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Chapter Title: Productivity in Individual Industries

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PRODUCTIVITY IN INDIVIDUAL INDUSTRIES

The rate of growth in the entire economy's productivity is the prime fact with which we are concerned. The facts on productivity in individual industries are worth presenting here, however, because they help us to understand the process by which national productivity has been raised.

Rise in productivity has been a general industrial phenomenon. Virtually every individual industry for which a reasonably adequate index can be calculated shows an upward trend in output per manhour, and this was almost as universally true of output per unit of tangible capital and of output per unit of labor and capital combined.

Among individual industries, as for the economy as a whole, the rise in output per manhour — the index most commonly available — nearly always exceeded the rise in productivity with capital as well as labor taken into account. For some industries the difference between the two measures was considerable.

Though virtually all industries showed rises in productivity, there was great variation among them in average rate of rise. Also, as might be expected, individual industries generally experienced greater temporal variation in the rate of productivity increase than did the economy as a whole.

The industries whose productivity advanced more rapidly than productivity in industries generally, were more often than not also those that expanded their output and employment of labor and capital more than industry at large. Industries in which productivity lagged, usually had a smaller growth in output and employment of labor and capital than industry at large — or even a decline.

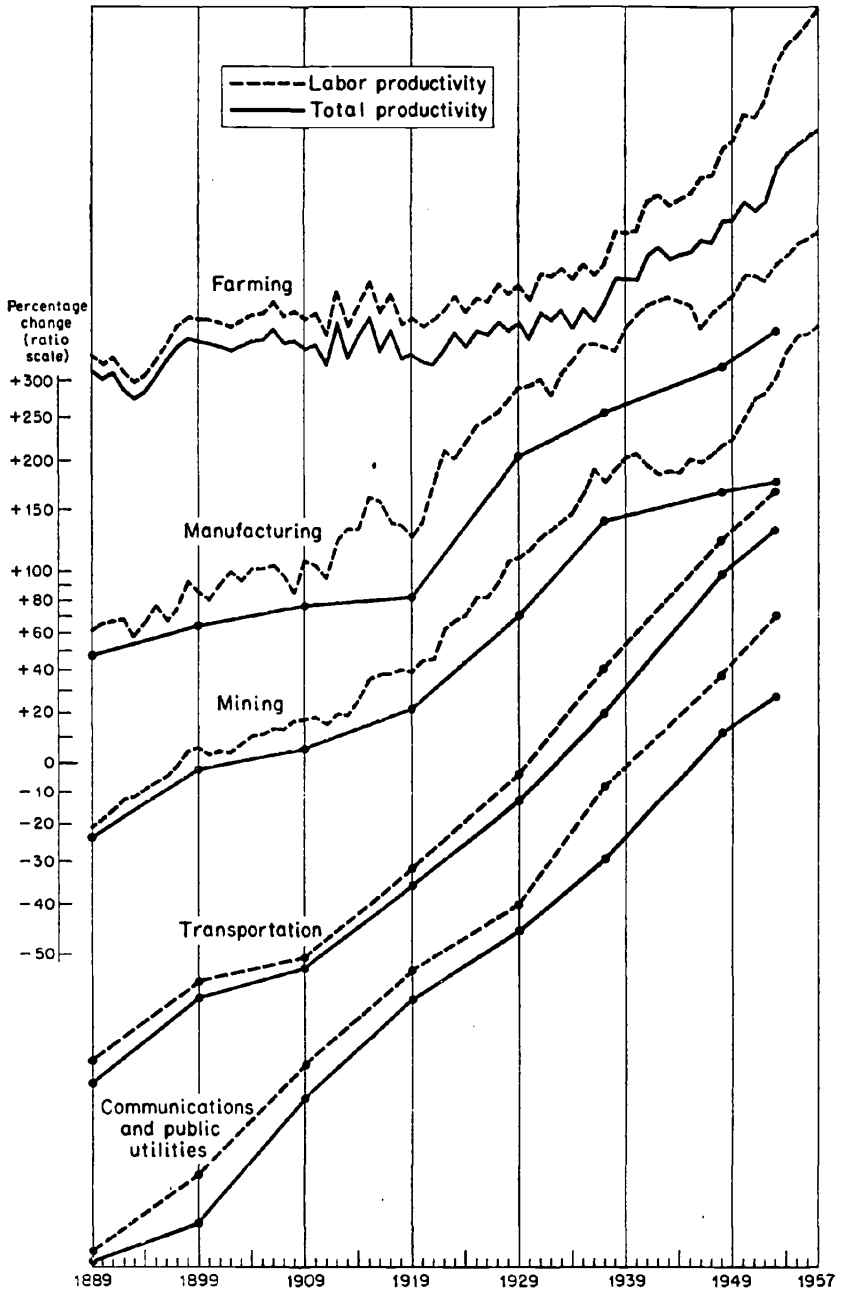
The generality of rise in productivity is the outstanding fact that emerges when individual industries are studied. It is illustrated by the detailed figures for five major divisions given in Chart 4, and by the changes between 1899 and 1953 in thirty-three industries or divisions.¹⁵

It is true that the statistics relate to a limited number of industries. The thirty-three industries for which individual productivity indexes are available make up less than half the entire economy, measured either by output or input. These industries, some nar-

¹⁵The detailed data are given in Table B, in the appendix.

CHART 4

Indexes of Productivity in Five Major Industrial Divisions Estimates for 1889-1957 or 1889-1953



rowly and some broadly defined, are largely from the commodity-producing sectors of the economy, and observations are for the period beginning with 1899. Lack of data prevents giving similar information for earlier years and for other industries — the service industries, construction, trade, and government, and even some individual manufacturing, mining, and utility industries.¹⁶

However, it is very likely that productivity has increased not only in the industries for which separate productivity indexes could be calculated, but also in the others, including the service industries. This is indicated by Kendrick's comparison of the productivity rise in the "covered" industries with the rise in the economy as a whole (Table 1). The implied rate of increase of productivity in the industries not covered is of the same order of magnitude as the rate for the aggregate of those covered. Since this estimate is subject to considerable error, it cannot be conclusive in itself. But what we know of technological developments and the other immediate causes of productivity change in the service industries, for example, supports the impression of a rise.¹⁷ We know, too, that the factors that make for increasing efficiency in the use of resources are general in character, felt everywhere in the economy. Virtually all industries use mechanical power and have reaped some advantages from broadened national markets. More fundamentally, no industry has been free of the drives that improve efficiency.

Since the indexes for individual industries are often put to specific use, it is well to recognize that they are often less reliable than the indexes for the economy at large. In part, the deficiency arises from the diversity of sources from which the data on output and input come. This causes discrepancies in the matching of output and input. And other statistical errors are imbedded, which tend to cancel out in the indexes for the economy as a whole.

¹⁶Kendrick's index for manufacturing as a whole, like all such indexes, is based on a sample of manufacturing industries. This is also true, in greater or lesser degree, of the other industries he could cover.

¹⁷See, for example, the interesting discussion of developments in trade in Harold Barger's *Distribution's Place in the American Economy since 1869*. Princeton University Press for the National Bureau of Economic Research, 1955.

NOTES TO CHART 4 ON FACING PAGE

Labor productivity: output per weighted manhour (in the case of farming, per unweighted manhour).

Total productivity: output per weighted unit of labor and tangible capital combined.

Output is measured gross, except for the farming index which is net.

Probably more important is the difficulty created by interindustry flows of materials, fuel, services, and semifabricated components. For a single industry, output is generally measured on a gross basis: that is, output is not only the value (at base-period prices) of work done by labor and tangible capital on the goods and services supplied by other industries, but the sum of the value of the work done and the value (also at base-period prices) of these supplies from other industries.¹⁸ Subtraction of these supplies from gross output to yield an index of net output (as is in effect done to get the economy-wide index of output), would solve the problem. But only a few attempts to measure the net output of individual industries have been made, and these (except possibly for agriculture) must be viewed as still largely experimental and subject to considerable error.¹⁹ With output measured gross, the supplies from other industries constitute an input on a par with the services of the labor the industry employs and the services of the tangible (and intangible) capital it uses. Labor and tangible capital alone thus fall short of measuring total input — much more so than in the case of the private economy as a whole. The usual productivity index for an individual industry, even if broad enough to include capital in the measure of resources used, is therefore correspondingly deficient. For many industries, perhaps, the resulting error is small. But this is by no means always the case, as is indicated by figures available for agriculture (Table B).

There is good evidence, further, that improved efficiency in the use of materials, fuel, and the like has been significant in certain industries — for example, electric power plants — and for these, the index of productivity based on gross output relative to input of labor and capital alone will understate the rise of efficiency. On the other hand, industries have generally become more specialized, and many now purchase materials and services formerly produced on their own premises — power used in manufacturing is an example. This works in the other direction.

Connections of these sorts between individual industries and other industries not only create difficulties of productivity measurement, but point also to the sources of productivity increase and

¹⁸Gross output in this sense is "grosser" than gross national product, which differs from net product only by the amount of depreciation and other capital consumption.

¹⁹This and other problems of measurement were discussed in the most recent meeting of the Conference on Research in Income and Wealth (October 1958). The proceedings will be published under the title, *Output, Input, and Productivity Measurement*.

diffusion. The connections provide channels along which new or improved or lower-cost materials, fuel, power, services, and equipment, as well as ideas, flow in to improve efficiency. What happens in an industry is influenced by the diligence, enterprise, and ability of its workers, management, and investors. It is influenced also by the quality and quantity of what the industry obtains from the rest of the world, domestic and foreign.

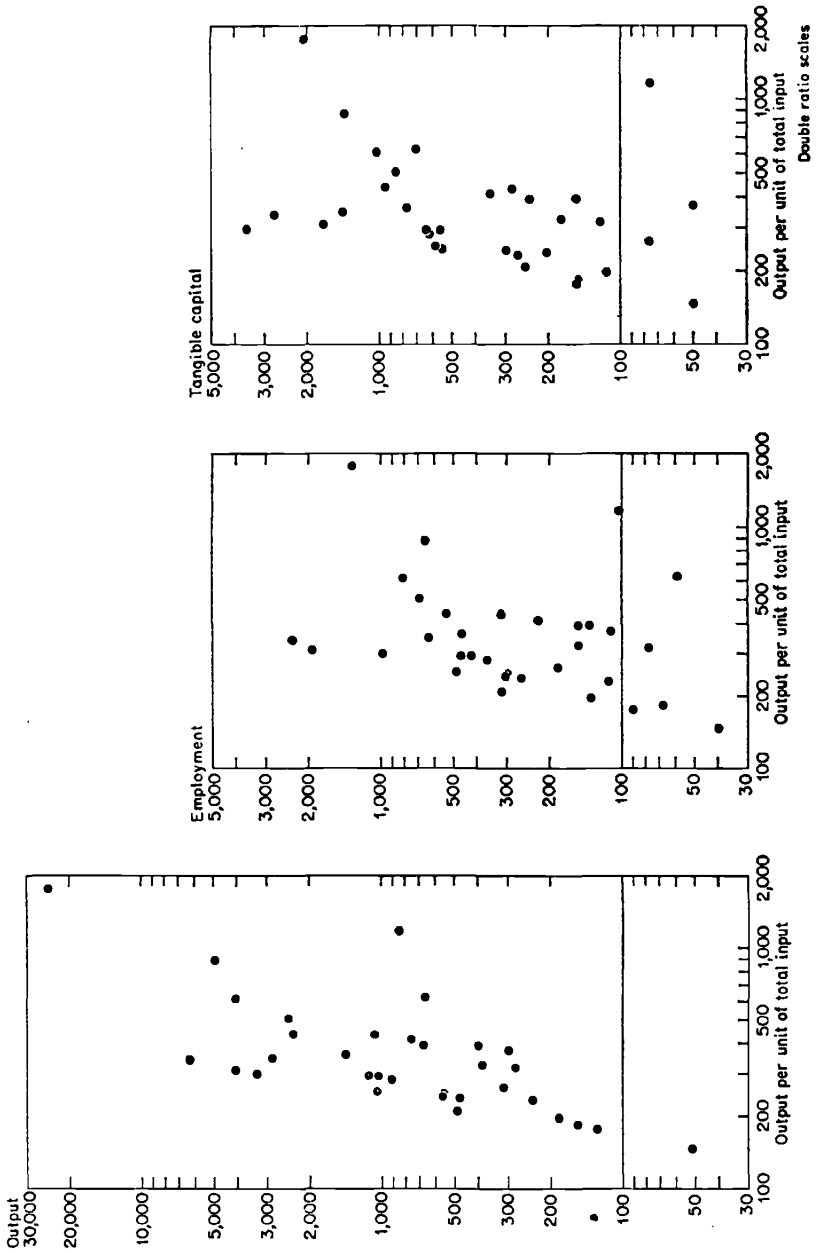
The fact that the individual industry indexes are subject to greater error than the national indexes partly accounts for the differences among industries in average rate of productivity increase. It also contributes to the greater temporal variability of the industry indexes as compared with the fluctuations of the over-all indexes. But these deficiencies can hardly account for all the variation in average rate or for all the differences in degree of fluctuation. Technological development and the other immediate factors that impinge on labor, capital, or total productivity often affect different industries at different times and in different degrees. Some of the time and space variation in rate of productivity increase must be "real."

Industrial differences in the behavior of output per unit of capital, especially striking, deserve comment. We noticed earlier that progress in the economy at large has led to reductions in the quantity of capital used per unit of product, despite substitutions of capital for labor. Over the period as a whole the phenomenon has been a general one, but the exceptions have been many. For example, output per unit of capital fell in agriculture over the twenty years 1899-1919, and more recently during 1948-53; rose during most of the other years of the period 1899-1953; and remained unchanged on net balance between 1899 and 1953. In manufacturing industries, also, output per unit of capital fell rather generally during 1899-1919, and in a fair number of them this was true also for 1948-53; but for the period as a whole, there was a net rise in output per unit of capital in the great majority of manufacturing industries. In the case of the railroads and public utilities, the figures suggest rather clearly that increase in the scale of operations led to important economies in the use of fixed capital. The tendency may have been operating in other industries also, but if so, it was overshadowed by other developments.

Increased efficiency in the use of supplies, materials, fuel, or equipment, and substitution of one input for another, already mentioned, altered relations among industries and caused differences in rates of growth of output and input. Further, a better than average increase in an industry's productivity usually meant lower relative

CHART 5

Relation between Change in Productivity and Output, and Productivity and Input, 33 Industry Groups: Indexes for 1953 Relative to 1899



costs, lower relative prices (as we shall see later), and therefore a better than average increase in its output (Chart 5). Better-than-average increases in output were usually accompanied by better than average increases in employment of workers and tangible capital, despite the more rapid rise in productivity. Correspondingly, less-than-average increases in productivity were usually accompanied by less-than-average increases (or even decreases) in output and in the use of labor and capital resources.²⁰

These relations do not exhaust the channels through which productivity and the forces back of it caused diversity in growth of industries. The general increase in productivity and the increased income it brought per capita raised the demand for the output of industries that produce the goods and services on which people spend more freely as they grow richer, and thus helped push their output up more than that of other industries less favored — even when their productivity lagged behind that of other industries and their costs and prices rose. The service industries are examples.

No one concerned with the rise and fall of industries, or — to single out a currently discussed problem — with the effects of "automation" on employment, may ignore these basic facts.

PRODUCTIVITY AND THE RISE IN REAL HOURLY EARNINGS

Productivity increase means more goods and services — more real income — available for distribution per unit of resources. Has the rise in productivity been reflected in the hourly real earnings of workers, as would be expected?

Real earnings per hour of work in the private domestic economy rose over the period since 1889 at an average annual rate about equal to the rate of increase in product per manhour, and greater than the rate of increase in product per weighted unit of labor and capital combined.

During recent decades, real hourly earnings have increased more

²⁰Coefficients of rank correlation between the changes compared in Chart 5 are as follows: between productivity (output per unit of total input) and output, 0.64; productivity and employment, 0.34; productivity and tangible capital, 0.40.

It should be noted that "better than average" in the text above refers to a comparison with the unweighted median of the thirty-three industry changes covered in the correlation, not to a comparison with the weighted average for the entire private domestic economy.