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Chapter VI

PRICES OF INPUT FACTORS AND COST BEHAVIOR

THE costs of an enterprise, it has been noted, are the result of the interplay of a large number of factors. For reasons of tractability, economic theory has singled out a few simple relations to depict the determination of costs. These determinants, for a functioning enterprise, are the rate of utilization, the prices of the factors of production, and their physical productivities. The influence of the first of these factors was discussed in the two preceding chapters with emphasis on the techniques that can be used in empirical studies in the endeavor to isolate the effects of variations in the rate of operations. The present chapter will deal with correlate issues arising from the role of factor prices in cost determination—in particular, the meaning and measurement of factor prices, the impact of their variation on costs in the several phases of the business cycle, and the methods and possibilities of empirical investigation in this field.

The general term "factor of production" implies no particular classification of the agents combined by business executives to produce goods and services. The familiar trinity of land, labor and capital is amenable to almost infinite subdivision, should such detailed designation be desired. For instance, labor may be subdivided according to various degrees of skill and occupation, and again into categories of specific operation; for the whole economy such a classification would be approximated by the occupational codes of the Employment Service.[1] No classification of

[1] United States Employment Service, *Dictionary of Occupational Titles*, Part I, "Definitions of Titles" (Washington, 1939).

factors can be entirely adequate for all purposes. Any attempt to determine the rewards to factors, in terms of receipts to individuals or classes of society, requires that the very closest attention be paid not only to the classification of factors but also to the translation of factor earnings into personal or group receipts. Such regroupings are beset with acute difficulties, as is readily apparent in the effort to identify the separate rewards of "factors" combined in the single person of an owner-farmer or classical entrepreneur. Of itself no classification of factors can go very far toward specifying individual or group returns. Here the interest in a classification of factors is concentrated solely upon the way in which fluctuations in their "prices" affect the costs of an enterprise. To this end it will be useful to adopt the following categories: (a) wage earners; (b) raw materials, purchased parts and supplies, containers, fuel and freight services; and (c) all other factors, including executive direction, plant and equipment. The present chapter will be concerned with the first two of these groups; the most important aspects of the third were treated in Chapter IV.[2]

Although it might be supposed that the influence of factor prices on costs would be entirely simple and direct, the sections to follow will show that customary measures of "factor prices" are influenced materially by considerations other than "price." Since the elimination of the effects of factor price variations is a major step preliminary to the measurement of the short run cost function, the inadequacies of customary measures of "factor prices" for these purposes require detailed attention. For if costs are deflated by factor price indexes that reflect considerations other than the "price" of these factors, not only will errors be introduced into the cost function, but a disproportionate share of cost variations will be attributed to factor prices. Some methods of deflation, analogously, may underestimate the influence of factor price variation. In the discussion below, the techniques of deflating costs for factor price

[2] No separate treatment of tax costs is included in this volume.

variations will be treated in brief, since they present few fundamental problems; major emphasis will be devoted to the meaning and measurement of "labor and materials" prices.

1. *The Measurement of Factor Prices*

It was noted in Chapter III that a contract of sale for goods or services typically contains a great many terms, some directly affecting the amount of money (or the current value of the credit instrument) exchanged between buyer and seller, and a large number with no direct influence upon the pecuniary terms of the contract. Terms of the first type were designated as the "dimensions" of a price structure. It is extremely important to recognize these complexities in the terms of sale, particularly as applied to the "price" of "labor and materials," if one is to appraise and interpret the customary measures of these "prices." A common practice, for instance, is to accept average hourly earnings as a measure of the "price" of labor, and indexes of these earnings as adequate gauges of the variation in this price.

The complexities in the terms of sale of labor will be apparent from a brief examination of a relatively simple and well-known trade union agreement, that between the Packard Motor Car Company and Local 190 of the United Automobile Workers of America, effective September 30, 1939.[3] It contains twelve articles and fifty-four sections, all of which could be construed either as part of the "price" of labor or an influence upon it resulting from the bargaining preliminary to the drafting of "price" and "nonprice" sections of the contract. The terms of the agreement readily identifiable as dimensions of price are those covering overtime rates by day and week, Sunday and holiday rates, minimum rates for new employees, students, apprentices or

[3] A copy of this agreement is included as Appendix A in William Heston McPherson, *Labor Relations in the Automobile Industry* (Brookings Institution, 1940), pp. 161-67.

improvers, afternoon or night shift rates; the speed of production;[4] the minimum hours of work possible in a day if a wage earner is required to report for work; and the status of demoted foremen. Other provisions of the agreement describe the form and character of union recognition, the procedure for the handling of grievances, the seniority of union representatives, and in great detail the provisions affecting discharges, transfers and layoffs. This last group of provisions may influence very materially the earnings of any wage earner or group of the working force, and indirectly may even affect future "wage rates" by reflecting the bargaining strength of the union. Nevertheless these provisions have been designated as nonpecuniary, because in general they do not directly condition the size of wage payments to the total group of employees. Such "nonprice" terms of the contract provide the institutional and "legal" framework for the employee-corporation relationship. In many instances, however, it is impossible to make a neat and clear-cut division between the "price" and other terms of an agreement.[5]

With so many dimensions to the wage structure, it is evident that indexes of basic wage rates can be valid only if variations in the base rate are not accompanied by other changes in the wage structure. Overtime rates and Sunday rates, for instance, must be presumed to remain "reasonably" fixed while the base rate is varied. But trade unions and even unorganized wage earners are usually more concerned with maintaining the basic rate than with other terms of the wage structure. Concessions made in the latter respect are probably easier to regain and more easily "sold" to the membership. The basic rate stands as a symbol of the strength and achievements of the union; furthermore, changes in terms other than the base rate can be more easily

[4] Important in this connection for wage earners on piece rates. Perhaps one third of the wage earners in the industry are on piece rates in spite of recent shifts back to hourly rates. *Ibid.*, pp. 94-97.

[5] This is especially true in the case of more complex agreements. For a compendium of clauses from trade union agreements, see Elias Lieberman, *The Collective Labor Agreement* (Harper and Brothers, 1939).

restricted in their effects on earnings. Overtime, for instance, cannot be reduced below straight time. Business executives follow precisely similar policies when special discounts and concessions are granted more readily than revision of the basic list prices. It is little wonder, therefore, that indexes of wage rates are not generally available for the United States[6] and that there has developed a tendency to designate average hourly earnings as the "price" of labor.

Average hourly earnings data are cited almost invariably in discussions of the "price" of labor or wage rates, if for no other reason than that they are easily obtained. Variations in these earnings cannot, however, be interpreted correctly unless the types of influence which can independently induce changes in average hourly earnings are clearly recognized. These channels of impact, equally applicable for any grouping of wage earners, may be summarized conveniently under four headings. (1) Changes in the basic wage rate or any other dimension in the wage structure, such as overtime rates, shift rates, or minimum guarantees. (2) Variations in the number of hours of work performed at each wage rate, or other dimensions to the wage structure. Changes in the relative distribution of wage earners among "rates" may be illustrated by a change in the proportion of women workers or apprentices at lower rates, a change in the proportion of overtime, and a change in the proportion of wage earners at starting rates within each occupation. Some of these changes may be correlated with fluctuations in the rate of output in the firm or the entire system. (3) Changes in technique and organization of the plant or other factors that result in a change in rate of output by piece-rate workers. At a given structure of wage rates changes in the rate of output may be brought about by coordination of different operations, the wage earners'

[6] In the construction of indexes of wage rates for England inadequate attention has as a rule been paid to these problems. There can be little doubt that discussions of wage-rate flexibility have underestimated the significance of other terms of agreement than the basic rate.

own intensity of effort, and the technical qualities of the machine and material with which they work. (4) The period of time *itself* over which average hourly earnings are calculated. This will affect the results of any of the above three factors independently. Perhaps the point can be stated more accurately by reference to the way in which payments are made on such accrued items as vacations with pay, profit sharing, and pensions. If payrolls per year or wage income over the lifetime of a worker were divided by hours worked, average hourly earnings would reflect these items. But since most averages are calculated over the payroll period (usually one or two weeks), they may not be affected by variations in these items.[7] With the spread of paid vacations and pension plans for wage earners in recent years, this limitation has become increasingly serious. Thus the variations in important terms in the wage rate structure will affect average hourly earnings according to the period over which earnings and hours worked are matched.

To identify average hourly earnings and wage rates (or variations in the two) is thus likely to give rise to serious error unless there is reason to believe that the other factors which could affect average hourly earnings are "virtually"[8] inoperative. The central argument of the following quotation is not relevant to the present discussion, but it does provide an instance of the confusion that results from unqualified comparison of wage rates and average hourly earnings:[9]

[7] Where employees nominally on vacation continue to work, the Bureau of Labor Statistics does not allow the vacation pay to influence average hourly earnings although average weekly earnings do reflect the vacation wages.

[8] Relative to the problem at hand.

[9] That the difference between the movement of average hourly earnings and wage rates for Great Britain during this period may have been appreciable is indicated by the fact that after correcting for some of the differences between these series, Professor A. L. Bowley reported an index of wage-rate variation for the period 1930–36 of 191 to 197 instead of the uncorrected 191 to 190 (1914 = 100). *Wages and Income in the United Kingdom since 1860* (Cambridge University Press, 1937), pp. 18 and 30, Appendix B.

> Between 1929 and 1938 the average hourly earnings of American workers (according to the figures of the National Industrial Conference Board) increased by 23 percent. . . . To place two figures in juxtaposition is not to prove that the one is the cause of the other. But it is at least suggestive that, while wage rates in Great Britain rose over the same period by less than a third of the American increase, British payrolls . . . increased by 20 percent.[10]

Six studies by the Bureau of Labor Statistics of particular firms in the agricultural implement, cotton textile, boot and shoe, and paper industries provide some information on the relative magnitudes of the movements of wage rates and average hourly earnings.[11] As in all indexes of wage rates, the term was used to refer only to changes in the base rate; other dimensions of the wage structure were assumed to be constant. The comparisons are, therefore, strictly between changes in average hourly earnings and variations in the base rate. The comparative variations over the period of observation (1930–37) and in the phases of the business cycle are summarized in Table 3 for different plants of the same firm in the agricultural implement industry. The data show wide discrepancies in the relative variations in "rates" and earnings.

Data for a firm in the paper industry are presented in Table 4 by months for the period 1936–38 inclusive. Average hourly earnings and an index of the number of employees are divided into five periods during which "wage rates" were constant. The rates were increased 10 percent in December 1936, 5 percent more in August 1937, and decreased 7 percent in September 1938. It is clear from an analysis of the data in Table 4 that there is an inverse correlation between average hourly earnings and the total

[10] "Laggard Recovery in America," *The Economist*, CXXXVI (July 1, 1939), p. 3. This quotation was reprinted and endorsed editorially by the New York *Times*. Also see, Waldo E. Fisher, "Union Wage-Hour Policies and Employment," *American Economic Review*, XXX (June 1940), pp. 298-99.

[11] Temporary National Economic Committee, *Monograph No. 5* (Washington, 1940).

number of employees, explained in part by the policies of the company. New employees, or old employees transferred to other jobs, were started at the beginning rate for the particular job. These rates were automatically increased by 2 cents an hour every three months until the full rate for the job was reached. This process took nine months on

TABLE 3

RELATIVE MOVEMENTS OF "WAGE RATES" AND AVERAGE HOURLY EARNINGS IN TEN PLANTS OF AN AGRICULTURAL IMPLEMENT COMPANY[a]

Plant	*Percent Change 1930–33*		*Percent Change 1933–37*		*Percent Change 1930–37*	
	Wage Rates	Average Hourly Earnings	Wage Rates	Average Hourly Earnings	Wage Rates	Average Hourly Earnings
1	−18.1	−15.9	+48.4	+50.3	+21.5	+26.4
2	−18.1	−19.2	+41.3	+47.5	+15.7	+19.2
3	−18.1	−13.3	+43.8	+72.3	+17.8	+49.4
4	−18.1	−13.5	+42.6	+52.6	+16.8	+32.0
5	−18.1	−18.2	+48.4	+68.6	+21.5	+37.9
6	−15.6	−20.8	+50.8	+77.8	+27.0	+40.8
7	−18.1	−16.5	+40.9	+52.2	+22.0	+27.1
8	−18.1	−25.6	+53.0	+61.3	+25.3	+20.0
9	−18.1	−11.9	+46.8	+43.4	+20.2	+26.3
10	−18.1	−19.3	+40.7	+57.9	+15.2	+27.4
11	−15.8	−12.1	+51.3	+68.3	+27.4	+47.9
12	−18.1	−23.6	+46.5	+68.1	+20.0	+28.4

[a] Temporary National Economic Committee, *Monograph No. 5*, pp. 107–14.

the lower paid jobs and as long as eighteen months for highly paid work. While the study found a relatively close covariation of "rates" and earnings, this tendency was modified by changes in the volume of employment and, to a lesser extent, by changes in the ratio of female employees to the total working force.

In the cotton textile study there was almost perfect correspondence in the variations of "rates" and average hourly earnings, whereas in the boot and shoe firms the divergences were relatively small. The firms in the four industries present a heterogeneous picture; at one extreme the

TABLE 4

EMPLOYMENT AND EARNINGS IN A PAPER MANUFACTURING COMPANY[a]

Year and Period Number		Index of Total Number of Employees 1936 Average = 100	Average Hourly Rate (cents)
1936	1	88	57.6
	2	94	57.0
	3	102	55.5
	4	107	55.4
	5	109	55.5
	6	101	56.2
	7	96	57.2
	8	95	57.4
	9	95	57.1
	10	100	57.2
	11	105	57.3
	12	110	55.6
First group average for twelve periods		100	56.42
1937	1	112	59.9
	2	115	59.5
	3	116	59.8
	4	117	59.5
	5	117	59.9
	6	117	60.1
	7	116	60.4
	8	116	60.4
Second group average for eight periods		116	59.93
1937	9	116	63.2
	10	116	63.1
	11	116	63.3
	12	115	63.9
	13	113	64.4
Third group average for five periods		115	63.54
1938	1	111	64.2
	2	111	64.4
	3	111	64.4
	4	110	64.9
	5	109	65.0
	6	107	64.7
	7	107	64.5
	8	105	64.8
	9	104	64.8
Fourth group average for nine periods		108	64.64
1938	10	104	60.3
	11	106	60.1
	12	107	60.0
	13	132	60.1
Fifth group average for four periods		112	60.10

[a] Temporary National Economic Committee, *Monograph No. 5*, p. 32.

agricultural implement firm showed marked deviations in many instances, while the cotton textile firm, at the other extreme, showed none. Although it is impossible to generalize as to the representativeness of these cases in industry as a whole, they do suggest that without special information it is unjustifiable to presume equivalence in movement of "rates" and earnings.

The preceding discussion has been focused on wage structures as the price of the services of wage earners, but correlate points can be made also for raw materials, purchased parts and supplies, fuel and freight services—that is, for the second group of "factors" classified above (p. 117). (a) The "price" of these items is composed of a number of terms or dimensions. (b) Indexes of these "price structures" are almost always confined to list prices;[12] as measures of changes in "what the buyer pays or seller receives" they are as inadequate as average hourly earnings are with reference to wage rates.

Finally, it is important to recognize that certain types of expenditures which are a part of wage costs are not usually considered a component of the wage structure. Except for these items the total labor costs of a firm would equal the total wage and salary payments. They correspond to freight and sales taxes, noted in Chapter II as considerations which make the receipts of the seller unequal to the amount paid by the buyer. Connected with the purchase of labor services are payroll taxes and social services that may be required by law in addition to all expenses incurred in behalf of wage earners, such as uniforms, medical care and all types of welfare expense.

2. *The Influence of the Individual Enterprise on Factor Prices*

The evidence just examined leads to the conclusion that, at least under some important conditions, the customary

[12] For a more detailed discussion of these problems, see Chapter III, above.

measures of factor prices may prove inadequate for appraisal of the effect on costs of changes in these prices. Accepted measures of factor prices, such as average hourly earnings, may be influenced substantially by considerations other than price. The present brief section discusses three ways in which the individual enterprise may affect factor prices.[18] Sections 3 and 4 are concerned with a more explicit description of the influence of factor price changes upon costs. Section 4 examines particular instances of cost variation and indicates some of the problems that arise when one attempts to specify the extent to which the influence of factor prices can be isolated. Section 5 continues the same discussion with particular reference to the cyclical setting.

The ways in which a single enterprise may affect the price it pays for factors are summarized *seriatim.* (1) From the standpoint of the enterprise, the elasticity of demand for the factors it employs depends in part on their relative importance in total costs. The larger one factor's share of total costs the greater is the resistance to a rise in its price —in other words, the more elastic the demand. But the proportion of labor to materials costs obviously depends on the scope of the activities of the firm, or the degree of vertical integration. If the whole economy were completely integrated into a single corporation, the proportion of labor to total costs in that "enterprise" would equal the proportion of labor to total income. At the other extreme, with almost infinite subdivision of the productive process between firms, labor costs would be a very small part of the costs of any enterprise. The more frequently the productive process is cut by the limits of individual firms, the smaller the proportion of labor to materials costs. Vertical integration in industry necessarily operates in the opposite direction. It is evident, therefore, that the degree and character of the existing industrial organization and structure are important

[18] Any attention to the ways in which an individual enterprise can influence factor prices presumes market conditions which are not those of pure competition.

considerations which affect the pricing of factors for particular enterprises by influencing the elasticity of their demand.[14]

(2) An enterprise may influence the "price" it pays for factors by a process of bargaining among the "price" and "nonprice" terms of a sales contract; greater possibilities for such substitution probably exist in connection with the labor contract. A concession dealing with the kind of union recognition or seniority status of wage earners may be traded for a wage change. This kind of substitution is apt to be of greater importance in periods when unionization is expanding rapidly. In many instances wages have been increased simply to prevent the expansion of a trade union; such moves are more properly regarded as means of purchasing a preferred kind of industrial relationship than simply as payment for services. There can be little doubt that a concern's wage structure is not independent of its other policies. The American Federation of Hosiery Workers, for instance, accepted wage reductions on the condition that the funds be used to modernize the plants and purchase new machinery. Other wage earners have accepted a yearly guaranteed volume of employment in lieu of a change in the wage structure.[15] In a certain sense the welfare emphasis of many personnel departments in the

[14] In an economic system with considerable division of the productive process at different "stages" among firms, the pricing policies pursued by individual companies are of crucial significance because of the large proportion of total costs (of a single enterprise) represented by "materials." In a less divided productive process, wage policies would play a still more vital role.

The importance of this fact for interpretations of the policies of enterprises or trade unions has ordinarily not been given sufficient recognition. It would be worth while to explore the thesis that large *integrated* corporations have been opposed to union organization at least in part because a rise in wage rates among all employees makes a much larger proportionate increase in total costs than it would for a less integrated company.

[15] Wage changes of this character have been frequently urged for the building trades. See Thurman Arnold, "Agreement Between Labor Union and Employer to Establish Weekly Wages in Place of Daily or Hourly Wage Rates," Public statement (October 2, 1940).

1920's can be held to have affected the price of labor by substituting recreational and social facilities. The complicated and detailed specifications of a trade union agreement offer innumerable openings for substitution between "wage structure" and other terms of the contract, and similar opportunities arise for changes in the price structure of purchased parts or materials. Bargaining may be applied as between elements of the price structure and such other terms of sale as dates of delivery and penalties for cancellation of orders.

(3) A third way in which a single enterprise may influence the price of the factors it purchases—in addition to varying its degree of vertical integration and effecting a substitution among items in the price structure and other terms of sale—is through the impact of fluctuations in its output. If the firm is a sufficiently important purchaser in the market, an increase in its orders may induce a price rise in the whole "market" or a decrease result in a price reduction. And if business executives recognize the possibility that a rise in their output may increase price, and there is no reason why they should not, they may take steps to prevent such a development. For instance, the automobile industry is alleged to have attracted a large force of wage earners to Detroit not only to insure a labor supply for peak periods but also to forestall a demand for wage increases that might arise if there were no unemployment. An agricultural implement company was influenced in its choice of a new plant location by consideration of the probable effect on wage levels of additional workers in a certain city. In "markets" where a few large buyers purchase from a number of relatively small suppliers, such induced price changes may be minimized by the threat of ruptured relations. Prices may be relatively stabilized in such circumstances as a result of a very long view—the buyer desiring a continuous source of supplies and the seller confronted with the total loss of sales in the event of a refusal on the part of the buyer. Changes in factor prices induced by variations in the output of a single firm are

probably not as important as might be supposed, primarily because the possibility of such changes is anticipated by business executives, who take steps to prevent their occurrence or to minimize their extent.

3. *The Modus Operandi of Factor Price Variations*

This section is intended to trace the impact of changes in the price structure of factors on the costs of firms, regardless of the influence of a particular enterprise in inducing the variation. In general terms, this is a simple matter; the costs of a particular factor vary directly and proportionately with changes in factor prices, in the absence of induced or concomitant influences. If the prices of all factors are doubled, the costs to an enterprise double. If the price structure of a single factor is doubled, the cost of the factor will double only if there is no induced substitution between the resource and all others.

It must be made clear that substitution refers to the interchange of amounts of one factor in the productive process of a firm for amounts of another at a given state of knowledge and level of output. It does not cover cases of new techniques or changes in "the state of the arts."[16] For instance, a change in the price of mechanical loading equipment for bituminous coal relative to wage rates of loaders, brought about by an increase in loaders' rates, probably extended the use of the mechanical process.[17] This "substitution" is to be distinguished from the original introduction of the machinery or from any changes in its efficiency or technical effectiveness. The term substitution will always refer here to a change in a combination of factors of given effectiveness. If the change in the efficiency of one factor leads to its wider use and consequently a lowering of its price, the increased employment of this factor is made

[16] Problems associated with the meaning and measurement of technical change are treated in Chapter VII.

[17] Waldo E. Fisher, *Economic Consequences of the Seven-Hour Day and Wage Changes in the Bituminous Coal Industry* (University of Pennsylvania Press, 1939), pp. 67-75.

up of two logically distinguishable elements—the substitution arising from a change in relative prices of the factors and a technical change which increases the productivity of the factor.

In the framework of economic theory, the only situation leading to a change in the way in which factors of given productivity are employed would be a change in relative prices. From the standpoint of simple description of business practice, it is of course true that substitutions are made for many other reasons. For example, a manager in the automobile industry has been quoted as saying he had introduced machinery wherever possible because "machines don't strike." [18] Business executives may regard a particular arrangement as more convenient, or as necessary because of health standards enforced by law or agreement.

The substitution of one factor for another is certain to alter the composition, and most probably the level, of costs. The proportion of costs that are "materials" or "labor" or "overhead" will change according to the direction of the substitution. In the case of a classification of factors that is more than twofold, it is especially important not to draw inferences from a substitution between any two factors as to the net effect of the substitution on the amount of the factors employed. If, for instance, the threefold classification suggested at the start of this chapter were adopted, "overhead" might be substituted for "labor," but the total effect on the quantity of labor employed would depend also on the relative substitution between "materials" and "labor," and "materials" and "overhead." [19] Similarly the effects on relative costs will depend on all substitutes, rather than on the initial two alone. The purchase of such factors as machines, which are expected to last over several periods, results in a larger outlay in the current period and perhaps even in a greater total cost after the problem of allocation over time has been decided.

[18] William Heston McPherson, *op. cit.*, p. 147.

[19] The solution depends on the relative elasticities of demand compared to the elasticities of substitution.

If an attempt were made to observe historically the relative movements of a factor price and its cost to an enterprise, the above discussion of substitution would suggest that correspondence in variation should not be expected. Studies by the Bureau of Labor Statistics of wages, costs and prices in four industries (pp. 122-25 above) were directed toward these comparative movements. The results for the firm in the agricultural implement industry are shown in Table 5, with marked differences in the relative variations of labor costs and wage rates.

For a firm in the paper industry, neither direct nor in-

TABLE 5

CHANGES IN WAGE RATES AND LABOR COSTS IN AN AGRICULTURAL IMPLEMENT FIRM, 1929–37[a]

Implements	*Wage Rates*[b]	*Labor Costs*
	(Percent)	
Group I[c]		
Spring tooth harrow	+15.7	+18.7
Cultivator	+15.7	+20.1
Tractor plow	+17.8	−3.7
Grain binder	+22.0	+13.2
Corn binder	+22.0	+20.0
Side delivery rake and tedder	+20.2	+20.5
Disk harrow	+20.2	+6.5
Group II[c]		
Mower	+22.0	+24.9
Manure spreader	+22.0	+20.1
Tractor	+21.5	−15.2
Cream separator	+25.3	+47.7
Grain drill	+15.2	+5.2

[a] Temporary National Economic Committee, *Monograph No. 5*, Table 15, p. 119.

[b] Wage rate figures are for 1930 rather than 1929, but probably this is not important as there were no major changes in rates during the year. They refer to the wage rates paid to all employees of the plant in which the implement is made, rather than to the wage rates of employees working only on the implement. Since the wage rate changes were all plant-wide, this fact should not affect the comparisons made.

[c] The design of implements in Group I was not changed appreciably between 1929 and 1937; that of implements in Group II was changed.

direct labor costs advanced as much as wage rates over the period as a whole. As a result of the two increases, wage rates were approximately 19 percent higher in 1938 than they had been in 1936. Direct labor costs (per ton of product) were only 6.4 percent higher, and indirect labor costs 14.5 percent higher. Had the volume of production been as great in 1938 as in 1936, it is probable that indirect labor costs per ton would have been even lower in the latter year. The boot and shoe firms also indicated some divergence in relative movements, although not of such magnitude. The cotton textile firm alone showed almost complete equality in the variation of wage rates and labor costs.

These studies are of limited value, since it is impossible to ascertain from them whether the divergences are to be attributed to different rates of output, substitution of other factors for labor with the increases in wage rates, or "technical change." [20] Even acceptance of the linearity of each element of the cost function leaves a choice between the relative roles of the last two factors. The discussion of technical change in Chapter VII will return to this problem.

4. *Cyclical Setting*

The comparative movements of factor prices and costs are particularly significant when placed in the context of cyclical fluctuations. Not only have costs been a very important element in many "explanations" of price inflexibility, but factor prices have been specified as the determinant of costs which has the greatest bearing upon the

[20] The policy of inventory valuation will also certainly affect the costs in an accounting period for those factors which are carried over from one period to another. For instance, the choice of the lower-of-cost-or-market principle of valuation in periods of rising prices will "understate" costs compared to other methods and "overstate" them in a period of falling prices. George O. May, *Twenty-Five Years of Accounting Responsibility, 1911–1936,* Vol. I, pp. 86-88. See also *The New York Certified Public Accountant,* Vol. X, No. 5 (February 1940), Henry B. Arthur, "Inventory Profits in the Business Cycle," *American Economic Review,* XXVIII (March 1938), pp. 27-40, and Carl Thomas Devine, *Inventory Valuation and Periodic Income* (Ronald Press, 1942).

cyclical variation of costs.[21] In keeping with the focus of this chapter, the present concern is only with prices and costs of labor and materials. Two types of empirical studies are relevant in this connection: (a) case studies of individual firms, and (b) inquiries covering whole industries or the total system.

(a) The comparative movements of wage rates and average hourly earnings in the course of the cycle are influenced primarily by the changing composition of the work force in an establishment and the amount of overtime payments. In general, hourly earnings may increase more than "rates" on the upswing due to overtime, changes in technique favorably affecting the earnings of piece workers, etc. This tendency, normally expected to be dominant, might be counterbalanced by offsetting changes in the composition of the working force with expanding production and with many workers at starting rates. On the downswing, average hourly earnings may lag. With seniority provisions and discharge of the lower paid in each occupational group (most recent additions to employment), average hourly earnings could be expected even to rise for a period. Such an initial rise of average hourly earnings at the downturn has mistakenly been interpreted as an instance of reverse wage flexibility. When the boom has been associated with a great deal of overtime, average hourly earnings may well decline before reductions in rates. These expectations as to the cyclical pattern of earnings and "rates" are confirmed by Table 6 for a sample of six plants from the firm in the agricultural implement industry for the period 1930–37. The other studies in this group undertaken by the Bureau of Labor Statistics, although covering shorter periods, indicate similar patterns of less intensity.

The cyclical pattern of wage costs and "rates" for the same firm in the agricultural implement industry is shown

[21] See, for instance, Rufus S. Tucker, "Reasons for Price Rigidity," *American Economic Review*, XXVIII (March 1938), p. 51. For further discussion: Alfred C. Neal, *Industrial Concentration and Price Flexibility*, (American Council on Public Affairs, 1942).

in Table 7 for the years 1929–33 and 1933–37. While wage costs per implement fell less than the decline in wage rates, they also rose much less than the increase in wage rates in the upswing period. This disparity must suggest that factors other than the variation in wage structures influenced

TABLE 6

WAGE RATES AND HOURLY EARNINGS IN AN AGRICULTURAL IMPLEMENT FIRM, 1930–37[a]

1930 = 100

Year	*Wage Rates*[b]	*Average Hourly Earnings*	*Wage Rates*	*Average Hourly Earnings*	*Wage Rates*	*Average Hourly Earnings*
	Plant 1		*Plant 2*		*Plant 3*	
1930	100.0	100.0	100.0	100.0	100.0	100.0
1931	97.5	101.6	97.5	100.9	97.5	102.1
1932	82.9	89.6	82.9	86.4	82.9	89.2
1933	81.9	84.1	81.0	80.8	81.9	86.7
1934	97.3	99.0	96.3	94.2	96.3	102.3
1935	106.1	109.6	97.0	98.6	97.0	112.5
1936	108.6	111.0	104.4	105.2	104.5	124.3
1937	121.5	126.4	115.7	119.2	117.8	149.4
	Plant 4		*Plant 5*		*Plant 6*	
1930	100.0	100.0	100.0	100.0	100.0	100.0
1931	97.5	102.9	97.5	102.8	97.5	98.9
1932	82.9	89.0	82.9	89.5	82.9	86.3
1933	81.9	86.5	81.9	81.8	84.2	79.2
1934	96.3	99.8	96.3	96.1	109.5	107.5
1935	97.0	105.5	105.0	108.9	113.3	117.3
1936	104.4	113.5	108.6	116.2	114.0	117.2
1937	116.8	132.0	121.5	137.9	127.0	140.8

[a] Temporary National Economic Committee, *Monograph No. 5*, p. 114.
[b] Weighted average for each year of percentages of 1930 wage rates.

labor costs during these years. From the framework of economic analysis only three possibilities present themselves —"technical change," substitution both as between other factors and labor and among different types of labor, and variations in the rate of plant utilization. No effort was made in these studies to allocate statistically the divergences in move-

ment between wage rates and costs among these three factors. It must be noted, however, that the relative variations on the upswing are consistent with "technical change" and/or substitution (of a magnitude to offset any increase in cost from an increase in output) only if the traditional shape of the cost function is still accepted. If the statistical findings in Chapter V are generalized, then only substitution and "technical change" can be consistent with the observed results, unless the marginal cost function is assumed to slope downward throughout the observed range of output variation.

The observed covariation between wage costs and "rates" during the downswing period (Table 7) presents a more difficult problem. At first sight they would appear to

TABLE 7

CHANGES IN WAGE RATES AND UNIT LABOR COSTS IN AN AGRICULTURAL IMPLEMENT FIRM, 1929–33 and 1933–37[a]

Implements	*1929–33*		*1933–37*	
	Wage Rates[a]	Labor Costs	Wage Rates	Labor Costs
	(Percent)			
Group I[a]				
Spring tooth harrow	−18.1	−13.9	+41.3	+37.9
Cultivator	−18.1	−15.0	+41.3	+41.2
Tractor plow	−18.1	−23.5	+43.8	+25.8
Grain binder	−18.1	−12.6	+49.0	+29.6
Corn binder	−18.1	−11.8	+49.0	+35.9
Farmall tractor	−18.1	..	+48.4	..
Side delivery rake and tedder	−18.1	−5.8	+46.8	+27.9
Disk harrow	−18.1	−10.9	+46.8	+19.6
Group II[a]				
Mower	−18.1	−6.9	+49.0	+34.2
Manure spreader	−18.1	−17.9	+49.0	+46.1
Hammer mill	..	..	+49.0	+6.3
Cream separator	−18.1	−0.7	+53.0	+48.7
Grain drill	−18.1	−7.4	+40.7	+13.6

[a] See notes to Table 5.

be consistent only with the conventional notion of the shape of the cost function. But the year-to-year data reveal the same relationship throughout the whole downswing period. Studies of entire industries or the total system show very different patterns with the possible exception of the automobile industry. If it is true for even the initial period of contraction of output, the marginal cost function would have to be presumed to slope downward throughout its whole range if it is to be used as the only explanation of the observations. Since "technical change" is usually regarded as "irreversible," "substitution" provides the only other formal explanation for the data in Table 7. From a study of the policies of the company, several circumstances combined to bring about the observed result: (1) The wage earners with longest service and highest earnings were kept on, thus tending to raise average labor costs per unit of product at the start of the downswing. (2) At low levels of output skeleton forces were maintained without full work on current output. Repairs and changes in plant, which could not be measured in the units of work they performed, were undertaken. (3) Certain types of substitution took place as tasks that would have been performed by machine for larger lots were done by hand. These considerations do not easily fit the theoretical determinants of cost, but they might be classified under substitution and the shape of the cost function, particularly at exceptionally low levels of output. The relative movements of wage costs and "rates" probably do not present as uniform a picture in individual firms on the downswing as on the upswing. The comparative variations depend on the absolute volume of output at the peak relative to plant capacity, the employment and seniority policy of the enterprise, and the extent of substitution and "technical change." The larger the initial output and the more important the latter factors, the more certain it is that costs will decline more sharply than "rates."

(b) Several studies have attempted to indicate the comparative variations of labor costs and "rates" for industries as a whole or for the total system by utilizing generally

available indexes of payrolls and production. Since payrolls divided by production should yield labor costs per unit of production, indexes of these series should show the variation in labor costs. A study published by the Brookings Institution gives the comparative movements for "unit wage costs" and average hourly earnings in manufacturing industries (Table 8).[22] The study includes similar figures for mining, steam railroads, construction, and the following separate manufacturing industries: automobiles, iron and

TABLE 8

WAGE COSTS AND AVERAGE HOURLY EARNINGS IN MANUFACTURING INDUSTRIES, 1929–38

Year	*Average Hourly Earnings, in Cents*	*Unit Wage Costs, 1923–25 = 100*
1929	57.2	86.4
1930	56.5	83.0
1931	52.7	73.4
1932	46.5	65.8
1933	46.0	63.0
1934	54.8	74.6
1935	56.8	73.6
1936	57.5	71.5
1937	64.3	82.5
1938	64.6	82.5

steel, paper and allied products, cotton textiles, and tobacco. While each industry showed distinctive characteristics, the general pattern brought out in Table 8 is typical of the

[22] Spurgeon Bell, *Productivity, Wages, and National Income* (Brookings Institution, 1940), pp. 234 and 270. The Brookings study covers the period 1919–38. See the discussion of Mordecai Ezekiel, "Productivity, Wage Rates, and Employment," *American Economic Review*, XXX (September 1940), pp. 507–23. Similar calculations for the total of manufacturing industries have been made by the National Industrial Conference Board, "Manufacturing Relations: Prices, Production, Wages, and Employment, 1929–39," *Conference Board Graphic Business Trends* (October 1939), Chart 9. See also U. S. Department of Labor, *Productivity and Unit Labor Cost in Selected Manufacturing Industries, 1919–1940* (Washington, 1942), p. 1.

group.[23] It is interesting to note also that these patterns of relation between labor costs and average hourly earnings are similar to those indicated by the agricultural implement case study of the Bureau of Labor Statistics except, as noted, on the downswing.

If wage costs consistently decline more than "wage rates" or average hourly earnings on the downswing of the cycle, the accepted notion of the cost function may be used to explain the initial fall in costs, but would apparently be inapplicable at the very lowest levels of output. The persistent tendency of the industry studies to show larger falls in costs than in wage rates, particularly at the very bottom of a depression, would be consistent with the overwhelming importance of "technical change" or substitution as compared with fluctuations in the rate of utilization. This statement should, however, be qualified by the limitation noted under (d) in the next paragraph.

This type of study is logically a derivation from the more basic calculations of output per manhour.[24] Hence, it is important to recognize: (a) The limitations of output per manhour series (explored in Chapter VII) are inherent in such general indexes of labor costs. (b) Calculations for segments of the economy must meet a further difficulty, that of matching payroll and production series. On the basis of available series, it is impossible to be certain that industrial classifications include the same enterprises. (c) Logically these calculations of labor costs must neglect some labor items which are neither paid out directly to

[23] One possible exception should be noted; in several of the particular industry calculations, notably automobiles and iron and steel, unit labor costs increased in the first year or two after the peak only to fall considerably during the depths of the depression. The pattern for all manufacturing industries shown in Table 8 indicates a drop in unit labor costs through the downswing.

[24] Deflated labor costs per unit are the inverse of output per manhour. Since manhours times average hourly earnings equals payrolls,

$$\frac{\text{Payrolls}}{\text{Production}} = \frac{\text{Manhours} \times \text{Average Hourly Earnings}}{\text{Production}}$$

Division of both sides by average hourly earnings yields deflated labor costs per unit equal to manhours per unit of output.

wage earners nor entered into payrolls; items like payroll taxes, social services, uniforms, and recreational and sanitary facilities (noted in the previous section) cannot influence such estimates of labor costs. However, insofar as *variations* in labor costs are the central interest and these items vary in proportion to payrolls, they do not represent a serious limitation. (d) When the data for a number of firms are combined, it is very dangerous to reason from the aggregate results to a particular firm, especially when the firms which compose the group are constantly changing. Thus labor costs may fall for an "industry" with decreased output simply because the "least efficient" firms are no longer producing or have a smaller share of the total output. As output is increased by the addition of these same firms, costs may rise for this reason alone. Where the turnover of enterprises in an industry is large during the course of a business cycle, this consideration may be of major importance for an interpretation of the statistical cost series.

Investigations of particular firms, or those based upon general indexes for the whole economy or for separate industries, show important deviations between labor and materials prices and labor and materials costs. Both types of inquiry reveal that wage rates (average hourly earnings are usually substituted) increase much more rapidly than wage costs on the upswing of the cycle and over the cycle as a whole. On the downswing, as has just been observed, there are deviations that present no absolutely clear tendency. The statistical studies for industries indicated that costs decreased more than "rates" in almost every case, but the only case study through a whole cycle showed an opposite tendency. None of the studies made thus far attempts to allocate the divergences statistically among rate of plant utilization, "technical change," and substitution. A certain amount of substitution is to be expected as a result of relative price changes, i.e., as an induced change in costs from factor price variations.

Most of the difficulties of isolating the effects of factor price changes on costs, indicated in this chapter, arise *from*

inadequate measures of factor prices. Were indexes of wage *rates* more readily available, the deflation of costs for further analysis would be considerably simplified. Similar limitations apply at present to the availability of "price" data for raw materials and other cost components purchased by buyers. Studies of individual firms may well offer the most fruitful opportunity for overcoming these deficiencies. Even after factor price changes have been accurately measured, issues arise as to the techniques of eliminating their influence for purposes of further analysis, such as measuring the short run cost function or the rate of technical change. The major difficulty is a problem in index numbers: each change in a factor price must be weighted by its relative importance in total costs. This proportion obviously changes over time, necessitating the adoption of some base period. The problem, however, is common to all index number constructions.

5. *Research Suggestions*

Useful information on the questions raised in this chapter could be gained from case studies of the experience of particular firms. Special emphasis is needed on the following topics:

(1) It is important to know more about the classification of costs adopted by firms and about the methods used as a rule-of-thumb by executives in the process of making various types of decisions. In a vertically integrated company, what proportion of labor costs is generally classified as "labor"? Are special types of calculations made in appraising the effects of factor price variations on costs, and do these calculations involve a reclassification of items from their usual grouping? Payroll taxes are ordinarily included in "burden"; an appraisal of the impact of wage rate changes in cost would need to shift this item over to "labor" expenses.

(2) The adequacy of average hourly earnings indexes as measures of the variations in wage structures needs further

study with special reference to the magnitude of the differences between earnings and rates in various phases of the cycle. Again, much too little is known of the accuracy of wholesale price indexes as measures of what enterprises pay for the parts, materials and supplies they purchase. From the perspective of the seller, the question involves the reliability of these indexes as indicators of "net realization" from sales. Since the general wholesale index numbers are made up largely of list prices, their variations from "net realization" may be of special importance in the course of the cycle.

(3) The ways in which individual enterprises are able to influence and affect the price of the factors they purchase is a matter of considerable importance. A study of vertical integration in these terms might be a step toward an understanding of the problems of size of firms. The greater certainty of the price of supplies under integration may be an incentive influencing the scale of operations.

(4) The costing of materials carried over from one period to another presents many problems that are receiving increased attention. It would be of great value to determine the effects of various types of accounting methods on the amplitude of fluctuations in costs.

(5) A larger number of issues connected with factor prices is raised in Part III of this report, which deals with patterns of cost-price relationships. Such issues as the role of factor prices in price flexibility and the way in which individual firms handle factor price changes (e.g., price increases) will be deferred to the last section of this study.