PRODUCTIVITY

In gauging the performance of an automobile in terms of miles-per-gallon, all that is needed is to keep account of the number of miles covered and of the number of gallons consumed. A measurement of labor productivity is of the same character: it is a comparison of the number of units produced with the number of man-hours employed in their production. In measuring the productivity of one simple process which does not change in nature as time passes, the problem is a fairly simple one in conception, although not always so in execution. We simply divide the number of units produced in a period by the number of man-hours expended in the same period. The ratio so computed may be compared with the corresponding ratio for other periods.

One difficulty arises from the fact that most processes do change in nature as time passes. In fact, such changes are inextricably connected with

changes in productivity. Few industries continue to fabricate exactly the same end product out of exactly the same materials over any long span of time.

Most productivity measurements ignore changes in the quality of the end product. What is even more serious, they ignore changes in industrial organization which alter the relationship between the final output and the original input of materials. The seriousness of this point will become plain if the reader will reflect that it would be wrong to describe what goes on in a shoe factory as "the production of shoes." The production of shoes is a complex process involving the raising of cattle, the slaughtering of the cattle, the production of the chemicals used in the tanning, the production of the thread used to sew the shoes, and many, many other operations. What goes on in the shoe factory is merely one stage of the whole process. When we measure the productivity of the operation of a shoe factory -- in terms, say, of the number of pairs per man-hour -- we are not measuring the productivity of the shoe-producing activities of our economy. This still would not be too bad if the activity within the shoe factory retained a fairly constant relationship with the whole process. But if, for example, the factory began to buy its leather cut to convenient shapes and sizes whereas previously it had bought the leather in large sheets, the resulting decline in man-hours per pair expended in the factory could not be regarded as a genuine increase in productivity. However, productivity measurements based on large masses of data can seldom be corrected for such changes in the structure of industry. Where an industry tends toward increasing division of labor as between plants, failure to take this factor into account exaggerates productivity growth. Where an industry tends toward increasing integration of processes under one roof this understates the growth in productivity.

Where a productivity measurement is intended to cover a number of different processes -- as for example when we measure productivity in the entire manufacturing sector of the economy -- another critical difficulty arises. It is easy enough in principle to add up all the man-hours expended by manufacturing workers (the denominator of the productivity ratio). But how can anyone add up tons of steel, yards of cloth, barrels of gasoline, and so forth to get the total physical output of manufacturing (the numerator of the productivity ratio)?

In practice, this difficulty is usually solved by assigning a system of weights by which the output figures, in their diverse units of measurement, may be combined. In effect such weights amount to a set of economic equivalences: i.e., they amount to an agreement that one ton of steel shall be regarded as the economic equivalent of so many yards of cloth, etc. In this way the many different forms of manufacturing output are rendered commensurable and it becomes possible to measure total manufacturing output and hence productivity in manufacturing as a whole.

The weights, or economic equivalences, are not completely arbitrary, since they are usually based on the prices prevailing on some particular date or combination of dates. Thus one ton of steel might be regarded as equivalent to 1000 yards of cotton cloth if it turned out that the price of one ton of steel was the same as the price of the 1000 yards of cloth. But there is still an arbitrary element, since these price relationships vary from one date to another.

What should be stressed is that compilation of index numbers of aggregate production is intrinsically a meaningless procedure. It can be accomplished only by resort to certain rather arbitrary expedients. There is always a degree of choice among several of these expedients. There is never a unique answer when we ask "By what percentage did physical output of all manufactured goods in year X exceed or fall short of the corresponding output in year Y?"

Computations of productivity trends for a composite group of products are very seriously affected by a shift of manpower from one product to another. To understand this, suppose for a moment that one ton of steel is to be considered the equivalent of 1000 yards of cotton cloth. But suppose that it takes fewer man-hours to produce the one ton of steel than it takes to produce the 1000 yards of cloth. Then even without any change in the productivity of the cloth industry separately or of the steel industry separately, if manpower moves from cloth production to steel production, the composite productivity figure will show an increase.

This is a tremendously important fact which must be kept in mind in interpreting statistics on productivity in the economy as a whole or in any broad sector of the economy. Such measurements are affected not only by improvements in the efficiency with which particular jobs are done, but by shifts in the composition of output.5/

Aside from these difficulties of definition and interpretation, productivity measurements are affected by the necessity of relying on incomplete and unsatisfactory basic statistics. The available figures on output and employment are collected chiefly for other purposes, and they can be adapted to productivity measurement only by somewhat doubtful expedients. Broad gaps exist in the basic information, which must be filled by conjecture or assumption if the complete picture is to be presented. The truth is that all statistics on productivity are subject to a very large margin for error.

This discussion of the difficulties involved in statistical studies of productivity should not be taken as a disparagement of the excellent work in this field. Rather, it should be regarded as a tribute to the courage and ingenuity of investigators who have been willing to attempt a job beset by so many inherent difficulties.

THE NATIONAL BUREAU STUDIES

Without doubt, the most careful and most comprehensive studies of productivity in the American economy are those prepared by the National Bureau of Economic Research. Their main drawback is that they do not cover the period after 1939. However, they are the best available source of information on changes in productivity in the period 1899 to 1939. They are discussed summarily here, and only so much of the underlying detail is presented as is essential in understanding their implications.

5/ *Particular formulas for measuring productivity can be derived which are free of the effects of change in composition, but only at the cost of injecting other arbitrary elements into the measuring process.*

Manufacturing

If attention is confined for the moment to the manufacturing sector of the economy, the National Bureau computations show the following changes between 1899 and 1939:

1. Physical output of all manufacturing industries combined increased approximately fourfold.

2. The number of wage earners employed in manufacturing approximately doubled.

3. The workweek in manufacturing establishments decreased by approximately one-third (from about 60 hours to about 40 hours).

Putting these facts together we find that one-and-a-third times as many man-hours produced four times as much product, in 1939 as compared with 1899. Thus productivity -- output per man-hour -- tripled over the forty year period. This amounts to an annual increase of 3 percent, compounded, in the productivity of the manufacturing sector of the economy.

The changes within the period which produced this over-all result are portrayed in Chart 1. (The basic data appear in the appended Table 1.)

First there was an unmistakable upward trend in manufacturing productivity between 1899 and 1939. The chart suggests that productivity growth was somewhat more rapid in the second twenty years of the period than in the first twenty years. Moreover, the upward movement was not a completely steady or constant one. There were some sudden spurts and some reversals. Any long-term growth rate computed from these data should be considered as merely a summary description of what has happened, rather than as an "economic law" which tells what must happen.

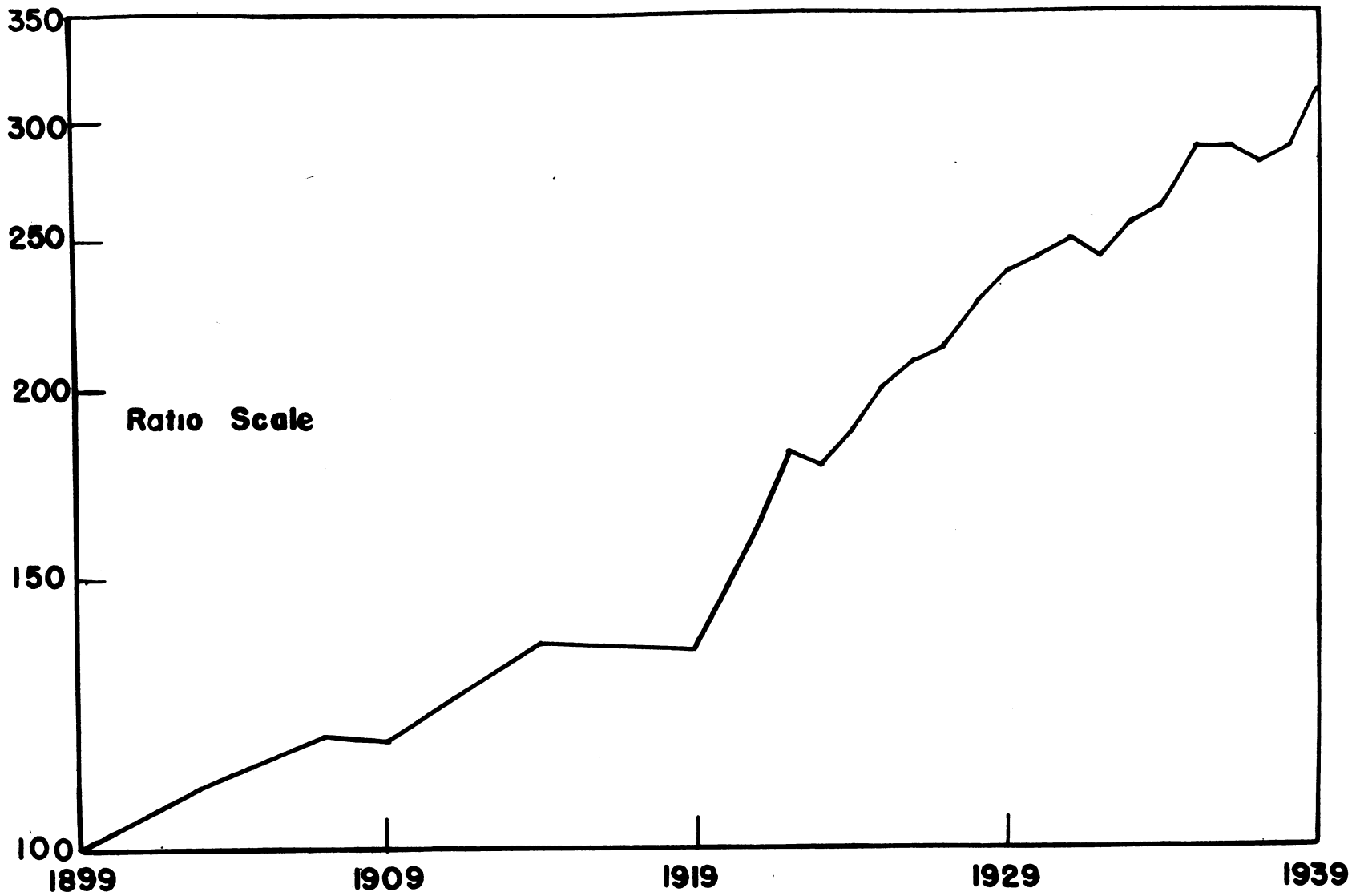
A second striking fact is that the deep depression following 1929 seems to have had very little effect on the growth of productivity in manufacturing. The trend was neither accelerated nor retarded in the depression years, except for a very slight decline between 1931 and 1932. Apparently, to judge from these data, two tendencies approximately balanced each other in the depression years. On the one hand, operations below the level of maximum efficiency tended to reduce productivity and on the other hand, the ability of producers to set aside the less efficient equipment and the less efficient workers tended to improve productivity. It does not necessarily follow that depressions will never affect the rate of productivity growth, but Chart 1 certainly lends no support to the view that business cycles are an important factor in influencing productivity.

However, the Chart indicates that World War I had a very marked effect on productivity growth. Since the National Bureau results are based on Census data they are available for 1914 and 1919 but not for the years in between. Over this five year interval, productivity did not increase at all, in fact it declined slightly. This is the only period of any length when the long term growth trend in manufacturing productivity was reversed. While it is dangerous to generalize from this fact, it suggests that the waste, inefficiency, and confusion of a war period act as a serious impediment to normal growth in productivity. But notice that the ground lost in World War I was regained by an exceptionally rapid growth in the period 1919 - 1922.

Chart 1

PRODUCTIVITY IN MANUFACTURING

(Physical Output per Man-Hour; 1899=100)



Source: National Bureau of Economic Research

An important question to raise at this point is: How much of the indicated growth in manufacturing productivity should be regarded as "technical" productivity and how much should be regarded as "economic" productivity? In other words, how much of the increase is due to increases in output per man-hour in the separate industries comprising manufacturing, and how much is due to changes in the composition of manufacturing output?

This question cannot be answered directly for the measurement already discussed. However, if attention is shifted to number of employees per unit of output (which is not the same as output per man-hour, but is closely related to it) an answer becomes possible, at least as regards the long-term trend. The National Bureau's computations indicate that, between 1899 and 1937, employment per unit of output declined by 55 percent. Of this drop only 2 percentage points were due to shifts as between industries in the composition of output, and the remainder was due wholly to improvements in the performance of the several industries.6/ That is, "economic" productivity has been a relatively unimportant factor in the long term growth of manufacturing productivity. The 3 percent annual growth rate may be considered, for all practical purposes, as exclusively due to improvements in technical productivity. However, this conclusion does not hold for the short term movements, which are distorted to an unknown degree by changes in the composition of output.

Mining

The National Bureau data on mining are quite interesting, as showing what has happened in an extractive industry. It might have been expected that this sector of the economy would show "diminishing returns." As the most readily available deposits are used up, it might be thought that more and more labor would be required to produce a unit of output. But the fact is that this tendency, if it existed, was more than offset by improved technology and the discovery of new resources. Productivity in mining improved steadily in the years preceding 1939.

In this case changes in composition of output had a considerable effect on the combined measurement of productivity. Oil and gas production increased greatly in relative importance during the period 1900-1939, and these are precisely the industries in which the value of output per man-hour is high compared with other mining industries. The overall increase in productivity in mining amounted to 3.6 percent annually, compounded, but when the effects of changing composition are eliminated the annual growth is only 3.0 percent.

The Economy as a Whole

The National Bureau's measurement of productivity growth in the economy as a whole is based on very sketchy information (as, of course, are similar measurements by other authorities), and therefore is much less precise than its measurements of productivity in manufacturing and in mining.

The basic information for the entire economy, as near as can be determined is contained in the following table. The data are in the form of index numbers, taking 1899 as 100:

6/ An explanation of the mathematical method used in making this distinction appears in "Employment in Manufacturing, 1899-1939," National Bureau of Economic Research, pp. 335, 336, 337.

		1899	1939
1.	Number of employed workers	100	175
2.	Hours of work per week per employee	100	80
3.	Man-hours of employment (1. multiplied by 2.)	100	140
4.	Physical output	100	270-330
5.	Physical output per man-hour (4. divided by 3.)	100	193-236

Thus it appears that productivity in the economy as a whole increased by something between 93 percent and 136 percent during the 40 years 1899 to 1939. This is equivalent to an annual growth rate between 1.7 percent and 2.2 percent, compounded. Notice that this is a substantially slower rate of growth than the 3 percent annual increase in the productivity of the manufacturing sector. The 1.7 to 2.2 percent growth in the productivity of the economy as a whole is affected to an unknown degree by changes in the composition of the national output. We can only conjecture as to what the results would be if "economic" productivity (i.e., changes in the distribution of output as among industries) were eliminated. However, since there has been a pronounced shift away from agriculture (in which the value of output per man-hour is low compared with the rest of the economy) it seems fair to conclude that elimination of this factor would reduce the annual growth rate of productivity to a substantial extent. We therefore conclude, provisionally, that the annual growth in purely technical productivity for the economy as a whole was at a rate somewhat below 2 percent in the four decades prior to 1939.

THE KENDRICK STUDY

A different but equally informative approach to the measurement of productivity is contained in a paper by John W. Kendrick.[7/] Mr. Kendrick's results have two advantages over those of the National Bureau: they give a year-by-year series on productivity in the economy as a whole; and they extend to 1950 whereas the National Bureau data terminate in 1939. However,

7/ "National Productivity and Its Long-Term Projection" by John W. Kendrick; Conference on Research on Income and Wealth, May 1951. Mr. Kendrick is Acting Chief of the National Economics Division of the Office of Business Economics, Department of Commerce. Mr. Kendrick's paper is as yet unpublished, but he has kindly consented to this use of his material. His estimates are preliminary and subject to revision before publication. His paper is his own responsibility and is not an official document of the U.S. Department of Commerce. Mr. Kendrick is in no way responsible for interpretations placed on his results in the present report.

the underlying economic influences are analyzed in greater detail in the case of the National Bureau studies. The two compilations should be regarded as supplements to each other, rather than as rivals.

Mr. Kendrick starts with estimates of the private gross national product. (**Private** gross national product excludes the output of the government, that is, the services of government employees. This exclusion is necessitated by the fact that there is no practical way of defining the physical product produced by the labor of government employees.) They are corrected for changes in the price level and expressed in constant 1939 dollars. In effect, the corrected estimates are measurements of the physical output of the private economy. Then estimates are made of the total number of man-hours employed in producing this product. From the two sets of figures Mr. Kendrick computes the "real private product per man-hour," which is a measurement of productivity. The results are summarized in the accompanying Chart 2 and in the appended Table 2, which is reproduced directly from Mr. Kendrick's paper.

The real private product per man hour changes from year to year in response to changes in productivity in the ordinary sense; that is, the efficiency of particular industries. But these overall measurements are also affected by an entirely different factor -- the shifts in the labor force from one industry to another.

For example, suppose there are two industries. In industry A real product per man-hour is $.50 and in industry B real product per man-hour is $1.00. Then if workers shift from A to B, real product per man-hour **in the two industries combined** will increase, even though real product per man-hour **in each industry separately** remains unchanged.

Because of this factor, and because there has been a tendency in recent years for workers to shift from the less productive to the more productive occupations, overall measurements of real output per man-hour exaggerate the improvement in industrial efficiency.

The fact can be illustrated, although it cannot be analyzed completely, by figures in Mr. Kendrick's report. He divides the private economy into two main sectors: farm and non-farm. His figures cover the period 1909 to 1950 and the total percentage changes in productivity for this 41 year period are as follows:

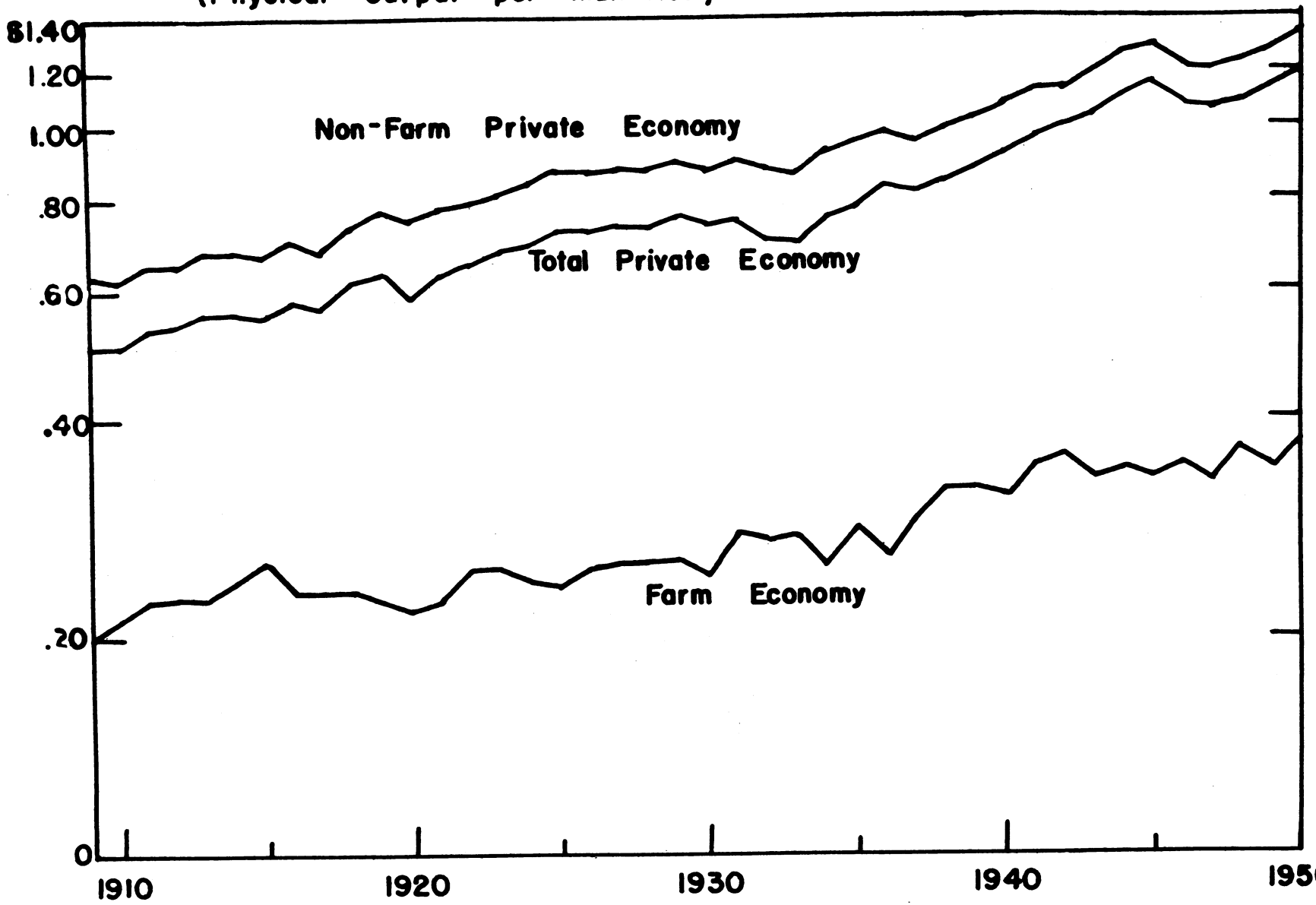
	Percentage Increase, 1909-1950, Real Product per Man-Hour
Private farm	+ 82%
Private non-farm	+ 114%
Total private economy (farm & non-farm)	+ 134%

We might have expected the figure for the two sectors combined to be an average of the two separate figures. Instead it turns out to be greater than either of them. The reason is that, along with changes in efficiency, there has been a shift in employment from the farm sector (low productivity) to the non-farm sector (high productivity).

Chart 2

PRODUCTIVITY IN THE PRIVATE ECONOMY

(Physical Output per Man-Hour, Valued at 1939 Prices)



Source: "National Productivity and Its Long Term Projection" by John W. Kendrick

The problem is not solved simply by turning attention to Mr. Kendrick's series on productivity in the non-farm sector. There has undoubtedly been a shift of labor force as among the various industries in the non-farm economy. This must have affected the trend to a substantial, although undeterminable, extent.

From one point of view productivity gains resulting from reallocation of man power are just as "real," and just as truly indicative of economic progress, as productivity gains resulting from greater efficiency in particular operations. But in applying the results the two types of productivity growth may have different implications. Where productivity gains are the expression of labor-saving in particular processes, they can be compensated by higher wage rates without raising unit labor costs. But where a productivity increase is solely the result of inter-industry shifts no rise in wage rates in particular industries is possible without a resulting increase in unit labor cost. In this case the social gains would occur from the movement of workers from a low-wage industry to a higher wage industry. In other words, gains in "technical" productivity can be compensated by higher wage rates, whereas gains in "economic" productivity are automatically compensated even when wage-rates remain unchanged.

If all these qualifications are borne in mind, Mr. Kendrick's results are interesting and informative. He has fitted trend lines which show the following annual growth:

	Annual Rate of Growth in Output per Man - Hour
Total private output	2.1%
Farm output	1.2%
Private non-farm output	1.9%

The trend lines are fitted for the period 1909-1941, but the data for years since 1941 fit the projected lines fairly well. The calculated growth rate for the private economy as a whole, 2.1 percent per year, is in remarkably close agreement with the National Bureau's overall result.

The non-farm output has increased at a rate of about 1.9 percent per year. This figure exaggerates the improvement in efficiency since it is affected by shifts of the labor force. Also, in estimating the growth in purely technical productivity for the whole economy, it must be diluted somewhat by the much lower rate of growth in agricultural productivity.

Mr. Kendrick has estimated, rather crudely and provisionally, that shifts within the non-farm sector exaggerate the annual increase in productivity by about one quarter of one percent. Deducting this, it would appear that the long term growth in productivity -- eliminating the effects of shifts from one industry to another -- is only about 1.6 percent per year.

This is not a very firm figure, nor one that Mr. Kendrick should be held responsible for. Nevertheless, it is the best figure, as a general measure of growth in technical efficiency of the economy, which can be derived from his computations.

Short-Term Movements in Productivity

Mr. Kendrick's study is also useful in providing information on the shorter term movements of productivity, particularly the changes which occur during war and postwar periods and during business cycles. The reader will recall that two tentative conclusions were drawn from the National Bureau series on productivity in manufacturing. (See Chart 1.) The first was that productivity growth ceased during World War I. The second conclusion was that productivity growth continued at the previous historical rate through the depression years of the early 1930's except for a brief interruption in 1932.

Mr. Kendrick's statistics throw doubt on both these conclusions. (See Chart 2.) In fact they suggest the directly opposite theses. Productivity in the private economy, as measured by these data, continued to increase with no noticeable slowing down during the period 1914-1919. Productivity growth ceased during the period 1929-1933 and a substantial decline was recorded.

There are many factors which may account for the different behavior of the National Bureau statistics and the Kendrick statistics in the critical war and depression years. First, Chart 1 shows productivity in manufacturing alone, whereas the Kendrick series, in Chart 2, give data for the total private economy, including utilities, trade, services, etc.

Possibly the main explanation of the divergence between the two statistical compilations is the fact that **changes in industrial composition of output** would have a much greater effect on the Kendrick statistics for the entire private economy than on the National Bureau statistics for manufacturing alone. Certain rough calculations make it possible to eliminate the effects of changing composition on the long term growth rate in either series. However, it is not possible to correct the detailed year-to-year fluctuations in a similar way. In periods of drastic economic changes -- such as depressions or wars -- very great changes occur in the "product mix" of our national output. The exact effect of such changes on productivity measurements is incalculable but presumably it would be serious. The effect on one type of productivity measurement may be very different from the effect on another type of productivity measurement. We never can be sure that **any** of the available measurements show the growth of productivity in the purely technical sense. This situation should warn us against accepting at its face value the pattern of productivity change indicated by the Kendrick series for years since 1945. According to these statistics productivity in the non-farm economy fell substantially between 1945 and 1947, but grew at an exceptionally rapid rate from 1947 through 1950. But these years were a period of radical change in the composition of national output, and this change must have had an important, although unmeasurable, effect on the productivity statistics. It would be dangerous to base any policy conclusions on the particular year-to-year pattern of productivity change in the postwar period indicated by the Kendrick data or for that matter by any other set of statistics.

With respect to short term movements, the contradictory results of our two studies are disappointing, since they make it impossible to draw any firm conclusions as to the nature of year-to-year fluctuations in productivity. However, this experience should serve as a salutary warning that no great significance can be attached to the year-to-year fluctuations in any of our

statistical measurements of productivity. We simply cannot say how productivity, in the broadest sense, behaves during war or depression years. Likewise, we cannot say with any confidence just how much productivity has changed between this year and last year. The available statistics simply do not possess the degree of refinement necessary to answer these questions.

The same negative conclusion would not apply to our knowledge of the long-term growth rate in productivity. In this respect the National Bureau results and the Kendrick results are in fairly close agreement. Both indicate an annual growth of about 2 percent in the productivity of the whole economy. We also know that this exaggerates somewhat the growth in technical productivity, due to shifts in composition of output.

THE BUREAU OF LABOR STATISTICS STUDIES

The U.S. Bureau of Labor Statistics has also done extensive work in the field of productivity. Currently its work consists of the preparation of index numbers of "unit labor requirements" 8/ in a large selection of industries, both manufacturing and non-manufacturing. So far the Bureau has not combined its material into an index number for the economy as a whole or for all manufacturing. In fact the Bureau specifically warns against drawing such generalizations from its work for particular industries.

It has been explained that the rate of growth in overall productivity exaggerates the increase in **technical** productivity because of the inter-industry shifts. It might seem that the obvious solution of this problem is to measure productivity in separate industries. But here a new set of difficulties arises. The chief problem involves the measurement of **net** output in an industry.

It would be fairly simple to measure the total output of, for example, shoes and then to compare this with total man-hours in the shoe industry. But the gross output of shoes represents work done in many industries beside the shoe industry. Some of the man-hours devoted to shoe production take place on farms, in the tanneries, in railroads which transport the cattle and the leather, in factories which make the shoe machinery, etc. With changing technology we cannot assume that the relationship among the various types of labor remains constant.

The solution might be to measure the **net** output of the shoe industry -- that is, output of shoes less input of materials -- and compare this with man-hours of labor in the shoe industry. Such a solution appears to be beyond the capacity of existing statistical resources.

Most industry studies, including those of the BLS, ignore this difficulty and simply measure productivity in terms of **gross** output per man-hour.

8/ "Unit Labor Requirements" measures the number of hours of labor needed to produce a unit of a given product or a specified composite of products. It is the reciprocal of "productivity" which measures the number of units which one hour of labor can turn out.

For short periods this may not be too bad, but over a long interval it would exaggerate the rate of growth in productivity in industries in which there was a secular tendency toward increasing division of labor and understate the gain in productivity in other industries in which there was a tendency toward vertical integration.

The Bureau of Labor Statistics prepares two types of index mumbers of productivity. First are those based on "secondary sources." These are computed by combining statistical series on physical output compiled by the Bureau of the Census, the Bureau of Mines, various trade associations, etc., with statistical series on man-hours-employed in the same industries. Productivity measurements of this type are available for 29 industries. The record for these industries since 1939 is presented in the accompanying Chart 3, and in the appended Table 3.

Two broad facts brought out in this data are worth remarking. First the unit chosen to represent physical output is in some cases arbitrary but it can nevertheless have a tremendous effect on the results. Railroad freight hauling is an example of this. If productivity is measured in terms of **freight-car-miles** per man-hour, the increase in productivity between 1939 and 1950 is only 4.6 percent. But if productivity is measured in terms of **ton-miles** per man-hour, the increase is 35.5 percent. The reason is that more freight was carried per car in 1950 than in 1939. It is a moot question as to whether the performance of the industry should be gauged in terms of car-miles handled or ton-miles handled. Similarly, in the copper mining industry the amount of ore mined per man-hour increased by 60.8 percent between 1939 and 1950, whereas the actual amount of metal recovered per man-hour increased by only 16.5 percent. The explanation is simply that lower grade ores are now being mined. Once again, there is no unique answer to the question of which unit is the "proper" one for measuring productivity in this industry.

A second point which deserves emphasis is the great variation as between industries in the productivity growth. Whatever general trend in productivity is discovered for the economy as a whole, it cannot be more than an average for industries which individually have shown a wide range of performance.

We will resist the temptation of drawing further broad conclusions from the data for these 29 industries. In its bulletin summarizing this material the Bureau includes the following warning:

"The industries included in this report do not constitute a representative sample of the entire economy or of manufacturing. Important manufacturing industries such as automobiles, lumber and furniture products, tires and tubes, basic steel, transportation equipment, textile mill products, and petroleum are not included. For this reason, the Bureau cautions users of its indexes not to generalize on the basis of these figures for all manufacturing or for the total economy." 9/

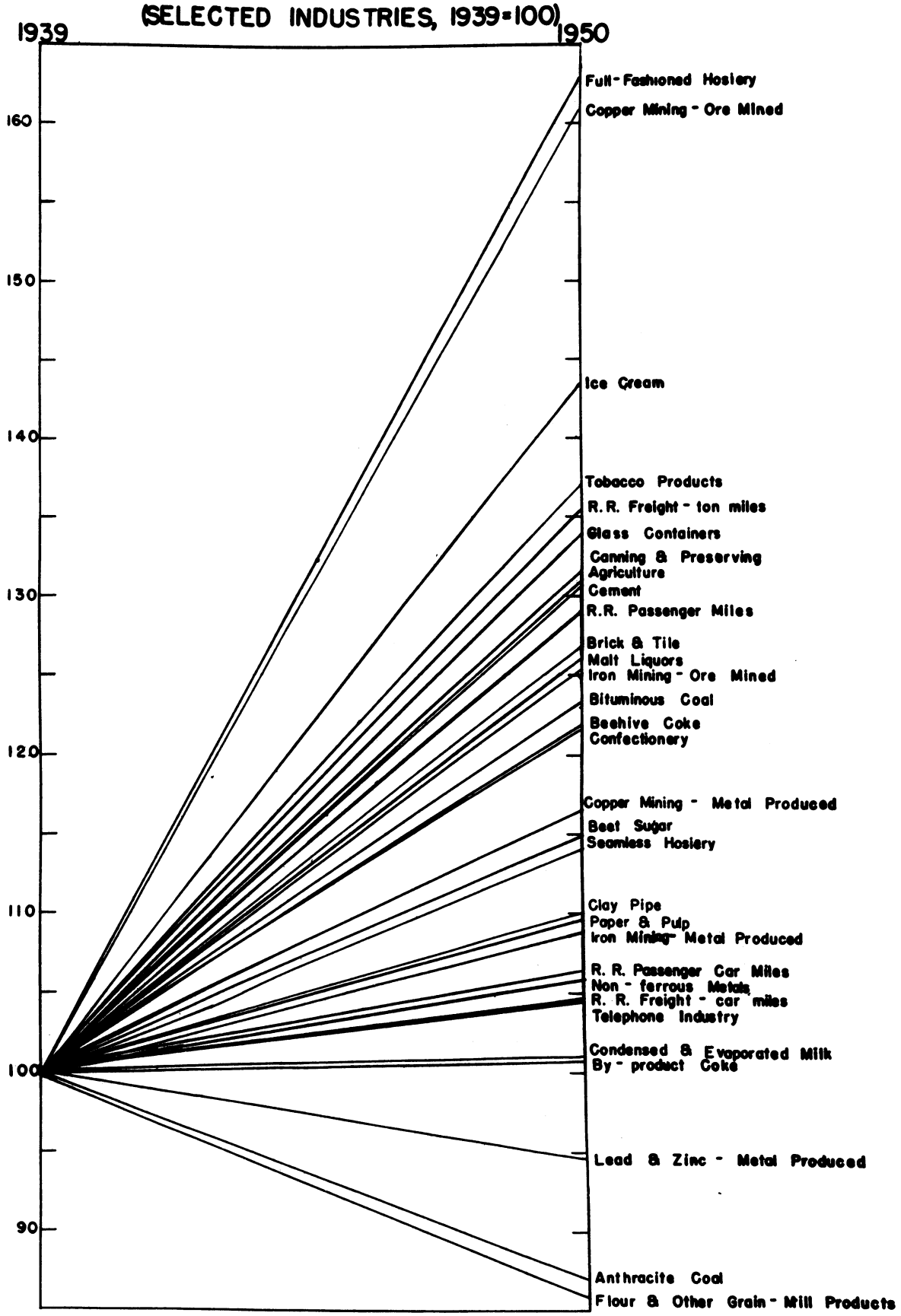
In addition to its index numbers based on secondary sources, the BLS makes direct measurements of "unit man-hour requirements" in the production

9/ *Bulletin No. 1046, U.S. Bureau of Labor Statistics, "Productivity Trends in Selected Industries; Indexes Through 1950", page 2.*

Chart 3

CHANGE IN PRODUCTIVITY, 1939 - 1950

(SELECTED INDUSTRIES, 1939=100)



Note: Productivity in "Rayon & Other Synthetic Fibers" industry in 1950, 286.1 (1939=100). Not shown because of scale limitations.

Source: U. S. Bureau of Labor Statistics

of certain specific types of goods. These are based on information collected from a sample of plants in each industry. A separate report is published for each industry, which presents a wealth of underlying detail. Requirements for direct labor and indirect labor are shown separately, and an analysis is made of the factors which cause productivity to grow faster in some plants than in others.

The direct measurements of unit man-hour requirements are invaluable to engineers and others whose interest is concentrated on the performance of particular industries. They do not, however, lend themselves to broad economic conclusions since their coverage is very limited and because of certain properties of the index numbers. (For example, each plant is given a constant weight so that a shift of output from the less efficient to the more efficient plants does not appear as an increase in productivity.)

Summary

At this point it may be helpful to summarize what has been learned from the preceding somewhat laborious survey of the record of productivity growth. What broad conclusions can be drawn?

The truth is that the quality of our information does not permit us to draw any very refined conclusions. But it is well to know this. Before discussing ambitious schemes for tying wage movements to movements in productivity we should know that we do not have any dependable measurements of the year-to-year fluctuations in the productivity of the economy. Although many improvements in the statistics are possible, and probably will be attained in the near future, there is little prospect that we shall in the foreseeable future be able to plot the details of short-term productivity movements with any degree of reliability.

All that we are reasonably sure of is that, over the past half century, productivity in the American economy has increased substantially. The increase has been at an average annual rate of about 2 percent, or somewhat less if the effects of inter-industry shifts are eliminated. However, our acceptance of any such general average must be tempered with the knowledge that it conceals a wide disparity as between industries.

One final note of caution: although the preceding discussion of the productivity record has been limited to the United States and to the past half century it should not be thought that this record is in any way typical of all countries or all eras. It should not be imagined that a 2 percent secular growth in productivity is "in the course of nature" and should be expected to occur under any and all circumstances. The truth is that, when a broader historical viewpoint is assumed, periods of stagnation are far more typical than periods of progress. Europe during the middle ages, and China throughout practically all of its recorded history, showed practically no gain in effective economic performance. The special circumstances which have stimulated the spectacular growth in productivity during the past fifty years in this country are a precious heritage. We can either preserve them by our wisdom or lose them by our folly.

III

PRODUCTIVITY AND WAGES

Wages, like prices, are not simply an end product of our economic mechanism. They are an integral part of the mechanism and they have an important function to perform in keeping it in operation. Wage levels have ramifying effects on the economy, and they are in turn affected in complex ways by many economic forces. The factors which determine what level of wages is justified or economically desirable are so many, so complex, and often so imponderable that it is impossible to summarize them in any simple formula. Certainly, no single formula would be applicable to all industries, all localities, and all job classifications.

Productivity is one, but only one, of the economic forces which enter into the process by which wages are set. Nevertheless, although it is only part of the story, a useful purpose may be served by studying this one factor in isolation.

It is only in isolated instances that productivity has entered as an explicit consideration in the wage bargaining process. That is not to say that productivity does not ordinarily have any influence whatever. It is obvious that the amount turned out by one hour's labor must have an important effect on the amount industry can afford to pay for one hour's labor. But, as in the case of many economic forces, the influence of productivity on wages was impersonal and often unrecognized by those doing the bargaining.

Recently, however, the word productivity has been heard more and more around collective bargaining tables and in the pronouncements of government regulatory bodies. The concept involved -- or rather the several concepts of productivity involved -- are seldom clearly defined by those who inject this issue. The various different (and sometimes conflicting) statistical measurements of productivity are used with no appreciation of their meaning or limitations. Confusion exists as to what relationship ought to hold between productivity and wages, as well as to whether that desired relationship has in fact been maintained.

It is no excuse to say that top-level discussants are dealing with a general principle and questions of definition and measurement can be left to technicians. The validity of the general principle can be discussed only on the basis of a sound understanding of what productivity is and how it is measured. It is pointless to discuss the formulas we would set up if we had accurate measurements when in fact we do not have accurate measurements. On the other hand, technicians cannot ignore policy questions; they must set up their concepts and procedures in relation to the purposes the results are intended to serve.

REAL WAGES AND PRODUCTIVITY

Any analysis of the economic connection between wages and productivity is complicated by the fact that **money** wages are affected by many other factors

beside labor productivity. Money wages are a price. As such they are related to other types of prices and they are subject to the impact of the same economic forces as the price of goods. The chief basic determinants of the general level of prices -- wages as well as other prices -- are monetary and fiscal in character.

But monetary and fiscal developments have no necessary connection with changes in productivity. This complication can be avoided by casting the analysis in terms of the relationship between **productivity** and **real** wages. In this way a logical comparison is made between the amount of goods produced by an hour's labor (productivity) and the amount of goods purchasable with the wages paid for an hour's labor (real wages). Money, the troublesome middle term which merely confuses the issue, is eliminated from the comparison.

Chart 4 presents a comparison of the growth in real wages with the growth in productivity. Real wages is represented by the average hourly earnings of factory workers, "deflated" by the consumer price index, and productivity is represented by the Kendrick series on real private product per man-hour. The period covered is 1909 through 1950.

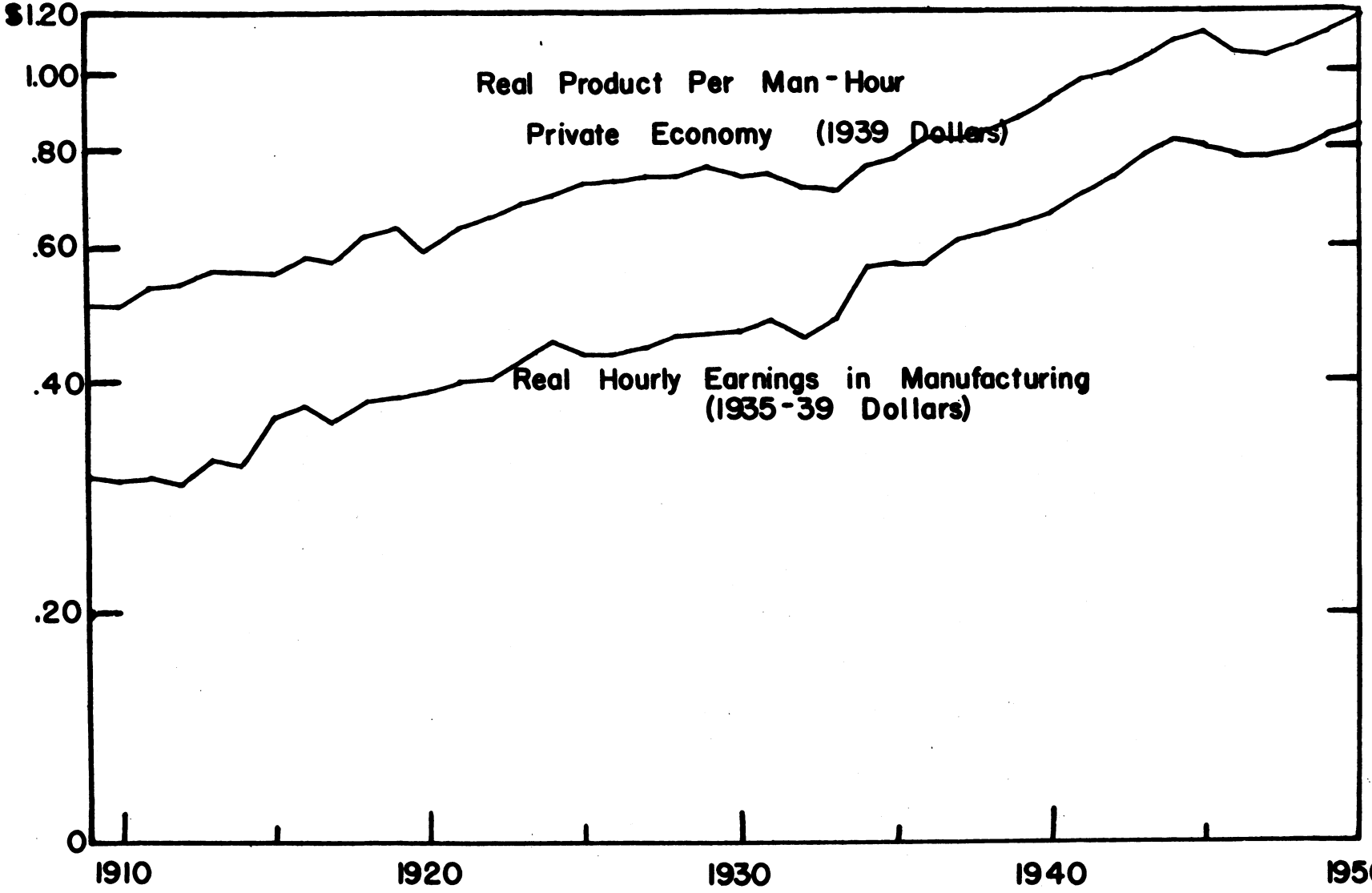
There is no close correspondence between the detailed year-by-year movement in the two series. Numerous instances can be found where productivity and real wages were moving in opposite directions for short periods. About all that can be said is that both real wages and productivity have shown a pronounced upward trend in the past forty-years, with the growth rate of real wages slightly greater than the growth rate of productivity. The chart does not, and in fact cannot, indicate whether there is any causal connection between the two.

The particular statistical comparison indicated on Chart 4 has been widely used as a basis for arguments on national wage policy. It should first be pointed out that the comparison is statistically imperfect in several respects. The productivity series is for the whole private economy, whereas the real hourly earnings figure is based on factory workers only. The growth of productivity is exaggerated by the shift of workers from agriculture to industry, a factor which does not enter into the series on real wages. The price index used as a deflator in computing real wages is the Consumer Price Index of the Bureau of Labor Statistics, whereas in computing real product a whole host of price indexes are used in deflating the separate elements of that total. For these and other reasons we should not expect to find more than a very general correspondence between the two sets of statistics, whatever may be the basic economic relationship between real wages and productivity.

/ Actually, the injection of such comparisons into arguments on wage policy is based on confusion as to the real issues involved. The question of whether real wages have kept up with productivity growth is merely a concealed way of asking whether labor has continued to receive the same proportionate share of business proceeds. To understand why this is so it is only necessary to reflect that business product and business proceeds are exactly the same thing. When a dollar's worth of goods is sold to an ultimate purchaser this means on the one hand a dollar's worth of goods to be counted in the product total, and on the other hand a dollar of proceeds to be divided among the participants in the productive process. Since the two totals are the same they remain the same when they are reduced to a basis of constant dollars per man-hour. But real

Chart 4

PRODUCTIVITY COMPARED WITH REAL WAGES



Source: Real Product per Man-Hour — J. W. Kendrick
Real Hourly Earnings — U. S. Bureau of Labor Statistics

product per man-hour is a measure of productivity and real proceeds per man-hour is a measure of real incomes. Of course the latter contains other elements of income besides labor income, but if the latter remains at the same proportion of the total then real labor income per man-hour will, automatically and inescapably, increase in proportion to productivity.

The same thought can be put in this way: The basis for the argument that real wages should increase in proportion to increases in productivity is the proposition that, unless this happens, labor's percentage share of the national income will decline. With proper qualifications this is a correct proposition and can be demonstrated very clearly. If productivity increases and wage rates are left unchanged, labor costs per unit of output will decline. Unless prices are reduced, then labor will receive a smaller share of the final purchaser's dollar. If labor's percentage share is to remain unchanged, either money wages will have to be increased or the price of the product will have to be reduced. Either of these events will increase **real** wages.

The point of the foregoing discussion is simply this: the test of whether real wages have increased in proportion to productivity is whether labor's share of business proceeds has remained unchanged. The latter question can be answered statistically without any reference to productivity measurements or estimates of real wages. The answer is truly remarkable, and it is given in Chart 5.

During the past 22 years -- through the boom of 1929, the depression and partial recovery, the war and the reconversion, the postwar boom and inflation -- the employees' share of the total proceeds of business output has remained almost constant. The figures show that the share of the ultimate purchaser's dollar going to labor has remained at about one-half. The remaining half goes for taxes, depreciation allowances, rents, royalties, interest, and profit. The basic data, showing the shares of each of the various parties, appear in the appended Table 4.

Thus, on the test of the distribution of economic proceeds real wages must have risen proportionately with increases in productivity. It is significant that in most of this period there was no "national wage policy" set by any central authority. The result was the outcome of natural economic processes. This backward look reminds us that natural forces have a not-always-appreciated capacity for bringing about desired results.

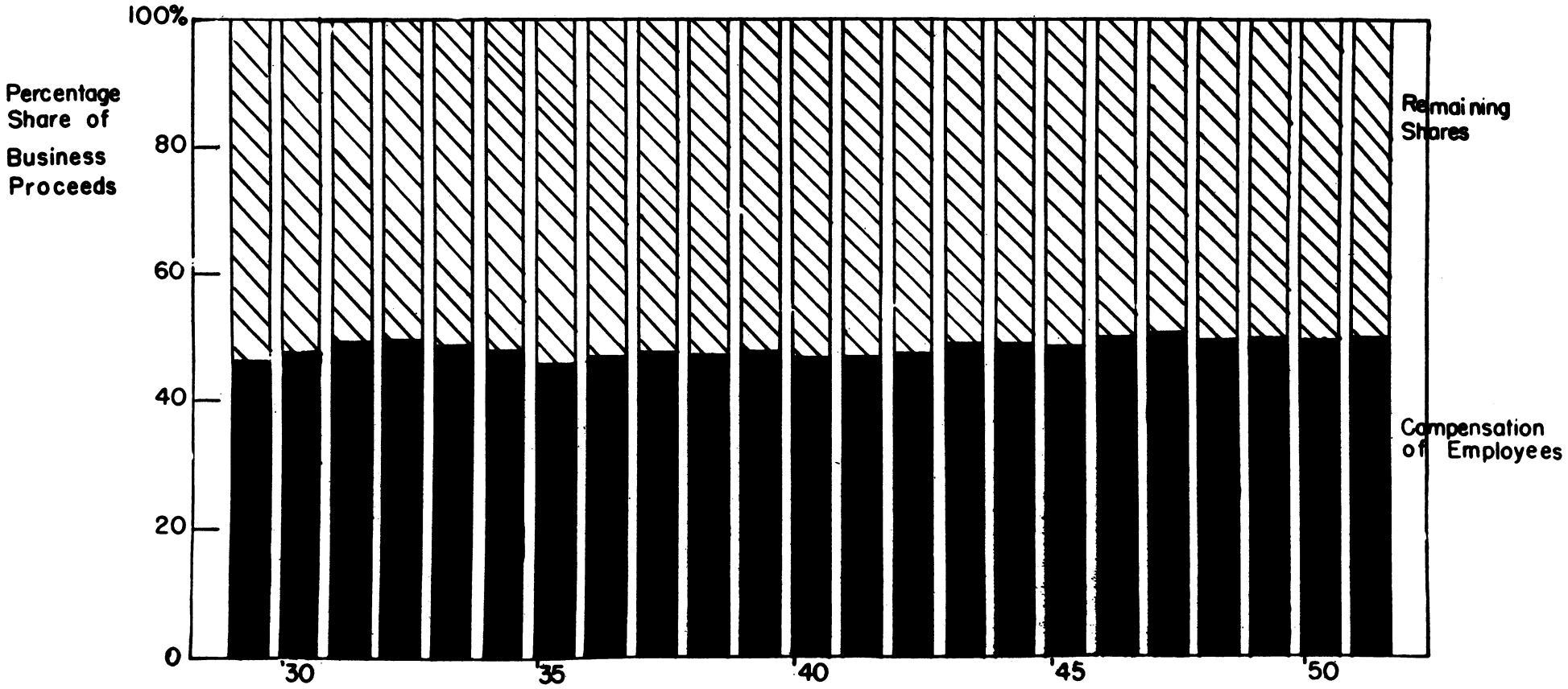
It is interesting to note that even in 1951, when a national system of regulation was in effect for the purpose of "stabilizing" wages, labor's share of business proceeds has remained close to the norm established in unregulated periods. In 1951 this percentage was 49.6 percent and it is estimated at 50.5 percent for the first quarter of 1952. Whatever may have been the effect (or lack of effect) of the wage regulations promulgated thus far, they have not resulted in a decrease in labor's share of the proceeds of operations or in a failure on the part of labor to receive its fair share of the benefits of whatever productivity growth may have occurred.

PRODUCTIVITY WAGE INCREASES AS "INCENTIVES"

Recently the argument has been advanced that an explicit recognition of productivity as a basis for wage increases is essential in order to provide

Chart 5

LABOR'S SHARE OF THE PROCEEDS OF BUSINESS



Source: Based on U. S. Department of Commerce Data

"incentives" to labor. In a brief presented to the Wage Stabilization Board on January 11, 1952, Mr. Stanley H. Ruttenberg, Director of Education and Research of the CIO, argued that: "Increases in output per man-hour must be reflected by increases in real wages. This is essential to provide proper incentives to labor..." The President's economic reports have contained statements in a similar vein.

These remarks are ambiguous and confusing. Do they mean that productivity can be increased by offering the incentive of resulting wage increases to labor? If so the argument is not a very convincing one.

In the first place it should be noted that automatic regular increases set in advance, such as the improvement-factor increases provided in certain labor contracts, are not likely to be an incentive to better individual performance. Only if the increases were made contingent on the attainment of the presumed improvement could they be useful as incentives.

Although productivity is measured in terms of output of labor, it is universally agreed that some of the most important factors affecting productivity depend on management. Productivity is increased by additional capital investment, by skillful scheduling of work and skillful plant layout, by speed in the adoption of the latest improvements, by intensive research, etc. All these are responsibilities of management, and logic would demand that incentives be offered to management. Wage increases might have the directly contrary effect, since they would mean that, the more efficient management became, the higher would be the wages it would have to pay.

This thought is raised here merely as a question. It is difficult to make much sense of the argument based on incentives.

"GENERAL" vs. "PARTICULAR" PRODUCTIVITY

Those who believe in wage increases based on productivity may advocate one of two courses. They may favor giving the employees in each industry (sometimes in each plant) wage increases proportional to the productivity improvement in that particular industry (or plant). Or they may favor giving all employees wage increases proportional to the general improvement in productivity, regardless of whether their own industry or their own plant participated in that improvement.

The second point of view seems to be the sounder one. The several industries, and the several companies, bargain for their labor in a market in which employees are not bound to any particular firm or industry. There is no logical reason why plant A should pay more than plant B for the same quality of labor simply because plant A uses that labor more efficiently. There is no sound reason why industry X should pay more for its labor than industry Y simply because industry X has made greater progress.

If an industry were to be exempt from paying higher wages merely because it did not share in a general increase of productivity, this would weaken the competitive pressure for keeping up with improvements in productive efficiency. Higher wages in the companies which increase their productivity at an exceptional rate would be penalizing them for actions which are in the public interest.

There should be no odium attached to the failure by any firm or any industry to participate in a general growth of productivity. Many special factors may account for this. But by the same token there is no reason why the workers in that firm or that industry should not share in the improved standards of living made possible by the improved efficiency of the economy as a whole.

Recent wage negotiations have given prominence to what is known as the "ability to pay" theory of wages. As usually applied, this theory asserts that a company's (or an industry's) profits are a measure of its ability to pay higher wages. Companies or industries with high profits should, according to this view, divide them with its workers.

The "ability to pay" theory is false when it is applied in this way. It is equally false, when the reverse side of the same logic is applied; that is, when the claim is made that less efficient less profitable marginal companies or industries should somehow be exempt from meeting the wages paid by more profitable companies or industries.

No one would argue that a less efficient firm should be permitted, as an offset to its lower efficiency, to buy its steel at a lower price than a more efficient firm. It would be just as absurd to argue that a company or an industry which did not keep up with the general trend in productivity should not be expected to keep up with the general trend of wages. If we believe in competition we must accept the fact that those who are not efficient enough to pay the costs set in the market for the factors of production must go by the wayside. The weeding out of the inefficient is one of the most important functions of competition.

In any given period some industries will be increasing their productivity faster than others. If those who fall behind have to increase their wages as fast as the others, they will have to raise prices and perhaps lose some of their markets. But this means a shift of resources toward the industries which are growing in productivity and this is desirable as a long run tendency. If the industries with slow growth of productivity resist raising their wages, they will lose workers to the other industries, and the same result will be achieved.

One point must be raised as a qualification of this general argument **in a period of price controls.** The price control authorities must recognize that industries which give higher wages based on general productivity, but show no growth in their own particular productivity, will have to charge higher prices if they are to continue producing. Of course, if the public is unwilling to pay these higher prices there will be a shift of resources out of those industries. If wages in every industry are to keep up with the growth of productivity in the economy as a whole, then there must be flexibility in the price structure to permit adjustments for industries which have either exceeded or fallen short of the general growth in productivity.

WAGE INCREASES vs. PRICE DECREASES

Even if it is agreed that real wages should increase in proportion to improvements in general productivity, a question still remains. Should the increases in real wages come about through an increase in monetary wages

(prices remaining unchanged) or through a fall in the price level (wages remaining unchanged)?

In normal times there are reasons for preferring to have the improvement in productivity expressed in lower prices. This is the best way of insuring that the gain will be shared widely. It is the only way by which those on fixed incomes -- annuitants, pensioners, etc. -- can share in the benefits of increased productivity.

Some labor leaders argue, however, that under present (1952) "emergency" conditions productivity gains must be expressed in higher monetary wages. The following paragraph is quoted from a statement of the United Labor Policy Committee (presented to the WSB, January 11, 1951):

"In the present sellers' market, it is obvious that reductions in unit costs of production resulting from improved efficiency will not lead to lower prices. The denial of wage adjustments based on industrial progress would not, therefore, benefit consumers. It would serve only to enhance the profits of employers."

But sellers' markets are of rare occurrence. Even during the present (August, 1952) mobilization period industrialists in certain fields -- notably clothing, television, shoes, etc. -- would be surprised to see their markets described as sellers' markets. In many sectors of the economy producers are finding it difficult to sell their capacity output. In several industries prices are well below ceilings set by OPS. Under these conditions it would be reasonable to expect that productivity increase if wages are not raised, would be translated into lower prices for consumers.

In one field productivity improvements definitely will be passed on to the purchaser -- and that is the field of defense goods sold to the government. The procedures of price redetermination and price renegotiation insure that any substantial reduction in costs will result in lower prices to the government. Thus, there are no compelling reasons why productivity increases cannot be passed on in lower prices or why they must be immediately translated into higher monetary wages.

TECHNICAL AND ECONOMIC PRODUCTIVITY

The reader will recall the distinction made earlier between so-called technical productivity and so-called economic productivity. The growth in technical productivity comes about through an improvement in the efficiency with which specific operations are carried on. The growth in economic productivity results from a shift in the labor force from operations in which the real value produced per man-hour is lower, into operations in which the real value produced per man-hour is higher. Whereas Mr. Kendrick's figures indicate that the long-term growth rate of productivity in the private economy is 2.1 percent annually, when the effects of shifts in the labor force are eliminated the growth is only about 1.6 percent annually.

The practical question is: should we expect real wages to keep up with the growth in technical efficiency alone (about 1.6 percent per year according to the Kendrick estimates)? Or should we expect real wages to keep

up with the growth in productivity including the effect of inter-industry shifts (about 2.1 percent annually according to the Kendrick figures)?

It might be argued that a shift of the labor force into more productive occupations is in itself an improvement in the overall efficiency of the economy. There is something to this argument, but it does not follow that wage-rates in each occupation should be adjusted upward to take account of this type of an increase in productivity. The reason is that such a shift automatically brings with it an increase in average wages even without any increase in wage rates. The industries of high real output per man-hour are industries of high wage rates, and industries of low real output per man-hour are industries of low wage rates.10/ A shift of the labor force toward the former raises overall productivity (even with no change in the productivity of separate industries) and raises overall wages per hour (even with no change in the wage rates of separate industries). Thus the effect on real wages of this type of productivity growth is automatic, and need not be taken into account in formulating policies governing wage rates.

The upshot of all this is that where productivity measurements enter as a consideration in the setting of wage rates they should be freed of the effects of changes in the industrial composition of the labor force. In most instances the elimination of this factor substantially reduces the calculated rate of productivity growth.

UNRELIABILITY OF THE STATISTICS

The questions of whether, and how, productivity should enter as an explicit consideration in negotiations or government regulations affecting wage rates are partly a matter of principle and partly a matter of practical feasibility. It must be remembered that, even if there were grounds for conceding the desirability of a policy of linking wages with productivity, the statistical tools available for carrying it out are crude and thoroughly unsatisfactory. Nor is this situation likely to be remedied in the near future since it arises from the inherent difficulties of the problem and not from any lack of attention to it on the part of qualified economists.

Proposals for linking wage rates to specific short term movements of productivity are especially impractical. Various existing measurements differ widely from each other in tracing the specific short term fluctuations of productivity. There is always the danger of parties to a controversy choosing whichever measurement suits their purpose.

Such measurements as are available indicate that there have been short periods when productivity actually declined, and it is fair to raise the question of whether it would ever be possible for wage rates to follow the downward as well as the upward movements of productivity.

10/ This is inevitable since, in comparing real output per man-hour in one industry with real output per man-hour in another industry, we are really comparing total costs plus profit per man-hour in the two industries. Wage costs are the largest element in total costs plus profit in practically any industry.

Measurements of the long-term growth rate in productivity for the private economy center around a figure of 2 percent annually. But this is overstated, to a degree not precisely calculable, by the industrial shifts in the labor force.

FUTURE GROWTH OF PRODUCTIVITY

Many persons have predicted that, owing to certain special features of the present day economy, we may, in the future, expect productivity to increase at a rate much faster than its historical growth rate. This prediction is used as an argument in favor of wage increases greater in magnitude than could be justified by past growth in productivity. The problem is worth considering although it should be understood that such discussion of the future can be no more than speculation.

Some of the factors to be considered in appraising the future growth of productivity are:

a. **Accelerated Scientific Research.** A much larger share of the nation's manpower and facilities is now being devoted to scientific research than ever before. Business, government, and others are investing enormous sums annually in research -- far exceeding previous levels. It might seem reasonable to expect a faster growth in productivity than ever occurred before.

   On the other hand there may very well be a "law of diminishing returns" applying to research. As time goes by, the scientific principles that are easiest to discover are discovered. The industrial applications that are easiest to devise are devised. Only more and more difficult problems remain. It may be that this tendency will offset the larger monetary amounts now being applied to research so that productivity will increase no faster than before. Only time will tell whether this is so, but it is a possibility to be considered.

b. **Increased Capital Investment.** Industry is spending large sums every year for plant and equipment. The cumulative effect of these investments should be to accelerate the improvement of industrial efficiency.

   However, a large part of the annual investment in plant and machinery goes merely to maintain the current stock -- to replace the current wear and tear and obsolescense. More than half the current outlays of corporations for plant and equipment now goes for replacement.[11/] As the stock of capital increases, larger and larger amounts are needed to

11/ *See "Financing Business Expansion," NAM Economic Policy Series, No. 30, Page 11.*

pay the current replacement bill. As time goes on we shall have to run faster and faster merely to stay in the same place.

c. **Full Employment.** It is argued that high levels of employment and production will cause productivity to grow at a rate faster than in the historical period when we did not always have full employment.

But periods of unused capacity and unusued manpower have certain advantages as far as productivity is concerned. The unused capacity will consist of the least efficient plant and equipment. The unemployed workers will, in general, be the least productive. In periods of full employment the marginal plant and marginal employees are put back in service.

d. **Defense Boom.** There is a widespread impression that boom conditions favor unusually rapid growth in productivity. Fortune Magazine 12/ expressed that thought in the following words: *"...the very circumstances of a defense boom create or permit unusual increases in productivity."*

Perhaps they do in some instances but in others they permit inefficiencies which would not be tolerated in more normal times. Time rather than cost becomes the important consideration. High cost mines and plants are brought back into operation. Material shortages, transportation difficulties and other delaying factors lead to a wasteful use of man-hours.

And so it goes. There are weighty arguments on both sides of the question. It is impossible to foresee just where the balance will be struck and whether productivity will grow faster or slower than it has grown in the past.

SOME CONCLUSIONS ON THE RELATIONSHIP BETWEEN PRODUCTIVITY AND WAGES

On the subject of productivity and its relation to wages many questions still remain moot. This applies both to questions of fact and questions of policy. Some conclusions which emerge from the preceding analysis are as follows:

1. The final test as to whether real wages have progressed at a rate equal to the increase in productivity is whether labor has maintained its proportional share of business proceeds. By this test labor has nothing to complain of.

2. Allegations that productivity increases are needed as incentives to labor do not make much sense. Measures for increasing productivity depend as much on management decisions as on the effort or skill of workers.

12/ *October, 1951, page 26.*

3. Wage policy should be based on the general productivity of the economy as a whole, rather than on productivity in particular plants or industries. A policy of basing wages on the productivity of particular plants and industries would be an economic monstrosity.

4. Measurements of productivity based on the total output of the economy exaggerate the increase in productivity, in the sense of increases which can be compensated by higher wage rates.

5. The long-term increase in the overall efficiency of the economy, which can be translated into higher real wages, has been at a rate well below 2 percent annually.

6. The available (and potentially available) statistics on productivity growth are not sufficiently accurate to justify any attempt to link wages and productivity by any rigid formula.

The net conclusion is that proposals for linking wages with productivity on a short term basis are impractical and undesirable. On a long run basis they are unnecessary since the matter takes care of itself. This is demonstrated by the fact that, through all the economic vicissitudes of the 1930's, 1940's, and early 1950's, employees have received a practically constant share of the proceeds of production.

Table 1

OUTPUT PER MAN HOUR
All Manufacturing Industries Combined
1899 = 100

1899	100
1903	110
1907	119
1909	118
1914	137
1919	135
1920	149
1921	164
1922	182
1923	179
1924	189
1925	200
1926	208
1927	213
1928	227
1929	238
1930	244
1931	250
1932	244
1933	256
1934	263
1935	286
1936	286
1937	278
1938	286
1939	312

Source: National Bureau of Economic Research

Table 2

Gross National Product in Constant (1939) Dollars
Man-hours Employed, and Real Product per Man-hour
By Major Sectors of the U.S. Economy, 1909-50

Year	(1) Gross national product (billions of 1939 dollars) Private	(2) Farm	(3) Private non-farm (1) + (2)	(4) Man-hours employed (billions) Private (5)+(6)	(5) Farm	(6) Private non-farm	(7) Real product per man-hour (1939 dollars) Private (1)÷(4)	(8) Farm (2) ÷ (5)	(9) Private non-farm (3) ÷ (6)
1909	45.3	5.1	40.2	89.7	25.2	64.5	.505	.202	.623
1910	46.2	5.3	40.9	91.5	25.1	66.4	.505	.213	.616
1911	47.8	5.6	42.2	90.0	24.9	65.2	.531	.225	.647
1912	49.6	5.6	44.0	92.3	24.8	67.4	.537	.227	.652
1913	51.6	5.6	46.0	92.4	24.8	67.6	.558	.226	.680
1914	50.3	5.9	44.4	89.9	24.8	65.2	.559	.238	.682
1915	49.8	6.3	43.5	90.2	24.7	65.5	.552	.255	.664
1916	55.6	5.8	49.8	96.1	24.8	71.3	.579	.233	.699
1917	58.2	5.6	52.6	101.8	24.3	77.4	.572	.232	.679
1918	63.4	5.6	57.8	103.1	23.8	79.3	.615	.233	.729
1919	60.4	5.3	55.1	94.9	23.4	71.6	.636	.228	.770
1920	55.7	5.2	50.5	93.8	23.8	70.0	.594	.219	.721
1921	51.9	4.9	47.0	82.7	21.9	60.8	.628	.225	.773
1922	58.5	5.7	52.8	89.8	22.7	67.1	.652	.249	.787
1923	65.8	5.7	60.1	97.0	22.9	74.2	.678	.250	.810
1924	65.4	5.5	59.9	94.5	23.1	71.4	.692	.239	.839
1925	71.3	5.5	65.8	98.8	23.6	75.2	.721	.235	.875
1926	74.4	5.9	68.5	102.6	23.7	78.9	.725	.250	.869
1927	75.4	5.8	69.6	102.4	22.8	79.7	.736	.255	.874
1928	76.3	5.9	70.4	103.7	23.2	80.5	.736	.256	.874
1929	81.5	5.9	75.6	107.5	23.0	84.5	.758	.257	.895
1930	73.5	5.6	67.9	100.1	22.8	77.3	.734	.246	.879
1931	67.7	6.5	61.2	91.2	23.4	67.9	.742	.279	.904
1932	57.4	6.2	51.2	81.2	22.5	58.6	.707	.274	.877
1933	56.5	6.2	50.3	80.5	22.5	58.0	.702	.276	.869
1934	62.0	5.1	56.9	81.9	20.0	61.9	.757	.254	.922
1935	67.6	5.9	61.7	86.4	20.9	65.5	.783	.283	.943
1936	76.4	5.3	71.1	92.7	20.2	72.4	.824	.262	.982
1937	80.9	6.4	74.5	98.7	21.9	76.8	.820	.291	.972
1938	76.4	6.6	69.8	90.4	20.5	69.9	.845	.320	1.000
1939	83.7	6.6	77.1	95.2	20.6	74.6	.879	.321	1.034
1940	92.1	6.4	85.7	99.5	20.5	79.0	.926	.313	1.082
1941	106.2	7.0	99.2	108.5	20.2	88.4	.978	.345	1.122
1942	116.5	7.5	109.0	117.0	21.1	95.9	.996	.354	1.136
1943	125.3	7.0	118.3	121.1	20.9	100.2	1.035	.335	1.180
1944	133.0	7.0	126.0	120.3	20.8	99.5	1.105	.339	1.265
1945	129.7	6.6	123.1	114.8	20.0	94.9	1.130	.333	1.297
1946	125.6	6.8	118.8	117.5	19.8	97.7	1.069	.343	1.215
1947	128.8	6.4	122.4	121.8	19.5	102.4	1.056	.330	1.195
1948	133.7	7.0	126.7	123.4	19.5	103.8	1.083	.359	1.221
1949	133.2	6.7	126.5	119.0	19.4	99.6	1.119	.345	1.270
1950	143.8	6.9	136.9	121.3	18.8	102.5	1.185	.367	1.336

Source: "National Productivity and Its Long Term Projection" by John W. Kendrick, May 1951. (Unpublished paper).

Table 3

Index Numbers of Productivity in Selected Industries (1939 = 100)

	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950
1. Manufacturing (output per man-hour)											
1. Beet sugar											
a. Beet sugar produced	104.2	99.2	90.5	73.0	75.7	79.6	82.3	93.1	91.8	104.5	115.0
b. Sugar beets sliced	110.9	104.7	98.8	75.8	77.8	85.5	92.5	99.7	100.6	109.5	126.0
2. Canning & Preserving	110.2	108.7	103.5	102.5	111.6	113.9	117.8	111.1	116.4	127.6	131.6
3. Cement	100.4	108.3	108.4	94.7	83.8	90.1	108.7	111.5	117.8	120.4	130.7
4. Clay Construction Products	105.2	103.8	97.0	80.5	83.8	88.0	105.4	106.1	114.9	117.3	123.7
a. Brick & Tile	na	na	na	na	na	na	na	107.6	118.6	120.5	127.2
b. Clay pipe	na	na	na	na	na	na	na	99.5	100.9	104.2	110.0
5. Coke	104.4	105.3	106.2	98.4	103.1	100.5	97.0	106.7	102.9	98.5	101.5
a. By product coke	104.6	105.4	106.2	98.2	103.0	100.2	96.5	106.3	102.6	98.4	100.8
b. Beehive coke	99.2	102.0	103.9	104.8	109.7	108.7	116.4	121.5	111.7	100.0	122.0
6. Condensed & Evaporated Milk	104.9	101.7	86.6	77.7	82.3	94.9	97.3	96.9	99.7	97.2	101.1
7. Confectionery	107.5	113.2	113.1	109.3	111.7	112.2	112.6	111.8	114.8	116.4	121.9
8. Flour & other Grain-Mill Products	101.8	101.6	97.0	89.4	85.3	90.4	87.5	91.3	90.2	83.0	85.9
9. Glass Containers	99.2	105.8	107.5	111.0	121.0	118.4	120.9	129.6	125.8	127.5	133.9
10. Hosiery	109.0	109.9	114.4	121.9	126.1	131.4	124.7	114.9	118.3	127.3	138.1
a. Full-fashioned hosiery	na	na	111.6	125.9	137.5	143.8	131.7	123.4	133.6	145.4	162.8
b. Seamless hosiery	na	na	118.4	117.0	112.8	117.4	115.9	104.9	102.1	108.5	114.0
11. Ice Cream	101.9	105.1	111.6	113.8	121.4	137.6	165.3	137.7	138.6	138.4	143.4
12. Malt Liquors	102.2	106.2	111.0	106.4	111.7	118.0	120.4	117.0	115.8	125.3	126.9
13. Paper & Pulp	105.3	106.2	99.9	89.9	87.0	87.6	89.8	91.6	94.6	99.1	109.7
14. Non-ferrous Metals	103.7	98.5	96.4	92.6	91.9	89.5	86.5	94.2	92.9	96.1	105.7
15. Rayon & other Synthetic Fibers	113.4	133.7	150.5	148.9	158.6	170.2	184.7	206.9	235.5	239.9	286.1
16. Tobacco Products	100.6	103.7	104.0	102.1	107.1	115.7	114.4	115.8	123.3	131.2	137.1
a. Cigars	98.7	98.4	99.3	98.8	107.2	118.0	112.5	109.3	115.6	125.0	132.2
b. Cigarettes & other tobacco products	103.3	111.8	111.1	106.5	106.9	112.7	117.2	125.5	135.4	140.5	144.1
II. Mining											
1. Mining (output per man-hour)	102.1	103.9	104.0	101.5	104.7	106.1	107.2	111.1	110.9	108.6	117.4
2. Anthracite coal (output per man-hour)	98.5	100.5	92.1	87.5	92.0	89.2	93.5	90.5	90.5	90.6	87.2
3. Bituminous coal (output per man-hour)	104.0	104.4	102.9	98.7	102.5	105.7	109.7	112.1	111.7	109.9	123.3

(Continued on next page)

Table 3 (Cont'd)

Index Numbers of Productivity in Selected Industries (1939 = 100)

	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950
II. Mining											
4. Copper Ores											
a. copper ore mined per man-hour	107.2	107.0	113.9	122.9	140.4	151.0	134.3	151.2	142.2	140.3	160.8
b. copper metal produced per man-hour	103.2	99.3	101.6	103.6	113.1	114.1	99.4	110.8	106.2	104.4	116.5
5. Iron Ores											
a. Iron ore mined per man-hour	119.8	123.4	117.3	104.0	106.7	120.7	113.3	117.8	119.5	113.8	125.4
b. Iron metal produced per man-hour	117.4	117.3	107.8	96.9	99.7	110.5	104.9	106.0	105.5	101.9	108.8
6. Lead & Zinc Ores											
a. Ore mined per man-hour	99.5	107.7	102.3	95.1	108.4	112.8	104.7	87.2	77.0	86.1	---
b. Metal produced per man-hour	96.4	98.3	90.4	75.3	78.8	78.7	70.5	76.5	82.3	85.3	94.7
III. Public Utilities											
1. Electric Light & Power (Output per man-hour)	108.6	123.2	145.8	182.7	191.1	182.5	160.7	167.0	171.0	---	---
2. Line-Haul Operating Railroads											
a. All hourly basis employees											
(1) Revenue traffic per man-hour	105.2	115.5	139.6	150.9	148.1	139.5	129.1	135.0	133.2	131.5	149.9
(2) Car miles per man-hour	102.5	104.2	108.7	103.9	101.2	95.3	94.8	99.6	99.6	106.3	116.4
b. Road Freight Employees											
(1) Ton-miles of freight per man-hour	103.4	108.4	115.1	120.0	120.5	117.0	115.3	122.5	125.9	127.8	135.5
(2) Freight car-miles per man-hour	100.8	98.8	94.2	91.2	91.5	88.5	90.0	92.1	94.9	103.8	104.6
c. Road Passenger Employees											
(1) Passenger miles per man-hour	105.2	125.2	197.9	279.9	283.8	266.2	208.2	163.9	149.4	136.0	128.9
(2) Passenger car miles per man-hour	101.5	104.6	105.3	106.9	105.4	104.9	105.7	103.6	104.4	105.3	106.4
3. Telegraph (services per man-hour)	na	na	na	na	na	na	na	na	na	na	na
4. Telephone (services per man-hour)	103.0	99.5	98.2	97.9	99.6	98.8	94.8	94.0	93.3	99.1	104.5
IV. Agriculture (output per worker)	102.5	106.5	117.8	115.5	122.6	120.1	120.2	115.9	130.1	133.9	131.0

na--Not available

Source: U.S. Bureau of Labor Statistics

Table 4

Percentage Distribution of Business Proceeds

	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945
1. Compensation of employees	46.4	47.8	49.1	49.6	48.6	47.8	45.6	46.8	47.6	47.2	47.7	46.8	46.9	47.7	49.0	49.0	48.9
2. Wages & salaries	45.9	47.3	48.5	48.8	48.0	47.2	45.1	45.8	45.7	45.1	45.4	44.8	44.9	45.8	47.1	47.0	46.8
3. Supplements to wages & salaries	.5	.6	.6	.8	.6	.7	.6	1.0	1.8	2.1	2.3	2.1	2.0	1.9	2.0	2.0	2.1
4. Income of unincorporated enterprises	14.8	13.3	12.3	9.9	11.0	11.8	15.4	13.9	15.0	14.6	14.2	14.3	14.8	16.4	16.3	16.8	18.3
5. Business & professional	8.8	8.5	8.0	6.5	6.1	7.7	7.8	8.5	8.1	8.5	8.5	8.7	8.6	9.0	9.2	9.9	11.0
6. Farm	6.0	4.7	4.4	3.4	4.9	4.1	7.6	5.5	6.9	5.9	5.6	5.5	6.2	7.5	7.2	6.9	7.3
7. Payments for use of property	16.8	17.9	18.5	19.2	17.3	15.4	13.7	15.1	13.8	13.1	13.2	11.9	10.5	9.0	8.1	7.9	7.6
8. Interest	4.6	5.6	6.9	8.9	8.7	7.0	5.8	4.9	4.2	4.6	4.1	3.5	2.7	2.1	1.6	1.4	1.3
9. Dividends	6.0	6.7	6.2	5.2	4.4	4.6	4.3	6.4	5.8	4.0	4.6	4.4	3.9	3.0	2.7	2.7	2.7
10. Rental income of persons	6.2	5.7	5.4	5.0	4.2	3.8	3.6	3.8	3.8	4.5	4.4	4.0	3.8	3.8	3.7	3.8	3.7
11. Retentions by business - gross	12.4	10.7	8.0	5.4	5.5	8.8	10.1	9.2	9.6	10.8	10.7	11.9	10.3	9.8	9.8	10.1	9.1
12. Undistributed corporate profits*	3.1	.1	-4.5	-10.1	-9.7	-4.1	-1.4	-1.5	-.2	--	.5	2.5	2.0	2.7	3.2	3.2	1.8
13. Depreciation & other capital consumption allowances	9.3	10.5	12.5	15.5	15.2	12.9	11.5	10.8	9.9	10.8	10.2	9.5	8.3	7.1	6.5	6.9	7.3
14. Business transfer payments	.6	.6	.9	1.4	1.5	1.1	.9	.8	.7	.5	.6	.4	.4	.3	.3	.3	.3
15. Business taxes	8.9	9.7	11.1	14.5	16.1	15.2	14.3	14.1	13.2	13.8	13.7	14.5	17.1	16.7	16.5	15.9	15.7
16. Indirect business tax & non-tax liability	7.4	8.7	10.4	13.7	15.0	14.0	12.7	12.2	11.3	12.4	11.8	11.3	10.1	8.4	7.8	8.1	9.1
17. Corporate profits tax liability	1.5	1.0	.7	.8	1.1	1.2	1.6	2.0	1.8	1.4	1.9	3.3	7.0	8.3	8.8	7.8	6.6
18. Total business proceeds	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	100.0	100.0

(Continued on next page)

* *Including inventory valuation adjustment*

Table 4 (Cont'd)

Percentage Distribution of Business Proceeds

	1946	1947	1948	1949	1950	1951
1. Compensation of employees	50.0	50.8	49.5	50.3	48.6	49.6
2. Wages & salaries	47.9	48.6	47.5	48.0	46.1	47.0
3. Supplements to wages and salaries	2.1	2.2	2.1	2.3	2.5	2.6
4. Income of unincorporated enterprises	19.2	16.9	16.8	15.0	14.2	14.3
5. Business & professional	11.2	9.4	9.3	9.4	9.1	9.0
6. Farm	8.0	7.4	7.5	5.6	5.1	5.3
7. Payments for use of property	7.8	7.5	7.3	8.0	7.9	7.4
8. Interest	1.1	1.1	1.2	1.5	1.5	1.4
9. Dividends	3.1	3.0	3.0	3.1	3.3	2.9
10. Rental income of persons	3.6	3.4	3.2	3.4	3.1	3.0
11. Retentions by business - gross	8.0	9.8	12.0	12.1	12.7	11.4
12. Undistributed corporate profits*	1.4	2.8	4.6	3.6	4.4	3.0
13. Depreciation & other capital consumption allowances	6.6	7.1	7.4	8.5	8.3	8.4
14. Business transfer payments	.3	.3	.3	.3	.3	.3
15. Business taxes	14.6	14.6	14.1	14.2	16.2	16.9
16. Indirect business tax & non-tax liability	9.4	8.9	8.6	9.5	9.1	8.7
17. Corporate profits tax liability	5.2	5.7	5.5	4.7	7.1	8.3
18. Total business proceeds	100.0	100.0	100.0	100.0	100.0	100.0

* *Including inventory valuation adjustment*

Source: Based on Data of U.S. Department of Commerce.

1952 ECONOMIC POLICY DIVISION SERIES

Number 47 Cut the Budget — How and Where
" 48 The Public Debt and What To Do About It
" 49 The FTC's Defense of Its Research and NAM's Reply
" 50 Industry and Government Research
" 51 Western Germany—An Economic Appraisal
" 52 Unemployment Compensation in a Free Economy
" 53 Productivity—Gauge of Economic Performance

1951 ECONOMIC POLICY DIVISION SERIES

Number 37 Symposium — Applied Research and Atomic Energy
" 38 Paying-As-We-Go
" 39 Inflation Is the Only Alternative to Pay-As-We-Go
" 40 Cut Non-Defense Spending Now *(out of print)*
" 41 Foreign Travel — Dollar Earner for Foreign Countries
" 42 Co-Determination
" 43 Studies On Concentration — The Federal Trade Commission versus the Facts
" 44 Bank Credit In a Defense Economy
" 45 Western Europe — An Economic Review
" 46 The Administrative versus the Cash-Consolidated Budget

1950 ECONOMIC POLICY DIVISION SERIES

Number 22 Nationalization — Costs and Consequences
" 23 Proceedings 1949 Patents and Research Seminars *(out of print)*
" 24 The Federal Program of Old Age and Survivors Insurance and HR 6000
" 25 Unemployment Estimates *(Revised April 1950)*
" 26 Bring Government Back Home
" 27 The Economic Impact of an Industry-Wide Strike
" 28 Federal Tax Revision *(out of print)*
" 29 The Meaning of Unemployment Statistics
" 30 Financing Business Expansion
" 31 Profits and Prices
" 32 Management Faces the Pension Problem
" 33 An Excess Profits Tax Is Against the Public Interest
" 34 A Federal Tax Program for the Period of Defense and Partial Mobilization *(out of print)*
" 35 Financing Small Business
" 36 Water in Industry

Copies of these publications may be obtained by request to the
NATIONAL ASSOCIATION OF MANUFACTURERS
14 WEST 49TH STREET, NEW YORK 20, N. Y.