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CHAPTER III

Price and Cost Changes in Manufacturing Industries of the United States, 1899-1914

IT is a commonplace that in a modern industrial society the pursuit of material satisfactions centers about the making and spending of money. Economic desires and activities alike are defined in terms of money and measured on a scale of prices and costs. In view of the wide scope of the activities which are thus measured, it is surprising that the price record is so scanty. Only for a limited number of goods, and these of restricted types, do we have adequate statistics of changing market values. The record is particularly meager for highly fabricated goods, and for the various services which enter as costs in the making of such goods.

There is no prospect of filling this great gap in our economic records by means of a direct attack. The statistics which would permit us to trace changes in labor costs, in overhead costs, and in the selling prices of complicated products of manufacture simply do not exist. In default of such materials we may attempt by indirect means to secure these highly important records for certain leading industries. To this end we turn to data compiled by the Bureau of the Census on manufacturing industries of the United States.¹ These include statistics relating to value of products, to certain elements of cost, and to the physical volume of production. Census records for the pre-war period are restricted to the four years, 1899, 1904, 1909 and 1914.

Changes in Physical Output and in Aggregate Values and Costs, Manufacturing Industries

In Table 37 are summarized certain statistics of manufacturing production which are to be utilized. The figures in this table do not

¹ I am indebted to LeVerne Beales, Chief Statistician for Manufactures, Bureau of the Census, for numerous courtesies in connection with the compilation of materials for use in this chapter and in Chapter VIII, and for a critical review of the procedure employed.

STATISTICS OF SELECTED MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914^a
(All value figures in thousands of dollars)

(1) Year	(2) Statistics relating to all products of industries represented in index of physical volume of production					(6) Overhead expenses, plus profits <i>f</i>	(7) Actual value of products entering into index of physical volume of production	(8) Ratio of col. (7) to col. (2)
	(3) Total value of products <i>b</i>	(4) Cost of materials <i>c</i>	(5) Cost of fabrication, plus profits <i>d</i>	(5) Total wages paid <i>e</i>	(6) Overhead expenses, plus profits <i>f</i>			
1899	4,669,569	3,086,322	1,583,247	696,369	886,878	4,203,180	.900	
1904	5,757,111	3,850,977	1,906,134	838,759	1,067,375	5,267,314	.915	
1909	7,883,874	5,337,880	2,545,994	1,056,923	1,489,071	7,268,558	.922	
1914 *	9,513,844	6,471,723	3,042,121	1,353,262	1,688,859	8,655,465	.910	
1914 **	9,430,609	6,411,249	3,019,360	1,341,820	1,677,540	8,586,887	.911	
1914 ***	9,012,084	6,161,366	2,850,718	1,247,567	1,603,151	8,187,655	.909	

* The statistics for 1914 which appear on this line are comparable with the data for 1899.

** The statistics for 1914 which appear on this line are comparable with the data for 1904.

*** The statistics for 1914 which appear on this line are comparable with the data for 1909.

^a For the years here covered the census enumerations included all establishments having products of an annual value of \$500 or more. ^b The item 'value of products', as reported by manufacturing establishments, represents the selling value, at the factory, of all products manufactured during the year, whether sold or not. In estimating 'selling value', account is taken of the increase or decrease in the stock of manufactured goods (or of stocks in process of manufacture) on hand at the end of the year as compared with the beginning of the year. When possible, freight and delivery charges and discounts from list prices are deducted. Establishments working under contract or doing repair work report the amounts received for such services rather than the value of the products.

For those establishments which make partly finished products, such as pig iron, destined to be used by other establishments under the same ownership, the value of the product must be estimated. Estimates of such 'transfer values' (made by the manufacturer) are based sometimes on market prices, sometimes on cost of manufacture.

^c Cost of materials represents the cost, delivered at the factory, of "all materials and mill supplies of every description, whether raw or partly manufactured, or whether entering into the product, used as containers, or consumed in the process of manufacture; and all fuel, whether used for heat or power or in process of manufacture, as in making coke, gas, or pig iron, . . . actually used during the year covered by the report." (*Abstract of the Census of Manufactures, 1914, p. 12*). The cost of those materials produced in the plant itself and used by it for further manufacture is not included.

^d 'Cost of fabrication, plus profits', or 'value added to materials by manufacture', is the difference between the value of products and the cost of materials. Cost of fabrication does not include the cost of fuel, payments for rented power, or cost of mill supplies. These are included under cost of materials.

^e The item 'total wages paid' represents the total amount paid to wage-earners (including piece-workers) during the year. It includes board or rent furnished as part compensation.

^f 'Overhead expenses plus profits', being secured by deducting wages paid from 'value added by manufacture', includes salary payments, rent, interest, depreciation, repairs, insurance, advertising costs and taxes, as well as profits.

relate to all manufacturing industries. Selection has been necessary to ensure the comparability of the statistics relating to physical volume and to other aspects of production. (In general, the volume figures are not as comprehensive as the other manufacturing statistics, and are not in all respects comparable with them.) In column (7) is given the value of the products actually employed each year in constructing the index numbers of physical volume of manufacturing production which were presented in Chapter I. The ratio of this value to the value listed in column (2) is given in column (8). Such a ratio was computed for each of the smallest industrial groups for which statistics relating to volume of production, value of products, cost of materials, etc., are given. This ratio serves as a measure of the adequacy of the index of physical volume, or as a measure of the degree of comparability of the volume figures and the other statistics. For example, in 1899, for all commodities, the products entering into the index of physical volume had a value of 4,203,180 thousands of dollars [column (7)]. The entries in columns (2) to (6) for the same year relate to the production of manufactured goods having a value of 4,669,569 thousands of dollars [column (2)]. The ratio of the first of these figures to the second is .900. In other years covered by Table 37 this ratio varies from .909 to .922. The two sets of statistics have nearly identical coverage.

In the present study use has been made only of statistics relating to those industries for which the 'adequacy ratio' exceeded .60. Industries for which no quantity figures, or only inadequate figures, were available have been excluded.¹

It is possible to break up the total value of products of manu-

¹ The relative importance of the industries covered is indicated by the following summary, giving the percentage relation of the value of products included in the index of physical volume of production to the total value of manufactured products reported by the Bureau of the Census.

Year	Total value of products reported in Census of Manufactures (thousands of dollars)	Value of products in industries represented by index numbers of physical volume (thousands of dollars)	Percentage of total value of manufactured products represented in index numbers
1899	11,406,927	4,669,569	40.9
1904	14,793,903	5,757,111	38.9
1909	20,672,052	7,883,874	38.1
1914 *	24,246,435	9,513,844	39.2
1914 **	24,246,435	9,430,609	38.9
1914 ***	24,246,435	9,012,084	37.2

* The statistics for 1914 which appear on this line are comparable with the data for 1899.

** The statistics for 1914 which appear on this line are comparable with the data for 1904.

*** The statistics for 1914 which appear on this line are comparable with the data for 1909.

facture into three elements, measuring the costs of the contributions of sellers of materials, of wage-earners, and of a composite group of owners, creditors, managers and other salaried employees. These are distinct and significant classes, though rather far removed from the classical economic categories of land, labor, capital and business enterprise. Measurements relating to the elements noted are to be interpreted with an understanding of their precise significance. Thus, the materials of manufacture are in many cases semi-processed before they reach a given manufacturing plant. Moreover, the cost of transportation to the manufacturing plant is included with material costs, as are, also, costs of fuel, power and containers. Again, the second item in the list includes only wages paid, not salaries. Finally, the third element, which we have called 'overhead expenses plus profits', includes such items as interest charges, depreciation, taxes, rent and salaries, as well as profits.¹

Since our interest is not in the absolute figures but in changes occurring in these various elements, we present them in relative form in Table 38, together with an index of the physical volume of manufacturing production between 1899 and 1914.

The index numbers of physical volume given in this table have been constructed by means of the 'ideal' formula, weights being based upon 'value added' (i.e., upon cost of fabrication, plus profits).² In this process each of the years, 1899, 1904 and 1909, has been paired, in turn, with 1914, the base being shifted later to 1899. The only novel feature of the procedure lies in the correction of the original quantity data to offset the variations from year

¹ Data on salaries are available, but it has not seemed desirable to treat them separately, or in combination with wages. Salary payments relate to a wide range of services. In some cases the distinction between profits and salaries may not be clearly drawn. Wages, as a separate item in manufacturing costs, constitute a far more clearly-defined and homogeneous element than would wages and salaries in combination.

Colonel M. C. Rorty comments: "Special care must be taken in interpreting the results secured when salaries are combined with returns to capital. It is my opinion that a tendency prevailed, over the period here covered, to place more and more of productive labor on a salaried basis."

² In averaging data relating to different industries weights have been based upon the materials actually included in the index. In general, no attempt has been made to employ imputed weights, by means of which given commodities might be made to represent related commodities for which no data are available. However, industries producing automobiles, forest products and petroleum products have been given reduced weights, proportionate to their relative importance among all industries covered by the Census of Manufactures. For an explanation of this reduction see footnote, pp. 26-27.

TABLE 38

RELATIVE NUMBERS DEFINING CHANGES IN IMPORTANT ELEMENTS OF MANUFACTURING PRODUCTION IN THE UNITED STATES, 1899-1914^a

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year	Physical volume of production (fabrication)	Value of products	Cost of materials	Cost of fabrication, plus profits	Total wages paid	Overhead expenses plus profits
1899	100.0	100.0	100.0	100.0	100.0	100.0
1904	120.2	125.1	128.2	118.5	119.5	117.7
1909	154.5	178.2	183.5	167.2	158.7	173.5
1914	176.3	199.5	206.7	184.4	186.6	182.7

^a The entries in columns (3) to (7) define changes in aggregates; they do not measure changes per unit of product. As is explained elsewhere, three industries were given reduced weights in securing relative numbers from the data given in Table 37.

to year in the adequacy ratio. This is a matter requiring some further explanation.

As will be clear from the subsequent uses to which the measurements in Table 38 are to be put, the highest possible degree of comparability between the index numbers of physical volume and the other index numbers in the table is desirable. If, for a given industry, the adequacy ratio were .90 in one year and .80 in a later year, direct comparison of changes in volume of output and, let us say, in number of workers employed, would be invalid. Either because the coverage of the quantity statistics was less complete in the second year, or because the industry in question devoted more of its resources to the production of secondary products, the quantity index would show a decline in production which did not actually occur, or would understate the advance which did occur. If we are interested in variations in the aggregate output of that industry some correction must be made for the variation in the degree of coverage of the quantity statistics. If this is not done quite misleading conclusions as to the degree of change in productivity per worker (and in other respects) will be drawn.¹

¹ If the adequacy ratio declines because, in a given industry, a secondary product for which quantity statistics are not compiled is being produced in greater quantities, it may be justifiable, for certain purposes, to make no correction. This would be proper if sole interest attached to the variations in production of the major product, let us say automobiles. But in this case it would not be valid to compute index numbers of per capita production, and similar measurements, with-

In the present study correction for a changing adequacy ratio has been made, for each industry, by increasing the number of physical units reported for each census year to a standard corresponding to an adequacy ratio of 1.00. The index numbers of physical output thus secured for individual industries measure changes in the aggregate output of those industries, not changes in the output of specific commodities. The problem of correcting for changes in adequacy does not then arise when the group index numbers are combined in an index number of volume of production for all manufacturing industries. The ratios in Table 37 have been included because of their bearing on the representativeness of the data employed.

The construction of index numbers of the physical volume of manufacturing production which are comparable with other census statistics opens the way for further exploitation of the detailed statistics of manufacture. In such exploitation, however, certain of the difficulties involved in the construction of quantity index numbers must be recognized. The chief of these difficulties is that, from time to time, changes occur in the *quality* of manufactured goods. Thus, an automobile in the year 1932 is many degrees removed in quality from the automobile of 1920, and still further removed from the automobile of 1900. For a large number of standard commodities such quality changes do not occur, or are of minor importance. But for manufactured commodities as a whole they cannot be ignored. A thoroughly accurate index of the physical volume of production should perhaps measure the production of units of service and use, rather than the production of harvesting machines, automobiles, sides of bacon, loaves of bread, pairs of shoes. It is, of course, impossible to construct such an index, and we must restrict ourselves to measurements of changes in the number of physical units produced.¹

This fundamental difficulty which arises out of quality changes is involved in all attempts to measure changes in the volume of production or in the prices of manufactured goods. In the construc-

out adjusting either the production index or the index measuring changes in the number of employed workers.

¹ In some cases it has been possible to take account of changing quality in the output of a given industry, by using detailed statistics of output in which goods of different grades, or quality, are distinguished. If this had not been done, an increased output of goods of high quality would have been submerged in an aggregate dominated by cheaper products.

tion of index numbers of prices we must content ourselves with measuring changes in the prices of what are designated shoes, tractors, automobiles, even though we know or suspect that the purchaser of these commodities may, at a given time, be getting more or less in the way of serviceability and utility than at a previous date. There appears to be no solution of the problem beyond that of dealing with the actual physical units and interpreting our results with the realization that these units may have undergone quality changes. In this interpretation, therefore, we shall attach greater weight to comparisons over short periods of time, during which quality changes would ordinarily be slight, than to comparisons covering longer periods.¹

CHANGES IN THE SELLING PRICES OF MANUFACTURED GOODS

Having comparable measurements of the volume of physical production and of the aggregate value of product between 1899 and 1914, it is possible to derive index numbers defining changes in the average selling price per unit of manufactured products during this period. An index of changes in aggregate value, divided by a properly weighted index of changes in volume of production, yields a properly weighted index of changes in average price.²

§ *On changes in the apparent physical contributions of different agents of manufacturing production.*—The method of weighting em-

¹ This same problem arises in attempting to measure changes in the purchasing power of the dollar, or of other monetary units. For this purpose it would appear to be proper to employ only standard commodities not subject to quality changes from time to time. Yet this is not a perfect solution. Standard commodities which do not change in quality are in all probability subject, as a group, to particular price-determining forces. Their price movements, therefore, measure not only changes in the purchasing power of money, but also alterations in the terms of exchange between this group and all other commodities, alterations not necessarily proportionate to quality changes in these other commodities.

² The operation is the reverse of the 'factor reversal test' suggested by Professor Irving Fisher (*The Making of Index Numbers*, Houghton Mifflin Co., Boston, 1927, pp. 72-82) and used extensively by him in testing different types of index numbers. That is, a properly weighted price index number multiplied by a properly weighted volume index number yields a series of relatives defining accurately changes in aggregate value. In reversing the process, as is done in the present case, it is essential that the index numbers employed satisfy the factor reversal test. It is for this reason, in part, that the 'ideal' formula has been used in constructing the present volume index numbers. The same argument applies, of course, to the process of deriving the index numbers of per capita output and of per establishment output which were presented in Chapter I.

ployed must be appropriate to the purpose in mind. Thus in deriving an index number of selling price per unit of product of manufacture, the weights employed in constructing the index of physical volume should be based upon value of product. The volume index number, that is, should measure changes in the aggregate output of manufacturing establishments, not changes in the specific contribution of agents of fabrication. In deriving an index of per capita production, on the other hand, the weights used in constructing the index of physical volume should be based upon value added in manufacture, for it is the contribution of fabricating agents which is here in question. In deriving measurements of changes in various elements of cost, as is done hereafter, weights should be based upon the corresponding elements of total value of product (e.g., upon wages paid, if labor cost per unit is being measured). Index numbers of physical volume in which these several weighting factors have been used are given below.

TABLE 39

INDEX NUMBERS MEASURING CHANGES IN THE APPARENT PHYSICAL CONTRIBUTIONS OF DIFFERENT AGENTS OF MANUFACTURING PRODUCTION, 1899-1914

(1)	(2)	(3)	(4)	(5)	(6)
Year	Aggregate output (weights based on value of product)	Volume of materials (weights based on cost of materials)	Volume of fabrication (weights based on 'value added')	Apparent contribution of labor (weights based on wages paid)	Apparent contribution of ownership and management ^a (weights based on overhead expenses plus profits)
1899	100.0	100.0	100.0	100.0	100.0
1904	118.8	118.0	120.2	118.3	120.8
1909	148.5	145.8	154.5	151.6	155.6
1914	163.3	157.8	176.3	169.4	180.4
Average annual rate of change 1899-1914 (per cent)	+3.4	+3.2	+3.9	+3.7	+4.1

^a The phrase 'ownership and management' is used for convenience to include owners, managers and salaried employees, as well as the agents represented by such items of overhead expense as rent and interest payments. Where this composite element—the difference between 'value added' and wages—bulks large, it means, presumably, that the contribution of ownership and management in the form of equipment and organization is relatively important. To the extent that monopoly and windfall profits swell this item, the assumption of a corresponding 'contribution' is not justified. It should be made clear, moreover, that the use of the term 'con-

For each individual industry there is, of course, but one index of changes in physical volume of production. If the volume of output increases in a certain proportion we are forced (in default of exact knowledge) to assume that the contributions of those providing materials and of those providing labor and management have all increased in that proportion. But when averages relating to the production of a number of industries are secured we may take some account of the varying contributions of these different factors. Index numbers of volume of output secured by the use of different weighting factors will differ, and should differ, when there are differences in the rates of growth of industries in which cost of materials bulk large and of industries in which fabrication costs are relatively large. If the latter industries are growing more rapidly, the aggregate physical contribution of agents of fabrication is increasing more rapidly than is the aggregate physical contribution of those providing materials.

That this was the case between 1899 and 1914 is apparent from the measurements in Table 39. The increased importance of fabrication in manufacturing processes is shown by the sharper advance of the index weighted by 'value added'. Most rapid was the gain in the index which purports to measure changes in the physical contribution of ownership and management. The increasing importance of overhead with the growth of industrial equipment is indicated by this series.

This method of measuring changes in the prices of manufactured products differs materially, of course, from that ordinarily employed in constructing price index numbers. The normal procedure is to collect price quotations in representative markets and, by appropriate technical methods, to secure weighted averages of these quoted prices, the weights being based, ordinarily, upon quantities marketed. In the present case we start with a series of figures measuring the actual values of the products of manufacture of all, or nearly all, the establishments in the United States producing commodities of the type included. We have, that is, a practically all-inclusive record of the values of the commodities in question. Paralleling this, we have a series of index numbers defining changes in the aggregate physical output of the establishments to which the value figure relate. A simple process of division gives us, then, a series of relatives measuring changes in the average selling price, per unit of product.

The wide coverage of the data employed in deriving price index numbers by this method is notable. Instead of basing estimates of

tribution' does not imply that the specific productivity of different agents is being measured. There are here measured only those apparent changes in the physical contributions of different agents which result from the varying rates of growth of industries with widely different combinations of the factors of production.

price movements upon occasional quotations in a restricted list of markets, it is possible to employ data relating to about 90 per cent of the total sales of manufacturing establishments producing the commodities in question. The securing of separate price quotations as comprehensive in scope as the census value and quantity figures would be quite impossible. For the commodities and industries actually included in the present study the main problem encountered in the use of price index numbers, that of the representativeness of the quotations, does not arise, for the quantity, value and price figures relate to practically the entire universe of inquiry, and not to a selected sample. (If we wish to go beyond this group of industries the usual questions of representativeness must of course be faced.)

Price index numbers derived from census statistics of manufacture have another distinct advantage, in their homogeneity as regards the markets to which the prices relate. Such index numbers measure changes in the prices received by manufacturers. The term 'wholesale price' has come to be a very vague term. Most wholesale price index numbers are based upon quotations drawn from many markets, at different distributive stages, and relating to transactions of the most diverse sorts. An index of prices received by manufacturers has a clear and unequivocal meaning.

Index numbers of value of product, of physical volume of production and of average price per unit appear in Table 40, below. These and the other index numbers cited in this chapter are derived from statistics relating to approximately 40 per cent of the total product, by value, of all manufacturing industries in the United States. The industries directly covered by the compilations are enumerated in the next section, while a list of the commodities included is given in Appendix IV. These index numbers are shown graphically in Figure 19.

Between 1899 and 1914 the stream of values derived from manufacturing operations increased 100 per cent, at an average rate of 4.9 per cent a year. This gain was due to an increase of approximately 63 per cent in physical volume of production and of 22 per cent in average selling price per unit. On a yearly basis the average rate of increase was 3.4 per cent in volume, 1.5 per cent in price per unit. The gain in volume, as we have seen, was most rapid during the census interval 1904-1909. This was also

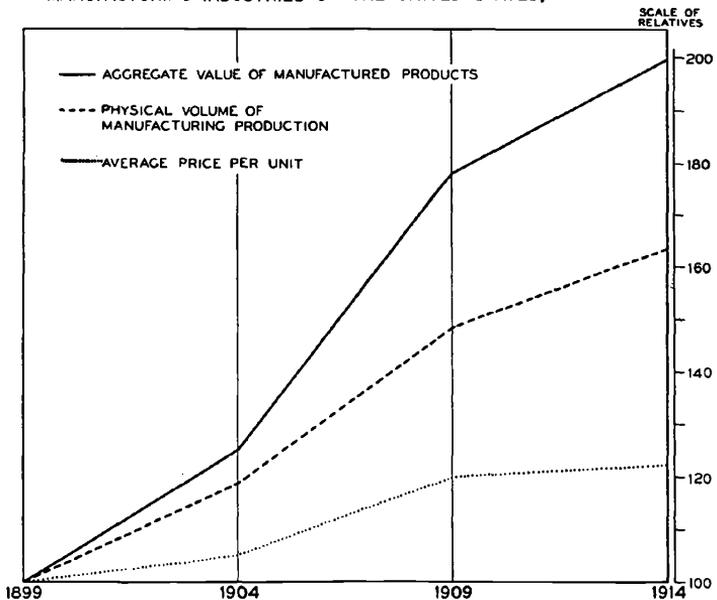
TABLE 40
INDEX NUMBERS OF AGGREGATE VALUE, PRODUCTION AND PRICE, 1899-1914^a
Manufacturing Industries of the United States

Year	Aggregate value of manufactured products	Physical volume of output ^b	Average selling price per unit, products of manufacture
1899	100.0	100.0	100.0
1904	125.1	118.8	105.3
1909	178.2	148.5	120.0
1914	199.5	163.3	122.2
Average annual rate of change 1899-1914 (per cent) . .	+4.9	+3.4	+1.5

^a The volume, price and per-unit cost index numbers given in this and later tables are all derived from 'ideal' indexes, on the 1914 base. The comparison of each year with 1914 is accurate, but the cross-comparison of other years introduces a slight element of error.

^b The components of this index are weighted according to value of product. These weights give the correct quantity index to use in deriving an index of changes in average selling price per unit from an index of changes in aggregate value.

FIGURE 19
CHANGES IN AGGREGATE VALUE, VOLUME OF PRODUCTION
AND AVERAGE PRICE OF PRODUCTS
MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914



the period of most rapid rise in the prices of manufactured goods.¹

§ *Selling prices, individual industries.*—A truer picture of changes in the selling prices of manufactured goods is secured when we view these movements in detail. The interpretation of such detailed measurements is not clouded by the problems of weighting and of representativeness that must be faced in dealing with averages. Index numbers for separate manufacturing industries, as given in the following table, reveal the great diversity of the changes that lie behind the general averages. The rates of change of the selling prices of manufactured products are shown graphically in Figure 20.

The variations in selling price changes between 1899 and 1914 are fairly wide, from industry to industry. Explosives, at one extreme, declined at an average annual rate of 2.3 per cent, while products of slaughtering and meat packing industries, at the other, advanced at a rate of 3.7 per cent per year. The degree of variation among these rates is measured by a standard deviation of 1.7.² This figure is significantly lower than the corresponding value of 5.7, measuring the standard deviation of the rates of change in quantities produced by the same industries. There is far more coherence among the price changes than among the quantity changes. There is a suggestion here that the prices at which the products of a given industry are sold are more subject to the influence of economic forces at large, are less free to diverge radically from the general trend, than is the physical production of that industry. It is the price nexus which binds industries together, and unequal price changes are probably more disturbing to a given economic equilibrium than are unequal changes in quantities marketed.

¹ It is of interest to compare these index numbers of the prices of manufactured goods with a series derived directly from the price quotations compiled by the U. S. Bureau of Labor Statistics. Such index numbers, constructed as unweighted geometric averages of 178 series of price quotations (168 in 1899), appear in column (3) below:

(1)	(2)	(3)
Year	Index of average selling price per unit of manufactured goods, derived from census data	Unweighted geometric average of price relatives, manufactured goods
1899	100.0	100.0
1904	105.3	109.5
1909	120.0	118.6
1914	122.2	120.9

There is no reason to expect very close agreement between those two independently derived series. The degree of resemblance actually existing must be in part accidental, but it justifies belief in the substantial accuracy of the two sets of measurements.

² Weights drawn from the terminal years, 1899 and 1914, have been used throughout in the computation of standard deviations of rates of change for census data.

TABLE 41
CHANGES IN THE SELLING PRICES OF PRODUCTS OF MANUFACTURING INDUSTRIES
OF THE UNITED STATES, 1899-1914
Index Numbers for 35 Industries, with Average Annual Rates of Change

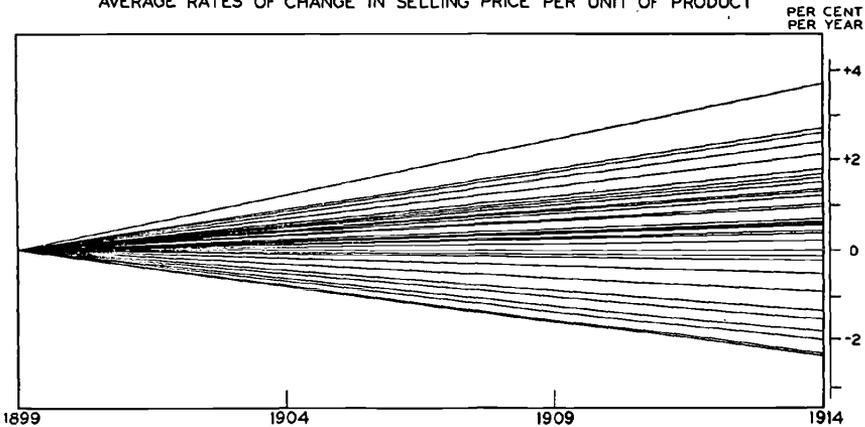
Industry	Index numbers of selling price, per unit of product				Average annual rate of change 1899-1914 (per cent)
	1899	1904	1909	1914	
Slaughtering and meat packing.....	100.0	103.1	135.3	165.8	+3.7
Flour-mill and gristmill products.....	100.0	137.0	161.6	153.4	+2.7
Butter, cheese, and condensed milk....	100.0	105.8	141.9	139.8	+2.6
Turpentine and rosin.....	100.0	146.1	163.9	149.0	+2.4
Coke, not including gas-house coke....	100.0	112.0	125.9	135.9	+2.1
Cotton goods.....	100.0	118.3	131.9	132.1	+1.8
Lumber and timber products.....	100.0	114.6	138.2	126.2	+1.7
Gloves and mittens, leather.....	100.0	91.9	120.7	119.1	+1.6
Hosiery and knit goods.....	100.0	108.4	114.6	125.5	+1.5
Hats, wool-felt.....	100.0	133.3	161.7	119.1	+1.3
Fertilizers.....	100.0	96.6	116.9	115.7	+1.3
Hats, fur-felt.....	100.0	99.8	108.8	118.0	+1.2
Carpets and rugs, other than rag.....	100.0	112.1	111.3	118.2	+1.0
Paper and wood pulp.....	100.0	100.6	112.8	113.0	+1.0
Woolen and worsted goods.....	100.0	108.8	119.9	109.3	+0.7
Silk goods.....	100.0	91.7	99.8	107.8	+0.6
Paint and varnish.....	100.0	104.8	102.5	111.7	+0.6
Canning and preserving: fruits and vegetables; pickles, preserves, and sauces	100.0	97.4	98.3	109.9	+0.6
Musical instruments: pianos.....	100.0	100.0	101.7	106.2	+0.4
Rice, cleaning and polishing.....	100.0	73.2	99.7	96.7	+0.4
Petroleum, refining.....	100.0	114.3	101.4	107.9	+0.2
Musical instruments: organs.....	100.0	102.1	102.5	99.2	0.0
Ice, manufactured.....	100.0	100.5	101.6	97.2	-0.1
Iron and steel: blast furnaces.....	100.0	96.4	105.8	94.1	-0.2
Sugar, beet.....	100.0	107.4	105.7	91.4	-0.5
Iron and steel: steel works and rolling mills.....	100.0	91.9	91.1	86.1	-0.9
Gas, manufactured, illuminating and heating.....	100.0	94.9	88.0	83.1	-1.3
Wood distillation, not including turpentine and rosin.....	100.0	91.7	84.8	79.8	-1.5
Automobiles, including bodies and parts	100.0	92.3	109.0	66.0	-1.8
Motorcycles, bicycles, and parts.....	100.0	75.5	70.1	75.2	-2.0
Salt.....	100.0	105.5	71.5	77.4	-2.3
Explosives.....	100.0	90.7	77.5	71.7	-2.3
Boots and shoes, other than rubber....	100.0	112.0	—	147.4	—
Cordage and twine.....	100.0	—	91.0	109.4	—
Jute and linen goods.....	100.0	—	110.5	128.4	—
Average ^a	100.0	104.6	124.6	127.4	+1.8

^a The average for each year is the arithmetic mean of the central items of a weighted frequency distribution, with weights based on value of product, averaged for the base year and the given year. The central one-fifth of the items, by weight, were included in computing the average.

FIGURE 20

ILLUSTRATING THE DIVERGENCE OF PRICE TRENDS AMONG
32 MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914*

AVERAGE RATES OF CHANGE IN SELLING PRICE PER UNIT OF PRODUCT



* Plotted on ratio scale. The lines here plotted relate to the industries listed in Table 41, in the order of that listing.

The averages of selling price changes among manufactured goods, as derived from the records for individual industries, differ somewhat from the 'ideal' indexes previously cited. The averages given in Table 41 are derived from the central values of frequency distributions, and are designed to represent *typical* situations among manufacturing industries (weighted, of course, by value of products). These averages of selling prices are slightly higher for 1909 and 1914 than are the 'ideal' index numbers.

CHANGES IN MATERIAL COSTS AND IN FABRICATION COSTS, MANUFACTURING INDUSTRIES

The compilations of the Census of Manufactures yield not only data on the total value stream; they permit that value stream to be divided in various ways, as was shown in Table 37. Thus we have the total cost of materials and the total value of the services of agents of fabrication ('value added'). Each of these may in turn be compared with the index of physical volume, and from the comparison may be derived index numbers of cost of materials and of cost of fabrication, per unit of manufactured product. The total value of the services of fabricating agents may again be subdivided into two streams, total wages paid and total overhead expenses plus profits, and from these, in relation to the stream

of physical volume, we may derive index numbers of labor costs and of overhead costs plus profits, per unit of manufactured product.¹ In addition, then, to the measurement of changes in the average selling price of products of manufacture, we may measure changes in the prices, per unit of manufactured product, of the services of various agents of production—of those who provide materials, on the one hand, and of fabricating agents, including labor, ownership and management, on the other. Here is a type of information concerning productive processes and industrial changes impossible to secure by direct methods.

Index numbers showing changes in the average per-unit selling price of manufactured goods between 1899 and 1914, and in two major elements of cost, appear in the next table. These are shown graphically in Figure 21.

Between 1899 and 1914 material costs per unit of manufactured product increased 31 per cent, while fabrication costs rose only 4.6 per cent. Material costs (the most heavily weighted factor) were primarily responsible for the increase of 22 per cent

¹ In connection with this procedure a question of some general significance may be raised. Are we justified in assuming, as we do throughout the study, that changes in the constituent elements of value of products indicate changes in the costs of the contributions of the several factors, rather than changes in the amounts of their physical contributions? If changes in the relative physical contributions of the different factors occur (for example, if a given quantity of raw materials is subject to a greater degree of fabrication in turning out a final product which remains the same in name) and if, at the same time, changes in the costs of the different factors occur, it is clear that there is no way of separating the two and measuring each in isolation. To the extent that changes in the physical contributions of the different factors have occurred, the indexes of costs to be presented hereafter are, in fact, measures of changing costs and of changing physical contributions combined in unknown proportions.

This is another aspect of the problem of changes in quality. As in the general case, it is probably safe to assume that over short periods indexes of changing costs measure, primarily, true alterations in costs, and that the relative physical contributions of the different factors are not altered. Over longer periods, and for certain classes of commodities (of which automobiles may be cited as an example), changes in the relative physical contributions of the different factors undoubtedly occur, and indexes of cost are to be interpreted with this fact in mind.

In so far as changes in the contributions of the several productive agents to the product of industry at large are due to the changing importance of individual industries (which differ among themselves with respect to the relative importance of material costs, labor costs and overhead costs) these changing contributions may be measured by constructing different index numbers of physical volume of production. This has been done in the present survey. But changes in the relative physical contributions of different agents within individual industries are not measurable.

TABLE 42

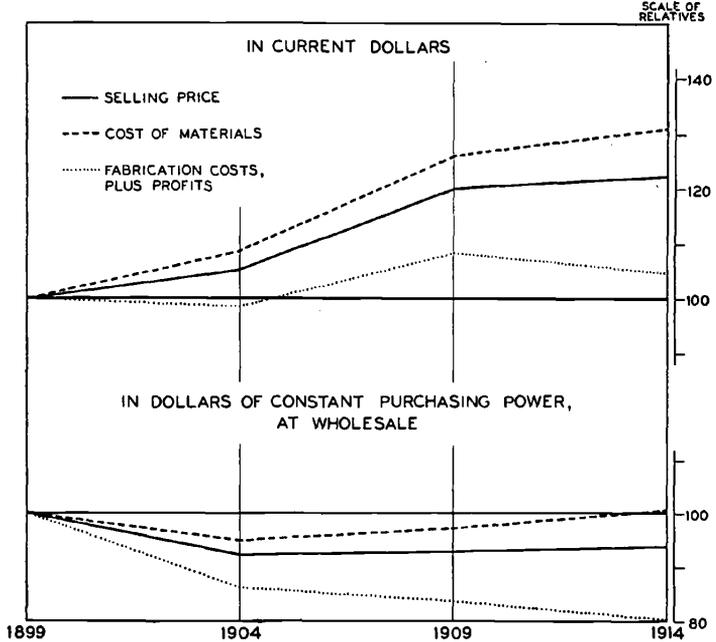
CHANGES IN SELLING PRICE, COST OF MATERIALS AND FABRICATION COSTS,
PLUS PROFITS, 1899-1914Manufacturing Industries of the United States
(All measurements relate to changes per unit of product)

(1) Year	(2) (3) (4) In current dollars			(5) (6) (7) In dollars of constant purchasing power		
	Selling price	Cost of materials	Fabrication costs, plus profits	Selling price	Cost of materials	Fabrication costs, plus profits
1899	100.0	100.0	100.0	100.0	100.0	100.0
1904	105.3	108.6	98.5	92.1	94.9	86.2
1909	120.0	125.9	108.2	92.6	97.2	83.5
1914	122.2	131.0	104.6	93.6	100.4	80.2
Average annual rate of change 1899-1914 (per cent)	+1.5	+1.9	+0.5	-0.3	+0.1	-1.3

in the average selling price of manufactured products. [The elements represented by the index numbers in columns (3) and (4) are, of course, components of selling price. The index of changes in the latter is, in effect, a weighted average of the two index numbers of per-unit cost.]

These movements are registered in terms of dollars which were declining in real value, for the level of wholesale prices advanced some 30 per cent between 1899 and 1914. If the true significance of changes in selling prices and costs is to be appreciated these should be expressed in dollars of constant purchasing power, as is done in columns (5), (6) and (7) of the above table. The transition from current dollars to dollars of constant purchasing power is made by dividing the price and cost index numbers, as first computed, by the index of wholesale prices of the United States Bureau of Labor Statistics. This is equivalent to evaluating the products of manufacture, the cost of materials and the services of the several agents of fabrication in terms of physical commodities, as they exchange at wholesale, rather than in terms of a monetary unit of changing value.

FIGURE 21
 CHANGES IN AVERAGE SELLING PRICE, COST OF MATERIALS
 AND FABRICATION COSTS, PLUS PROFITS,
 PER UNIT OF PRODUCT
 MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914



When the effect of fluctuating dollar values is thus removed, and changes in the prices and production costs of manufactured goods are measured against constant commodity values, a truer picture of the developments of this era is obtained.¹ As we have noted, manufactured goods were being steadily cheapened during the years preceding the war. The present figures indicate a fall in real value per unit amounting to about 6 per cent between 1899 and 1914, and averaging 0.3 per cent a year. Material costs, per unit of final product, remained practically constant,² when mea-

¹ Deflation by the wholesale price index of the Bureau of Labor Statistics only serves as an approximation, of course, to a full correction for fluctuating dollar values. This general index is used in default of more appropriate specific deflators for the particular value series cited.

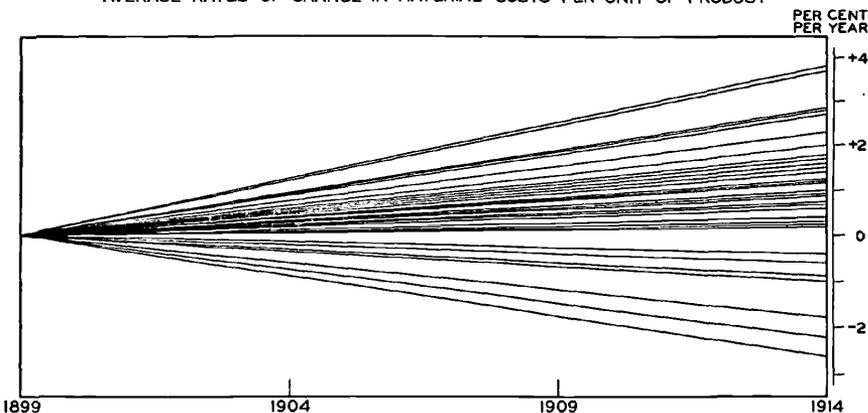
² Material costs, it must be remembered, include the cost of fuel, power, containers and supplies, and semi-processed materials, as well as the cost of raw materials proper. In so far as the materials employed in one manufacturing plant are products of other manufacturing industries, the general decline in fabricating

sured in dollars of constant purchasing power, while fabrication costs declined about 20 per cent during these fifteen years. The notable decline in fabrication costs reflects, in part, the increasing technical efficiency and advancing productivity which were characteristic of this period. In part this decline is due to the lagging adjustment of wages, and of some elements of overhead costs, to the secular decline in the purchasing power of the dollar.

§ *Material costs and fabrication costs, individual industries.*—Turning now to the changes occurring among individual industries, we have the records summarized in Tables 43 and 44. Average annual rates of change are shown graphically in Figures 22 and 23.

FIGURE 22

ILLUSTRATING THE DIVERGENCE OF COST TRENDS AMONG
32 MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914*
AVERAGE RATES OF CHANGE IN MATERIAL COSTS PER UNIT OF PRODUCT



* Plotted on ratio scale. The lines here plotted relate to the industries listed in Table 43, in the order of that listing.

costs would be reflected in their prices. A large proportion of the materials of manufacture are non-fabricated goods, which rose in real value between 1899 and 1914.

The following figures, taken from the *Census of Manufactures, 1905*, indicate the relative importance of the various items entering into material costs during the census year 1904:

Total cost of materials	100.0 per cent
Raw	37.0 " "
Partially manufactured	57.8 " "
Fuel	3.6 " "
Mill supplies, oil, waste, etc.	0.7 " "
Freight	0.7 " "
Rent of power and heat	0.2 " "

TABLE 43

CHANGES IN MATERIAL COSTS, MANUFACTURING INDUSTRIES OF THE
UNITED STATES, 1899-1914

Index Numbers for 35 Industries, with Average Annual Rates of Change

Industry	Index numbers of cost of materials, per unit of product				Average annual rate of change 1899-1914 (per cent)
	1899	1904	1909	1914	
Coke, not including gas-house coke. . . .	100.0	117.1	152.4	171.3	+3.8
Slaughtering and meat packing.	100.0	104.5	136.6	166.3	+3.7
Butter, cheese, and condensed milk. . . .	100.0	108.0	146.3	145.3	+2.8
Cotton goods	100.0	144.6	149.7	161.7	+2.8
Flour-mill and gristmill products.	100.0	139.5	164.5	153.9	+2.7
Turpentine and rosin	100.0	75.8	104.6	129.3	+2.3
Paper and wood pulp.	100.0	107.1	125.9	131.0	+2.0
Hosiery and knit goods	100.0	113.7	118.1	133.1	+1.8
Fertilizers	100.0	103.5	120.6	125.8	+1.7
Gloves and mittens, leather	100.0	92.5	120.4	119.7	+1.6
Iron and steel: blast furnaces.	100.0	117.0	136.3	123.2	+1.5
Lumber and timber products.	100.0	83.1	111.4	113.8	+1.4
Carpets and rugs, other than rag.	100.0	122.3	109.4	128.0	+1.2
Musical instruments: pianos.	100.0	97.5	117.0	114.9	+1.2
Ice, manufactured	100.0	105.7	111.4	118.9	+1.2
Woolen and worsted goods.	100.0	112.4	125.9	114.5	+1.0
Hats, fur-felt	100.0	89.6	103.4	110.1	+0.9
Canning and preserving: fruits and vegetables; pickles, preserves, and sauces	100.0	96.0	100.4	113.3	+0.9
Hats, wool-felt	100.0	130.8	160.5	105.4	+0.7
Rice, cleaning and polishing.	100.0	68.9	100.1	99.7	+0.7
Musical instruments: organs.	100.0	89.7	95.4	107.4	+0.6
Silk goods	100.0	89.7	93.8	105.4	+0.4
Gas, manufactured, illuminating and heating	100.0	103.6	101.6	106.5	+0.3
Petroleum, refining	100.0	109.8	102.7	106.7	+0.2
Paint and varnish.	100.0	107.4	100.8	105.6	+0.2
Wood distillation, not including turpentine and rosin	100.0	102.2	93.5	96.6	-0.4
Sugar, beet	100.0	97.3	91.4	92.2	-0.6
Automobiles, including bodies and parts	100.0	88.4	112.0	77.5	-0.9
Iron and steel: steel works and rolling mills	100.0	92.0	92.8	84.6	-1.0
Salt	100.0	111.2	78.4	82.4	-1.8
Explosives	100.0	87.3	73.0	73.5	-2.2
Motorcycles, bicycles, and parts.	100.0	73.2	63.3	70.3	-2.6
Cordage and twine	100.0	—	90.4	113.4	—
Jute and linen goods.	100.0	—	115.1	161.6	—
Boots and shoes, other than rubber. . . .	100.0	106.0	—	140.0	—
Average ^a	100.0	106.0	136.0	143.9	+2.7

^a The average for each year is the arithmetic mean of the central items of a weighted frequency distribution, with weights based on cost of materials, averaged for the base year and the given year. The central one-fifth of the items, by weight, were included in computing the average.

TABLE 44

CHANGES IN FABRICATION COSTS, MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914

Index Numbers for 35 Industries, with Average Annual Rates of Change

Industry	Index numbers of cost of fabrication, plus profits, per unit of product				Average annual rate of change 1899-1914 (per cent)
	1899	1904	1909	1914	
Slaughtering and meat packing.....	100.0	94.0	126.2	162.7	+3.8
Flour-mill and gristmill products.....	100.0	122.3	145.2	149.9	+2.7
Turpentine and rosin.....	100.0	176.8	189.8	157.7	+2.4
Hats, wool-felt.....	100.0	136.7	163.4	137.0	+2.1
Lumber and timber products.....	100.0	139.1	159.0	135.8	+1.9
Gloves and mittens, leather.....	100.0	91.2	121.0	118.4	+1.6
Hats, fur-felt.....	100.0	109.5	113.9	125.3	+1.4
Paint and varnish.....	100.0	100.3	105.5	122.9	+1.4
Butter, cheese, and condensed milk....	100.0	94.7	120.2	112.7	+1.2
Hosiery and knit goods.....	100.0	102.4	110.5	116.7	+1.1
Silk goods.....	100.0	94.5	108.0	111.2	+0.9
Carpets and rugs, other than rag.....	100.0	98.9	113.6	105.5	+0.6
Cotton goods.....	100.0	89.5	112.5	99.9	+0.5
Fertilizers.....	100.0	83.9	110.2	97.2	+0.4
Woolen and worsted goods.....	100.0	102.7	110.1	100.9	+0.2
Canning and preserving; fruits and vegetables; pickles, preserves, and sauces.....	100.0	99.8	94.6	103.8	+0.1
Petroleum, refining.....	100.0	136.9	94.9	113.8	0.0
Musical instruments: pianos.....	100.0	102.0	90.3	99.7	-0.3
Sugar, beet.....	100.0	126.9	133.2	90.1	-0.4
Musical instruments: organs.....	100.0	110.1	107.0	93.9	-0.4
Paper and wood pulp.....	100.0	92.6	96.6	90.8	-0.5
Ice, manufactured.....	100.0	98.8	98.5	90.3	-0.6
Coke, not including gas-house coke....	100.0	105.7	93.1	92.2	-0.7
Iron and steel: steel works and rolling mills.....	100.0	91.9	87.8	89.0	-0.8
Motorcycles, bicycles, and parts.....	100.0	78.1	77.6	80.7	-1.4
Rice, cleaning and polishing.....	100.0	101.8	97.2	77.3	-1.5
Gas, manufactured, illuminating and heating.....	100.0	91.7	82.8	74.4	-2.0
Explosives.....	100.0	95.8	84.4	69.0	-2.4
Automobiles, including bodies and parts	100.0	94.4	106.7	58.5	-2.5
Salt.....	100.0	101.4	66.5	73.8	-2.6
Wood distillation, not including turpentine and rosin.....	100.0	79.3	74.7	60.2	-3.1
Iron and steel: blast furnaces.....	100.0	60.4	52.6	43.2	-5.5
Boots and shoes, other than rubber....	100.0	123.1	—	161.2	—
Cordage and twine.....	100.0	—	92.4	99.8	—
Jute and linen goods.....	100.0	—	104.2	84.1	—
Average ^a	100.0	95.3	108.9	102.0	+0.4

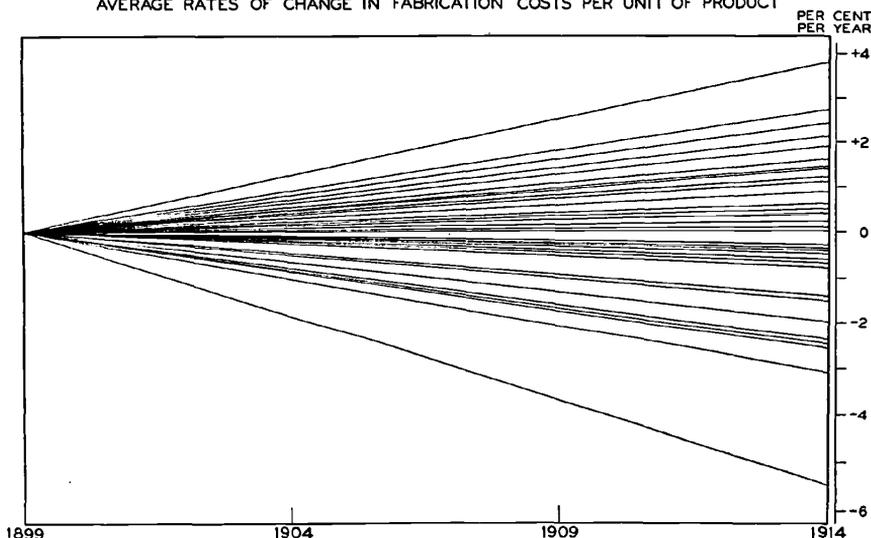
^a The average for each year is the arithmetic mean of the central items of a weighted frequency distribution, with weights based on 'value added', averaged for the base year and the given year. The central one-fifth of the items, by weight, were included in computing the average.

Material costs advanced most rapidly in the production of coke. Next in order were four industries utilizing agricultural products. Automotive and steel products, salt and explosives registered the greatest declines in the cost of materials. The degree of variation from industry to industry in the rates of change in material costs is measured by a standard deviation of 1.7, equal to that for index numbers of selling prices.

The averages secured from the central items of weighted frequency distributions, averages designed to represent typical situations among manufacturing industries, show substantial advances in material costs after 1904. Industries fabricating farm products, which were marked by advancing material costs during this period, exert a strong influence upon these averages.

Changes in fabrication costs in 35 individual industries are shown in Table 44, while the trends in such costs are depicted below.

FIGURE 23
ILLUSTRATING THE DIVERGENCE OF COST TRENDS AMONG
32 MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914*
AVERAGE RATES OF CHANGE IN FABRICATION COSTS PER UNIT OF PRODUCT



* Plotted on ratio scale. The lines here plotted relate to the industries listed in Table 44, in the order of that listing.

Between 1899 and 1914 the cost of fabricating a ton of pig iron declined 57 per cent,¹ while among slaughtering and meat packing indus-

¹ Profits are lumped with fabrication costs in the returns we are utilizing. The great decline in this element between 1899 and 1914 for blast furnaces is due in considerable part to exceptional conditions prevailing in the steel industry in 1899.

tries fabrication costs per unit of product increased 63 per cent. For 19 of the 35 industries studied, fabrication costs in current dollars actually declined. The concurrence of such declines with a steady advance in the general level of prices was, of course, a conspicuous feature of the pre-war period.

The standard deviation of the rates of change of index numbers of fabrication costs is 1.9, indicating slightly greater variation among industries than was found in dealing with changes in material costs.

CHANGES IN LABOR COSTS AND IN OTHER FABRICATION COSTS, MANUFACTURING INDUSTRIES

We now consider separately the two major elements of fabrication costs—labor costs and the composite of overhead costs, salaries and profits. Changes in these elements are shown graphically in Figure 24.

TABLE 45

CHANGES IN TOTAL FABRICATION COSTS, LABOR COSTS AND OVERHEAD COSTS
PLUS PROFITS, 1899-1914

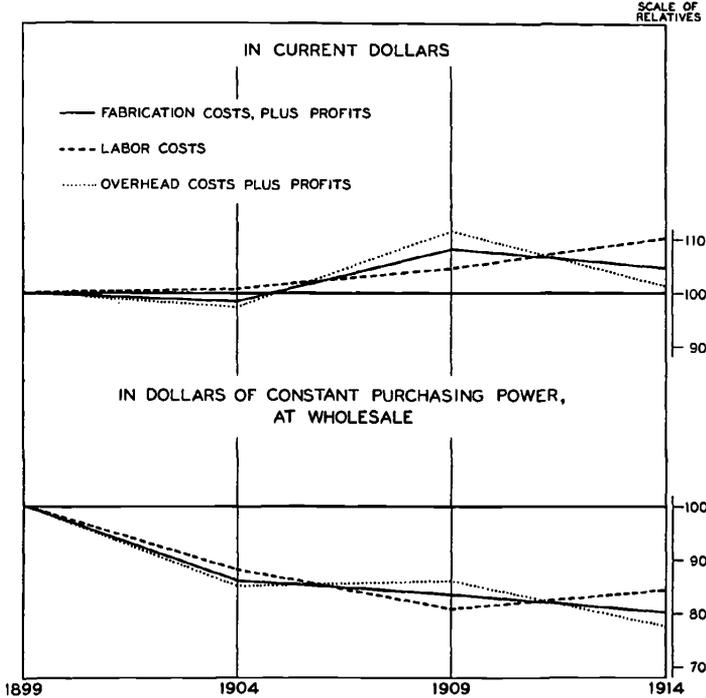
Manufacturing Industries of the United States

(All measurements relate to changes per unit of product)

(1) Year	(2) (3) (4) In current dollars			(5) (6) (7) In dollars of constant purchasing power		
	Fabrication costs, plus profits	Labor costs	Overhead costs plus profits	Fabrication costs, plus profits	Labor costs	Overhead costs plus profits
1899	100.0	100.0	100.0	100.0	100.0	100.0
1904	98.5	100.9	97.5	86.2	88.3	85.2
1909	108.2	104.6	111.5	83.5	80.8	86.1
1914	104.6	110.2	101.3	80.2	84.4	77.7
Average annual rate of change 1899-1914 (per cent)	+0.5	+0.7	+0.3	-1.3	-1.1	-1.4

Output was large, prices were exceptionally high, and profits were large. The year 1914 was one of depression, with low profits. While fabrication costs proper undoubtedly declined in the steel industry during this period, the degree of decline was probably much smaller than is shown by this index.

FIGURE 24
 CHANGES IN AVERAGE FABRICATION COSTS, LABOR COSTS
 AND OVERHEAD COSTS PLUS PROFITS,
 PER UNIT OF PRODUCT
 MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914



During the fifteen years before the war the two elements of fabrication costs moved forward at average rates which did not differ materially ($+0.7$ and $+0.3$ per cent a year), but they were not at all in step with each other. The comparative prosperity of 1909 increased overhead costs plus profits to a level over 11 per cent above that of 1899, while labor costs advanced less than 5 per cent. Depression in 1914 reduced overhead costs plus profits to a level close to that of 1899, and carried labor costs over 10 per cent above that standard.

Measuring changes in these elements of cost in terms of constant commodity values (at wholesale), we find a notable cheapening in both series. The real cost of the contribution of labor to each unit of manufactured goods was in 1914 some 16 per cent lower than in 1899, while the real cost of the contribution of own-

ership and management [using that term to cover the heterogeneous items represented by the index numbers in column (7)] was, in 1914, 22 per cent lower than in 1899.¹

§ *Labor costs and other fabrication costs, individual industries.*—The record of changing labor costs in 35 industries is contained in Table 46, on the following page. Trends in labor costs, by industries, are plotted in Figure 25.

The divergent changes revealed by this table emphasize the fact that the index numbers in Table 45 define average movements only, and ignore striking differences among industries. In the production of lumber products (at the sawmill stage) labor costs advanced 59 per cent, per unit of product, between 1899 and 1914; at the other extreme are motor vehicles, for which labor costs per unit of product declined 52 per cent over this fifteen-year period. Into the reasons for these differences we do not at present inquire, except to note that costs dropped most sharply in industries marked by the greatest increases in volume of production and in output per capita.

Considerable as were the differences which developed in labor costs, the degree of divergence among industries was less than for any of the other factors studied. The standard deviation of the rates of change is 1.4. Pre-war tendencies in labor costs were more uniform, from industry to industry, than were the tendencies prevailing among any other element of selling price.

The composite item which we have called 'overhead costs plus

¹In the main, these declines in real costs of fabrication are the results of persistent trends, but the difference between business conditions in the two terminal years has undoubtedly affected the index numbers of costs for these years. In 1899 a general state of prosperity prevailed, while 1914 was a year of rather severe depression.

It is possible to trace changes in certain of the component items of 'overhead costs plus profits'. Expressing these components as percentages of the total, we have the following record of changes. (The data for 1899 are incomplete.) These figures, taken from the *Census of Manufactures*, relate to all manufacturing industries in the United States.

Item of cost	Percentage of total overhead costs plus profits			
	1899	1904	1909	1914
Rent		2.0	2.1	2.4
Taxes		7.9	6.9	7.6
Salaries	13.5	15.6	18.4	22.0
Payments for contract work.....		3.9	3.5	3.4
Other elements of overhead plus profits.....		70.6	69.1	64.6
Overhead costs plus profits, total.....		100.0	100.0	100.0

The relative importance of rent increased slightly over this period, while taxes declined slightly. Salaries, which constituted but 13.5 per cent of the total in 1899, made up 22 per cent of all overhead costs (plus profits) in 1914. There is probably a reflection here of the expansion of corporate activities, as well as of the growing importance of 'organization' in the conduct of manufacturing operations.

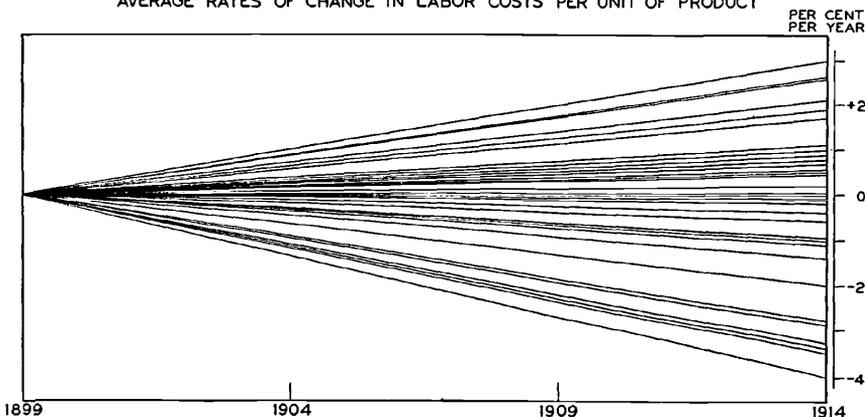
TABLE 46
CHANGES IN LABOR COSTS, MANUFACTURING INDUSTRIES OF THE UNITED STATES,
1899-1914
Index Numbers for 35 Industries, with Average Annual Rates of Change

Industry	Index numbers of labor costs, per unit of product				Average annual rate of change 1899-1914 (per cent)
	1899	1904	1909	1914	
Lumber and timber products.....	100.0	135.7	164.4	158.8	+3.0
Turpentine and rosin.....	100.0	124.0	147.0	147.7	+2.6
Slaughtering and meat packing.....	100.0	106.8	118.1	146.3	+2.6
Hats, wool-felt.....	100.0	128.6	139.7	140.7	+2.1
Flour-mill and gristmill products.....	100.0	111.3	120.9	132.3	+1.9
Butter, cheese, and condensed milk....	100.0	112.6	121.9	129.4	+1.7
Hats, fur-felt.....	100.0	93.8	98.6	116.3	+1.1
Woolen and worsted goods.....	100.0	103.6	106.0	116.5	+1.0
Cotton goods.....	100.0	98.6	108.8	111.6	+0.9
Hosiery and knit goods.....	100.0	98.1	100.5	113.6	+0.8
Paper and wood pulp.....	100.0	104.8	105.6	111.2	+0.7
Paint and varnish.....	100.0	102.1	95.9	110.3	+0.5
Gloves and mittens, leather.....	100.0	80.5	98.4	101.7	+0.5
Carpets and rugs, other than rag.....	100.0	108.3	105.2	109.1	+0.5
Silk goods.....	100.0	94.2	99.9	102.2	+0.2
Musical instruments: organs.....	100.0	113.8	102.0	103.8	0.0
Iron and steel: steel works and rolling mills.....	100.0	97.5	88.0	103.0	0.0
Coke, not including gas-house coke....	100.0	101.1	102.1	98.2	-0.1
Ice, manufactured.....	100.0	94.9	93.7	96.7	-0.2
Musical instruments: pianos.....	100.0	93.3	86.5	95.6	-0.4
Canning and preserving: fruits and vegetables; pickles, preserves, and sauces	100.0	92.9	90.3	92.0	-0.6
Rice, cleaning and polishing.....	100.0	94.4	82.4	88.9	-1.0
Petroleum, refining.....	100.0	120.4	77.6	97.4	-1.0
Fertilizers.....	100.0	93.5	89.7	84.9	-1.1
Wood distillation, not including turpentine and rosin.....	100.0	89.5	86.6	80.6	-1.4
Iron and steel: blast furnaces.....	100.0	88.1	74.4	75.5	-2.0
Sugar, beet.....	100.0	73.5	70.8	64.7	-2.8
Salt.....	100.0	96.3	66.6	69.7	-2.9
Gas, manufactured, illuminating and heating.....	100.0	78.8	67.2	61.6	-3.3
Motorcycles, bicycles, and parts.....	100.0	112.6	74.3	62.5	-3.4
Automobiles, including bodies and parts	100.0	88.6	97.8	47.7	-3.5
Explosives.....	100.0	72.8	59.7	55.8	-4.0
Boots and shoes, other than rubber....	100.0	107.1	—	137.6	—
Cordage and twine.....	100.0	—	105.9	117.8	—
Jute and linen goods.....	100.0	—	100.0	106.8	—
Average ^a	100.0	100.0	103.4	111.6	+0.7

^a The average for each year is the arithmetic mean of the central items of a weighted frequency distribution, with weights based on aggregate wages paid, averaged for the base year and the given year. The central one-fifth of the items, by weight, were included in computing the average.

FIGURE 25

ILLUSTRATING THE DIVERGENCE OF COST TRENDS AMONG
32 MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914*
AVERAGE RATES OF CHANGE IN LABOR COSTS PER UNIT OF PRODUCT



* Plotted on ratio scale. The lines here plotted relate to the industries listed in Table 46, in the order of that listing.

profits' includes all fabrication charges other than the cost of labor. It measures what is paid by the buyers of manufactured goods for the services of owners and managers, in the broadest sense. Index numbers defining changes in this element between 1899 and 1914 in 35 manufacturing industries are given in Table 47, on the next page. Average annual rates of change in overhead costs plus profits are shown graphically in Figure 26.

The measurements in this table reflect more closely than do other elements of selling price the ups and downs of business fortunes with the expansion and contraction of trade. We start with 1899, a good year, when profits were relatively high. The year 1904 was one of mild depression, and we find a drop in overhead costs plus profits in those industries which are most immediately affected by trade fluctuations. For blast furnaces the drop amounted to 49 per cent, for plants producing cotton goods, 21 per cent. Variations in profits, of course, are reflected in such fluctuations as these. In 1909, a year of prosperity, the general average was distinctly higher, while the depression of 1914 brought lower values again. Changes over the entire fifteen-year period varied from a drop of some 67 per cent, for blast furnaces, to an advance of more than 100 per cent for boots and shoes.

The degree of variation among the tendencies prevailing in different industries is measured by a standard deviation (of rates of change) of 2.4, a figure materially higher than that found among other elements of selling price. Manufacturing industries showed greatest uniformity in labor cost tendencies, least uniformity in respect of changes in overhead costs plus profits. Labor costs, it would appear, are most affected

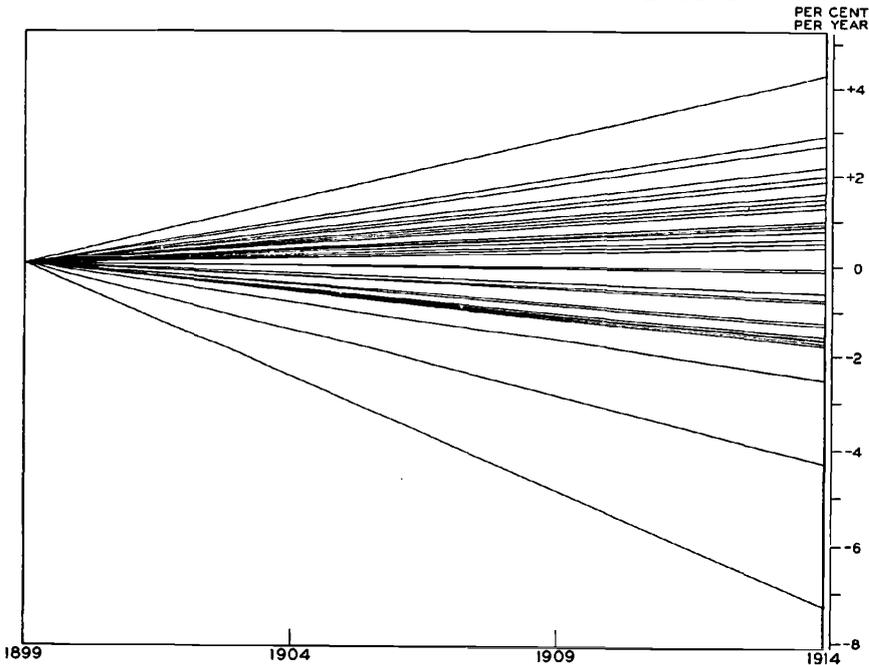
TABLE 47
CHANGES IN OVERHEAD COSTS PLUS PROFITS, MANUFACTURING INDUSTRIES OF THE
UNITED STATES, 1899-1914
 Index Numbers for 35 Industries, with Average Annual Rates of Change

Industry	Index numbers of overhead costs plus profits, per unit of product				Average annual rate of change 1899-1914 (per cent)
	1899	1904	1909	1914	
Slaughtering and meat packing.....	100.0	87.7	130.2	170.6	+4.3
Flour-mill and gristmill products.....	100.0	125.5	152.2	155.0	+2.9
Gloves and mittens, leather.....	100.0	104.9	150.0	139.8	+2.7
Turpentine and rosin.....	100.0	253.7	252.0	172.2	+2.2
Hats, fur-felt	100.0	137.2	140.8	141.3	+2.0
Hats, wool-felt	100.0	149.0	199.7	131.5	+1.9
Paint and varnish.....	100.0	99.8	107.9	126.0	+1.6
Silk goods	100.0	94.8	115.1	119.2	+1.5
Hosiery and knit goods	100.0	107.6	122.6	120.6	+1.4
Motorcycles, bicycles, and parts.....	100.0	37.4	81.7	102.2	+1.3
Butter, cheese, and condensed milk....	100.0	87.7	119.5	106.2	+1.0
Lumber and timber products.....	100.0	142.2	154.1	115.1	+0.9
Fertilizers	100.0	80.4	117.6	101.7	+0.9
Carpets and rugs, other than rag.....	100.0	88.4	123.1	101.6	+0.8
Sugar, beet	100.0	167.7	180.8	109.4	+0.6
Canning and preserving: fruits and vegetables; pickles, preserves, and sauces	100.0	103.8	97.2	110.6	+0.5
Petroleum, refining	100.0	144.6	103.1	121.5	+0.4
Cotton goods	100.0	79.1	116.7	86.5	-0.1
Musical instruments: pianos.....	100.0	110.2	93.8	103.7	-0.1
Woolen and worsted goods.....	100.0	101.9	114.0	85.6	-0.6
Ice, manufactured	100.0	100.7	100.8	87.2	-0.8
Musical instruments: organs.....	100.0	106.5	111.9	84.2	-0.8
Coke, not including gas-house coke....	100.0	109.4	85.9	87.4	-1.3
Paper and wood pulp.....	100.0	85.6	91.4	79.0	-1.3
Gas, manufactured, illuminating and heating	100.0	95.5	87.4	78.1	-1.6
Iron and steel: steel works and rolling mills	100.0	86.4	87.6	75.2	-1.7
Rice, polishing and cleaning.....	100.0	104.0	101.6	73.8	-1.7
Explosives	100.0	108.2	97.7	76.1	-1.7
Automobiles, including bodies and parts	100.0	98.2	112.8	66.7	-1.8
Salt	100.0	105.0	66.4	76.6	-2.5
Wood distillation, not including turpentine and rosin.....	100.0	73.9	68.4	49.4	-4.3
Iron and steel: blast furnaces.....	100.0	51.4	45.5	32.7	-7.3
Boots and shoes, other than rubber....	100.0	152.5	—	204.5	—
Cordage and twine.....	100.0	—	84.6	89.3	—
Jute and linen goods.....	100.0	—	109.0	58.5	—
Average ^a	100.0	94.3	113.5	98.6	+0.3

^a The average for each year is the arithmetic mean of the central items of a weighted frequency distribution, with weights based on overhead costs plus profits, averaged for the base year and the given year. The central one-fifth of the items, by weight, were included in computing the average.

FIGURE 26

ILLUSTRATING THE DIVERGENCE OF COST TRENDS AMONG
32 MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1899-1914*
AVERAGE RATES OF CHANGE IN OVERHEAD COSTS PLUS PROFITS PER UNIT OF PRODUCT



* Plotted on ratio scale. The lines here plotted relate to the industries listed in Table 47, in the order of that listing.

by factors common to all industries, while overhead costs plus profits are least affected by such factors. These varying degrees of divergence are clearly portrayed in Figures 25 and 26, and in similar charts previously presented.

ON THE RELATIVE IMPORTANCE OF DIFFERENT ELEMENTS OF COST AS FACTORS IN PRICE CHANGES, 1899-1914

The above index numbers reveal the changes occurring in the different elements of cost of manufacture, but they do not indicate the degree of importance of these elements, as factors in changing selling prices. We know that the average selling price per unit of manufactured goods increased 22.2 per cent between 1899 and 1914. In precisely what degree is this due to rising material costs,

in what degree to rising labor costs, and in what degree to increasing costs of overhead and management? ¹

The change in each of these elements, per unit of product, is indicated in the following summary:

Year	Selling price	Cost of materials	Labor costs	Overhead costs plus profits
1899	100.0	100.0	100.0	100.0
1914	122.2	131.0	110.2	101.3

To measure the relative influence of each of these cost factors on selling price, we must know the importance of each as a component of the total selling price. For the base year, ² we have the following figures:

Year	Elements of cost as decimal fractions of value of product:		
	Materials	Labor	Overhead costs plus profits
1899	.678	.140	.182

With these figures, and knowing the degree of change in each cost element between 1899 and 1914, we may readily determine the degree to which each contributed to the change in the selling price of the average product of manufacture between these terminal years. ³

We may summarize the results:

92.6 per cent of the gross change in the selling price per unit of manufactured goods between 1899 and 1914 is attributable to rising material costs.

¹ Profits, it has been explained, are included with overhead expenses in this last item, as the data available do not permit the separation of these two elements. Objection might be made to the above terminology on the ground that profits are not part of the costs of production, and should not be assumed to play an active part in price changes. In many cases, of course, the stimulus to changing prices is first felt in the markets for the final product, and the elements of selling price reflect in varying degrees the changes in the market price of the product. Terms which imply that changes in selling prices always originate in changing costs (profits being included in costs) are used for reasons of convenience, and for the sake of brevity of expression.

² Base year weights are used for convenience, though this usage involves the incorrect assumption that the relative physical contributions of the different productive agents did not change during the period. The error resulting from this assumption is small.

³ The advance of 22.2 per cent in the selling price of the product is the result

6.3 per cent of the gross change is attributable to rising labor costs.

1.1 per cent of the gross change is attributable to rising overhead costs (including profits).

Each of these figures should be compared with the corresponding item in the summary immediately above. Thus materials constituted 67.8 per cent of the total selling price, but accounted for 92.6 per cent of the change in price; labor costs made up 14.0 per cent of the total selling price, but accounted for only 6.3 per cent of the change; costs of ownership and management (overhead expenses plus profits) made up 18.2 per cent of the total selling price, and accounted for but 1.1 per cent of the price change.

The Activity Ratio

This last comparison may be facilitated by the use of what we may call an *activity ratio*, a ratio which serves as an index of the degree of activity of each element of cost, measured with reference to a standard of normal activity.¹ This is the ratio of the mea-

of an advance of 30.96 per cent in material costs, with weight of .678, an advance of 10.17 per cent in labor costs, with weight of .140, and an advance of 1.32 per cent in overhead costs plus profits, with weight of .182.

The detailed computations, upon which the measurements in the text are based, are given below.

Computation of influence of cost factors upon price change per unit of product, 1899-1914

Element of cost	Degree of change in cost (per cent)	Weight	Contribution to change in selling price	Percentage distribution of elements of gross change in selling price
Materials	+ 30.96	× .678 =	+ 20.99	92.6
Labor	+ 10.17	× .140 =	+ 1.42	6.3
Overhead costs plus profits	+ 1.32	× .182 =	+ 0.24	1.1
Total			22.65	100.0

The discrepancy between 22.65 and 22.2 is due to the presence of minor errors in the weights used and to the dropping of fractional values.

¹ The word 'activity' is here used without any implication as to the direction in which price-determining and cost-determining influences run. It is difficult to avoid a terminology which suggests that causal influences run from changes in costs to changes in selling prices. The present analysis does not bear on that problem, and such terminology is used for convenience only. If the cause and effect chain is assumed to run in the other direction, with changes in costs reflecting changes in selling prices, the above ratio may be thought of as a *sensitivity ratio*, an index of the sensitivity of elements of cost to changes in selling price. As regards certain of the elements in the item of 'overhead costs plus profits' this is certainly the proper view.

surement defining the actual importance of a given cost element in a given price change to the figure defining the importance of that element as a component of the total selling price. Thus, for the cost of materials, the *activity ratio* for the period 1899-1914 would be $92.6/67.8$ or 1.37. (This measurement relates, it should be noted, to the terminal years of the period, since no use is here made of intervening values.) In this case the ratio exceeds unity, indicating that changes in material costs exerted a greater influence upon changes in the selling prices of manufactured goods between 1899 and 1914 than was to have been expected in view of the proportionate importance of that factor in total costs.

Such a ratio offers a very convenient summary of the information defining the rôle of each cost element in selling price changes. The ratio is particularly useful in comparing data relating to different cost elements and different industries. It may be usefully interpreted in percentage form, as a measure of the proportion of the expected or 'normal' influence actually exerted by a given cost element upon a particular change in the selling price of the product.

Using the figures given in a preceding paragraph, we have the following ratios, relating to net changes in current dollars between the terminal years of the period 1899-1914:

Element of manufacturing cost	Activity ratio (current dollars)
Materials	$92.6/67.8 = 1.37$
Labor	$6.3/14.0 = .45$
Overhead costs plus profits.....	$1.1/18.2 = .06$

The contribution of overhead costs plus profits to the gross change in the average selling price of manufactured goods between 1899 and 1914 (or the degree to which that element reflected the change) amounted only to 6 per cent of what might have been expected, in view of the place occupied by that element in the total selling price. The influence of labor costs amounted to 45 per cent of expectancy. The influence of changes in material costs was 37 per cent greater than 'normal', as above defined.

In tracing the course of prices and costs among manufacturing industries we found it desirable to measure changes in terms of dollars of constant purchasing power, as well as in current dollars. We may now determine the relative importance of the different elements of manufacturing costs as factors in changes in the *real*

values of manufactured goods. The problem may be put in this form: Between 1899 and 1914 the average price of manufactured goods, per unit, in terms of dollars of constant purchasing power, declined 6.4 per cent. To what cost factors was this notable cheapening of manufactured goods due? This is an entirely different problem from that faced in the preceding section. There we sought to measure the influence of various cost factors in causing the prices of manufactured goods to depart from the level prevailing in 1899. We found that the costs of materials had played a leading part in this change. Now we seek to measure the influence of various cost factors in causing the prices of manufactured goods to deviate from the average of general prices, during the period 1899 to 1914. For it is such deviations from the general average which cause changes in purchasing power, or in real value.

Changes between 1899 and 1914 in selling price and in the chief elements of cost, per unit of manufactured goods, expressed in dollars of constant purchasing power, were as follows:

Year	Selling price	Cost of materials	Labor costs	Cost of management
1899	100.0	100.0	100.0	100.0
1914	93.6	100.4	84.4	77.7

Proceeding as before, we secure the following results:

- 4.0 per cent of the gross change in the per-unit purchasing power of manufactured goods between 1899 and 1914 is attributable to rising material costs (costs being expressed in dollars of constant purchasing power).¹
- 33.5 per cent of the gross change is attributable to declining labor costs.
- 62.5 per cent of the gross change is attributable to declining costs of management and overhead plus profits.

This is quite a different story from that which related to current dollars. Changes in material costs, which were responsible for 92.6 per cent of the change in actual prices of manufactured goods

¹ The influence of this element was positive, while that of the other two factors was negative. The base of the percentage figures which define the degree of influence of the several cost elements upon selling price is, of necessity, the numerical sum of the changes in the several elements (each factor properly weighted), this sum being taken without regard to sign. It is the *algebraic sum* of these changes which defines the actual movement of the price of the product, or the *net change*. The numerical sum measures the aggregate price-affecting changes among the several elements of cost, without reference to possible offsetting when the changes are in opposite directions. It is this aggregate, here

between 1899 and 1914, accounted for but 4.0 per cent of the change in purchasing power of manufactured goods, per unit. (The influence of material costs in this latter case was upward, moreover, while the other factors contributed to a decline in the real value of manufactured goods.) The explanation is found, of course, in the fact that material costs, which had departed farther than any other element of manufacturing costs from the absolute price level of 1899, deviated less than any other cost element from the 1914 level of wholesale prices. (If material costs had changed by exactly the same amount as had the general price level, no part of the change in the purchasing power of manufactured goods could be attributed to this factor.) Changes in costs of fabrication, including labor and overhead costs plus profits, were more potent in their effect on the real values of manufactured goods than upon current prices. These fabrication costs, making up but 32 per cent of total selling price, accounted for 96 per cent of the gross change and for all the reduction in the real per-unit value of the products of manufacture, as these are represented in our sample.

We summarize these figures in the form of *activity ratios*:

Element of manufacturing cost	Activity ratio (dollars of constant purchasing power)
Materials	4.0/67.8 = .06
Labor	33.5/14.0 = 2.39
Overhead costs plus profits.....	62.5/18.2 = 3.43

called the *gross change*, which is significant for the present purpose, and it is to this aggregate that the percentages and ratios relate.

The computations upon which the above results rest may make this point clearer.

Computation of influence of cost factors upon
price change per unit of product, 1899-1914

Element of cost	Degree of change in cost (per cent)	Weight	Contribution to change in selling price	Percentage distribution of elements of gross change in selling price
Materials	+ 0.38	× .678 =	+ 0.26	4.0
Labor	- 15.55	× .140 =	- 2.18	33.5
Overhead costs plus profits	- 22.34	× .182 =	- 4.07	62.5
Gross change (sum of items disregarding signs)			6.51	100.0
Net change (algebraic sum)			- 5.99	

The discrepancy between -5.99 and -6.4, the actual net change in selling price per unit, in dollars of constant purchasing power, is due to the presence of minor errors in the weights used and to the dropping of fractional values.

The reason for the reversal in the positions of these elements has been suggested. As a factor in changing real values material costs were relatively inactive, while labor and the residual element making up overhead costs and profits each exerted an influence out of proportion to its relative importance.¹

SUMMARY: PRICE AND COST MOVEMENTS IN MANUFACTURING INDUSTRIES, 1899-1914

The materials just reviewed have served, in the first place, to support the general findings of Chapter II concerning the relative cheapening of manufactured goods during the decade and more preceding the World War. Using measurements derived quite independently of those based upon direct price quotations, we have found clear evidence of a reduction in the real per-unit value of manufactured goods between 1899 and 1914.

Beyond this confirmation of previous results, we have employed measurements which permit some of the forces lying back of price changes to be examined, and their relative importance appraised. Changes in selling prices of manufactured goods have first been studied as the resultant of changes in material costs and in fabrication costs. Expressing changing values in terms of a constant monetary standard (i.e., in terms of dollars of constant purchasing power in wholesale markets) we have found that the per-unit worth of manufactured products declined, from 1899 to 1914, by 6.4 per cent. This was the net result of an advance of 0.4 per cent in the real cost of the materials entering into the average unit of finished product, and a decline of 19.8 per cent in the real cost of fabrication, per unit of product. In 1914, in other words, the services of the agents of fabrication in producing a unit of manufactured goods commanded 19.8 per cent less in terms of commodities in general than in 1899. The most conspicuous result of the improvements of manufacturing technique and of other changes

¹The reason for this is found, in part, in the characteristics of the U. S. Bureau of Labor Statistics' index of wholesale prices which was used in deflating the various price series. This index, in common with all other indexes of wholesale prices for this period, is heavily weighted with raw and semi-manufactured goods. (This is partly due to the difficulty of securing representative quotations on highly fabricated goods.) As a result, its movements accord most closely with those of the raw and partially fabricated goods which are used as materials of manufacture.

affecting manufacturing operations during the fifteen years preceding the war was this notable decline in fabrication costs.

We distinguish two elements of fabrication costs—payment for the services of wage-earners and a residual element representing overhead expenses, salaries and profits. Labor costs (still in terms of a commodity standard of value) declined approximately 16 per cent per unit of product between 1899 and 1914, while overhead costs plus profits declined 22 per cent. In some degree the substantial decline in labor costs reflects improved equipment, superior skill, better organization. In addition, however, the lagging adjustment of wages to the changes in values resulting from an advancing price level was a notable factor in this decline. Laborers in manufacturing plants barely maintained their standard of living during these years of rapid industrial expansion. A drop in real labor costs was a natural accompaniment of this movement.

The decline in overhead costs plus profits is doubtless due, in part, to the use of improved equipment and to the development of methods of mass production. Here, also, a lagging adjustment of certain fixed elements of cost to changing values of the dollar helped to reduce production costs. It is probably true, in addition, that profits per unit of product were substantially lower in 1914, a year of depression, than they were in 1899, when prosperity prevailed.

Taking account of the relative importance of each of the three cost elements in the aggregate of manufacturing costs, we have expressed in percentage terms the actual contribution of each of these elements to the gross change in the real per-unit value of manufactured goods between 1899 and 1914. Approximately 96 per cent of the gross change (the change being measured in terms of a commodity standard of value) was attributable to declining fabrication costs, plus profits, while only 4 per cent was attributable to changing material costs. (The influence of the change in fabrication costs was downward, while that of the change in material costs was upward. The former, of course, predominated.) Breaking the cost of fabrication into its two components, it appears that about 33 per cent of the gross change in selling price was attributable to declining labor costs, while 63 per cent was attributable to declining costs of management and overhead plus profits.¹

¹ The use of the phrase 'attributable to' must be qualified, since it does not follow that selling prices merely reflect, in a passive fashion, changes occurring in the elements cited. The causal sequence may run in the other direction.

The significance of these changes may be more accurately appraised when we have before us materials relating to other periods. Here, however, is a standard of reference, in the record of changes occurring in the various component elements of the selling prices of manufactured goods during the decade and a half of fairly stable growth that preceded the World War. These years saw no such violent changes as the next two decades were to bring. American economic powers pursued their 'manifest destiny' in comparative tranquillity. No cataclysmic price movements distorted business relations overnight. Slowly-acting secular forces dominated the course of events. It is for this reason, as much as any other, that later comparison with more disturbed epochs will engage our interest.