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Cyclical Change: Tests and Inferences

Resemblances Among Successive Cycles

Our observations are not numerous in all. There are only 89 expansions and 97 contractions of production in which we can trace the course of hours per unit and labor cost from month to month and stage to stage. Many transient circumstances can influence these two ratios. To minimize their influence, we have grouped together observations from widely different periods of time. The same count of directions of change includes some expansions in the vicinity of 1936 and some in the vicinity of 1956, and data for corresponding phases of successive business cycles are likewise combined. Certain apparent sequences emerge. But we would be dissatisfied if we thought they were the accidental upshot of radically different sequences in different periods.

It therefore seems desirable to divide our production phases into groups assignable to successive periods of time, and to examine each group separately. We have already classified the production expansions according to the business cycle expansions to which they most closely correspond. We cannot similarly group our production contractions according to business contractions, because some of them occurred during expansions, but we can assign each to the business cycle in which it occurred. (We leave out of account the railroad cycles of 1921-24, 1924-27, and 1927-33, for we have no cycles in other industries with which to group them.) How closely do these groups resemble each other?

In our analysis of the whole body of data we found that both hours per unit and cost were inversely related to output in most phases of production. With one exception, we find the same relation in each group (Table 32, lines for I to V and V to IX). Hours per unit rose in a minority of the expansions in each group and in a majority of the contractions. Cost likewise rose in a minority of expansions in every group except 1945-48 and in a

TABLE 32

Frequency of Rises in Man-Hours and Labor Cost per Unit of Product in Separate
Groups of *Production* Phases

	Groups to Which Assigned				
	1933-38	1938-45	1945-49	1949-54	1954-58
Number of production phases assigned to group:					
Expansions	14	19	14	23	16
Contractions	17	16	20	25	16
Percentage with rising h/p from stage:					
I to II	14	11	7	9	0
II to III	14	16	36	4	6
III to IV	14	47	36	13	31
IV to V	29	37	29	30	19
V to VI	88	56	65	76	81
VI to VII	65	62	65	68	38
VII to VIII	71	44	70	48	50
VIII to IX	47	56	55	48	75
I to V	7	11	21	4 [a]	0
V to IX	82	61 [b]	80	68	62
Percentage with rising c/p from stage:					
I to II	14	16	36	9	6
II to III	29	37	71	30	31
III to IV	21	74	79	57	62
IV to V	64	79	86	57	44
V to VI	94	69	75	80	94
VI to VII	88	100	75	80	75
VII to VIII	94	81	80	68	62
VIII to IX	65	62	70	56	81
I to V	21	47	93	25 [a]	19
V to IX	100	94 [b]	90	88	88

[a] Based on 24 phases.
[b] Based on 18 phases.

majority of contractions in every group. Under the great inflationary pressures of 1945-48, the usual relation between cost and production was reversed.

Previous analysis revealed a steady, progressive increase in the frequency of rising hours per unit from stage to stage of expansions in production, and an equally steady decline from stage to stage of contractions. We do not find such a smooth rise in any of the five individual groups (Chart 5). But a straight line fitted to the first four dots of any group would slope upward. Likewise in each group of contractions, a fitted straight line would slope downward.

We previously found a continuous increase in the frequency of rises in cost during expansions of production, and a continuous decline in all but the first segment of contractions. In the individual groups, only three of the twenty percentages for expansion are out of line with the expected steady rise in frequency. For contractions the patterns are more ragged, but there is a downward tilt in the frequencies for each group.
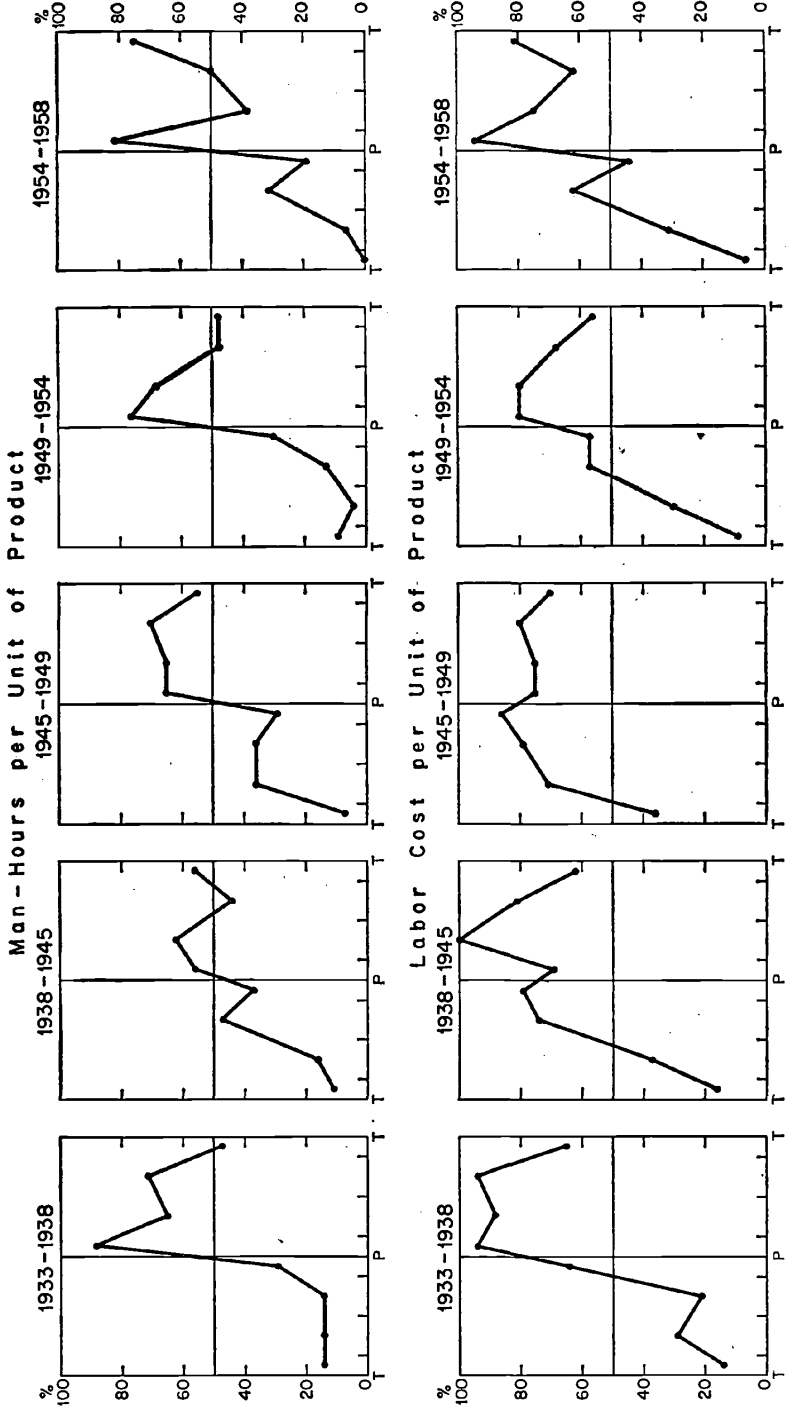
The foregoing remarks pertain to phases of production. For each phase of business, we have observations for a number of industries; these of course are for the change between the same dates in all industries in any one phase. Our study of the whole record led us to expect a predominance of net declines in hours per unit both in business expansions and in business contractions. The cycle-by-cycle score on this point is not perfect, but it is encouraging (Table 33, lines for I-V and V-IX). The whole record indicated a majority of net rises in cost during expansion and a minority during contraction; there were exceptions in three of the contractions.

We previously found rising hours per unit becoming more frequent from stage to stage of business expansions. There is an upward tilt in three of the five expansions (Chart 6). In all contractions except the one from February to October 1945 there is an expected downward tilt. The brief 1945 contraction was a peculiar one, however, as far as the thirteen industries are concerned. Seven had growing production in the first segment, five in the second, four in the third, and eight in the fourth; six had net growth for the phase as a whole.

We found no steady progression in the frequency of rising cost during business expansions, and there is no consistency among the patterns for individual phases. We did find a preponderance of rising cost in the last three segments, and this is confirmed in all instances except the third segment of 1933-37. The pattern of this expansion reflects the strange history of the period, with its Blue Eagle and the National Industrial Recovery Act under which wages were raised in many industries during the earlier stages of the expansion. The resulting rise in average hourly earnings was largely concentrated in the first two segments. The effect of higher wage

CHART 5

Percentage Frequency of Rises in Hours per Unit and Labor Cost in Successive Segments of Separate Groups of Production Phases

Man – Hours per Unit of Product

Labor Cost per Unit of Product

1933–1938   1938–1945   1945–1949   1949–1954   1954–1958

From Table 32.
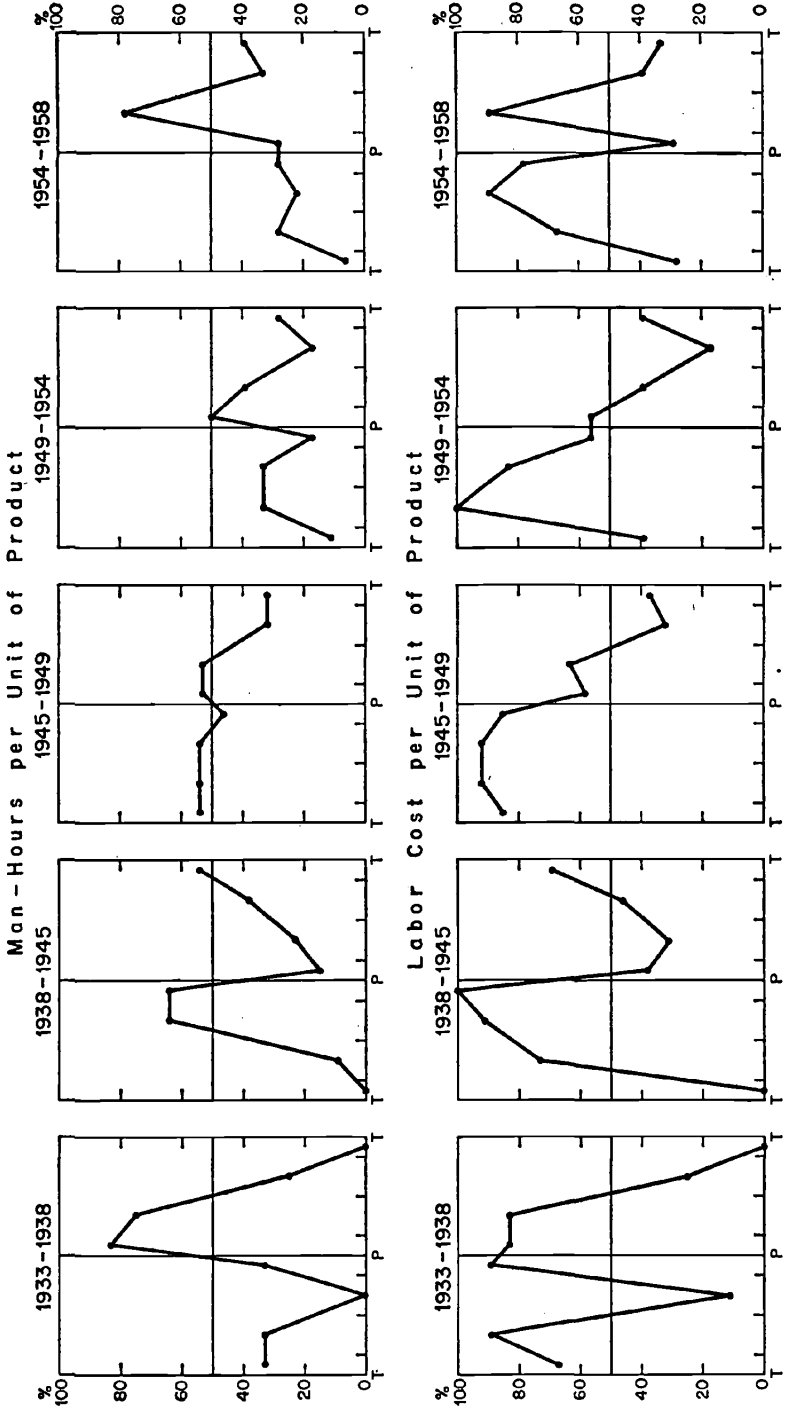
TABLE 33

Frequency of Rises in Man-Hours and Labor Cost per Unit of Product in Individual *Business* Cycles

Dates of Business Cycle					
Initial Trough	Mar. 1933	May 1938	Oct. 1945	Oct. 1949	Aug. 1954
Peak	May 1937	Feb. 1945	Nov. 1948	July 1953	July 1957
Terminal Trough	May 1938	Oct. 1945	Oct. 1949	Aug. 1954	Apr. 1958
Number of industries with data:					
Expansions	9	11	13	18	18
Contractions	12	13	19	18	18
Percentage with rising h/p from stage					
I to II	33	0	54	11	6
II to III	33	9	54	33	28
III to IV	0	64	54	33	22
IV to V	33	64	46	17	28
V to VI	83	15	53	50	28
VI to VII	75	23	53	39	78
VII to VIII	25	38	32	17	33
VIII to IX	0	54	32	28	39
I to V	11	36	54	6	6
V to IX	50	23	21	22	44
Percentage with rising c/p from stage					
I to II	67	0	85	39	28
II to III	89	73	92	100	67
III to IV	11	91	92	83	89
IV to V	89	100	85	56	78
V to VI	83	38	58	56	29
VI to VII	83	31	63	39	89
VII to VIII	25	46	32	17	39
VIII to IX	0	69	37	39	33
I to V	78	73	100	83	61
V to IX	50	54	32	28	61

CHART 6

Percentage Frequency of Rises in Hours per Unit and Labor Cost in Successive Segments of Individual Business Cycles

Man — Hours per Unit of Product

Labor Cost per Unit of Product

1933-1938   1938-1945   1945-1949   1949-1954   1954-1958

From Table 33.

rates was reinforced by that of falling production in the second segment. Production fell in four of the ten industries for which we have cost data in this period; it rose in all ten during the first and third segments. The frequency of rising costs is therefore much greater in the second than in the third segment.

From our earlier analysis we expect cost to be higher in the first than in the second half of a business contraction, and so it was except in 1945, which, as we have just remarked, was hardly a real contraction for our industries. We feel that if we had data for more industries—say fifty—in each group of production phases or each business phase, and also data for more groups of phases, most of the conclusions we have drawn from the whole body of available data would fit most of the periods individually.

The Sequence of Changes During a Cycle

Many industries are not represented even briefly in our data. Some giants, indeed, are included: textiles, petroleum refining, iron and steel, railroads, and others. But even in manufacturing, major divisions such as machinery or electrical equipment are not represented. Here production on a monthly basis has yet to be measured except by man-hours, so unsatisfactory for our purpose. The cost of saws and hammers, kitchen sinks, engines, turbines, harvesters, looms, pumps, calculators, switchboards, television sets, automobiles, airplanes, dental drills, cameras, pianos escapes our ken. In mining the important coal industries are present, but not oil and gas.[1] We have nothing for construction, trade whether wholesale or retail, service or repair industries.

Nevertheless the limited evidence does suggest a certain sequence of change in labor cost. The findings of previous chapters can be woven into a pattern. Consider first the sequence of developments during cycles in production. When an industry begins to expand its output, the amount of time its workers take to turn out a unit of product usually declines. As expansions of production continue on their upward course, however, hours per unit, in an increasing percentage, will cease to fall and begin to rise. But the cost-limiting influence of growing volume is fairly persistent, and even when production is approaching its peak, the level of hours per unit falls in most expansions. At the peak it will usually be lower than it was at the trough, even in some instances where it has begun to rise.

Meanwhile, however, competition and trade union action raise the average hourly compensation that workers receive. At first the rise in earnings is often not large enough to offset the decline in hours per unit, and labor

[1] Our main trouble here was that a large (but unmeasurable) percentage of man-hours and payrolls is devoted to capital investment (drilling wells, etc.) rather than to current production.

cost falls. But eventually rising hours per unit in some instances and rising hourly earnings in these and others cause labor cost to rise toward the end of most expansions. Even so, the later rise does not always negate the earlier decline; cost in most expansions is lower at their peaks than at their troughs.

Declining production usually brings a sharp change. In cases where hours per unit were already rising, there is now a further rise. Previous declines turn into rises. As a contraction of output proceeds, however, managers can often bring the labor-time component of cost under better control, and the early predominance of rising input per unit diminishes. As production approaches bottom, hours per unit fall in perhaps half of all instances. In most cases, nevertheless, they are higher even now than they were at the peak. Meanwhile hourly earnings, under the conditions prevailing in the labor market since 1933, continue to advance; but the advance is not as rapid as in expansions, and it is more common in the earlier than in the later parts of contractions. Labor cost rises, but increases are less frequent toward the end of contraction, although still predominant. At the trough, cost is usually higher than it was at the peak. Finally, when contractions of production turn into expansions, there is another sharp change. Hours per unit decline in a broad majority of instances, and cost also declines in a smaller majority.

Let us now consider the somewhat fuzzier sequence of events during a cycle in business at large. When the national economy begins to expand, many industries expand their own production and others introduce telling technological changes. For one reason or another, hours per unit fall in most industries. As the expansion unfolds, the frequency of declines diminishes. When the expansion reaches its climax, however, most industries still have lower hours per unit than they had when it began. But hourly earnings rise more or less throughout, and their advance is potent, for cost in most industries goes up in all portions of the expansion except the earliest. At the end it is higher in most than it was at the beginning.

When the national economy enters its declining phase, the majority of industries experience rises in hours per unit. But as the phase continues, technological improvements continue to be made, inefficient facilities are closed down, and some industries begin to expand. Hours per unit fall in most cases. Hourly earnings may continue to rise, but more slowly, and over a narrowing industrial front. In most industries cost rises at first, but declines before the end, and is lower at the trough than at the peak.

Technology Minimizes Rising Cost

In the foregoing sections a complicating influence, that of technological progress, has been mentioned incidentally. It deserves more emphatic recognition. Cyclical relations between hours per unit (h/p) and cost (c/p),

on the one hand, and production or the general condition of business, on the other, are modified by the continuous introduction of new industrial techniques that tend to reduce man-hours per unit and labor cost. Such innovations usually involve the completion and putting into service of new, improved plant and equipment. Their influence is felt not only in expansions but in contractions. Although businessmen make fewer and fewer contracts for construction and place fewer and fewer orders for equipment, the level in the early stages of contraction is often fairly high. Some of the construction started during expansion is completed in contraction, and some of the orders for equipment placed before a peak are not delivered until later. As the volume of production declines, enterprises can use their newer facilities and leave the older and less efficient ones idle.

If there were no technical innovations there would be more increases in h/p and fewer declines. Without them a majority of industries might have rising h/p in the last stages of production expansions, and a greater majority would have rising c/p. Technical change helps to account for the rather large, although not preponderant, number of industries with falling h/p at the end of contractions in production. Declines in h/p during expansions in volume are larger, and rises during contractions in volume smaller, than they would otherwise be. Because of economizing innovations, an industry that we have reason to believe has an inverse relation of h/p to volume nevertheless occasionally manages to have falling h/p during a shrinkage of output.

Even if an industry's h/p rises from the quarter of its production peak to the quarter of its production trough, technical change often enables it to make a better showing of efficiency during its trough year as a whole than during its preceding peak year. It may also make a better showing if the change in h/p is measured from the peak to the trough quarter in business at large. Most industries have declines in h/p between a business peak and the following trough, although not between their own peaks and troughs.

Technical change affects the record of a whole industry more gradually than it affects the h/p of individual enterprises. Major replacements of plant and equipment occur more continuously in an industry as a whole than in one of its component firms. It may well be that, where we observe a steady fall, many of the establishments included in the figures have an initial rise, followed by a sharp decline when a major new facility is fully broken in, followed by another rise stopping short of the initial level.

The direction of change in labor cost is determined mainly by the conflicting or allied influences of technology, volume, and hourly earnings. During expansions in particular kinds of production, technology and volume have tended to reduce cost, while changes in hourly earnings have raised it. In most cases the first two influences have triumphed over the third. In

general business expansions, on the other hand, rises in average hourly earnings have predominated and cost in most instances has risen. In severe contractions before 1933, technology and changes in hourly earnings tended to reduce cost and declines in volume to raise it. More recently, however, technology has been opposed both by volume and by hourly earnings, and the combination has usually predominated in contractions of production; costs have risen. In business contractions, on the other hand, technology has been relatively more and volume relatively less important; in spite of moderate rises in hourly earnings, cost in most of the instances studied has fallen.

Impact of Labor Cost: Prices vs. Profit Margins

If we were dealing in each industry with the production of one homogeneous commodity, changes in total cost (labor, materials, and overhead) per unit would necessarily be reflected either in proportionate changes in the average price received by the industry or in altered margins of profit. With a single product, if total cost per unit rises and the price does not rise by as great a percentage, the ratio of cost to price rises and the margin narrows; if price rises by a greater percentage, the margin widens in spite of the rise in cost. If cost falls and the price does not fall in proportion, the margin widens; if price declines by an even greater percentage, the margin narrows in spite of the fall in cost.

We have presented data for labor cost only. In fact they do not include all of that, for administrative, general supervisory, and central office labor is not included. Total cost no doubt often fluctuates by different percentages than labor cost and may at times move in the opposite direction.

Even if the data represented total cost, they would still not pertain in any instance, except perhaps cement, to an industry with a virtually homogeneous product. A single firm or industry often sells a variety of wares, each ware in a variety of sizes and qualities. Usually joint or common costs are present, and it is not feasible to segregate the cost, or the physical input, for each product. The alternative is to add the products together on the basis of some common dimension, and to compare the total with total cost.

If we wish to know whether, in such an industry, cost has changed so as to make either a change in price or a change in the profit margin inevitable, we must first make up our minds about what we mean by a change in price, since the industry charges many prices and they seldom all change by the same percentage; often indeed they move in different directions. An average is needed. We must then measure production in such a way that a change in cost will in fact be accompanied by the expected changes in price or margins.

One way of making sure that comparisons of cost in any two periods could be interpreted in this way would involve measuring production by

weighting the several kinds of product made in each period by their prices in the first period. Price would be measured by dividing the aggregate value of products in each period by production as thus defined. A change in cost per unit would then have the expected significance.[2]

Unfortunately the production measures available to us do not conform to this ideal standard. They give no recognition, or only limited recognition, to changes in the composition of output. If production of the more valuable chestnut and egg sizes increases by a greater percentage than the total tonnage of anthracite, the latter, which we use to measure total production, will understate the rise. In such a case production weighted by constant prices rises faster. The mining companies, without changing the price of any quality, can collect more revenue per ton of all coal. If cost per ton rises, prices will not have to increase in proportion to preserve the initial margin.

Even where composite indexes of production are used, the problem cannot be entirely avoided. The index for men's and boys' suits and coats, for example, is weighted, in effect, by their average base-period prices. But if production of high-grade coats and suits, sold for higher than average prices in the base period, increases faster than production of all suits and coats, the index takes no account of the upward shift in quality. If the index of cost per unit as computed rises, it will not be necessary to raise the average price as much as one might think to preserve the margin.

It is therefore possible that in some instances our measures of unit cost— even if they included all kinds of cost, not merely most labor cost, in the numerator—would incorrectly state the direction of change; that is, they would not indicate the direction of change in a weighted price index that would be necessary to offset the change in cost. It is certain that in many cases they understate or overstate the percentage change in price that would

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[2] Call the several separately priced varieties of product a, b, c . . . . . In period 1 call their respective prices p_{a1}, p_{b1}, p_{c1} . . . and the respective quantities produced q_{a1}, q_{b1}, q_{c1} . . . . . In period 2, use the same system, but with the subscript 2. Then, on the proposed definition, production is $\Sigma p_1 q_1$ in the first period and $\Sigma p_1 q_2$ in the second. Call aggregate cost in the first c_1 and in the second c_2. Price in the first is $\Sigma p_1 q_1 \div \Sigma p_1 q_1$ or unity, and in the second $\Sigma p_2 q_2 \div \Sigma p_1 q_2$. In the first, the ratio of cost to revenue is $c_1 \div \Sigma p_1 q_1$, which equals $(c_1 \div \Sigma p_1 q_1) \div (\Sigma p_1 q_1 \div \Sigma p_1 q_1)$, or unit cost divided by unit price. In the second, the ratio is $c_2 \div \Sigma p_2 q_2$ which equals $(c_2 \div \Sigma p_1 q_2) \div (\Sigma p_2 q_2 \div \Sigma p_1 q_2)$ or, again, unit cost divided by price. Consequently,

$$\frac{\text{Second cost ratio}}{\text{First cost ratio}} = \frac{\text{Second unit cost}}{\text{First unit cost}} \div \frac{\text{Second price}}{\text{First price}}.$$

Whenever the cost ratio rises, the profit margin of course falls. The relations among the variables are exactly the same as those described in the simpler case of a homogeneous product.

We are assuming that all production is sold, that a credit for unsold production is included in revenue, or that c refers to cost of goods sold, not cost of goods produced.

be compatible with unchanged margins, or the change in margins that would occur if there were no change in prices.

Our figures may contain errors, not only because the production measures are inadequately weighted by prices, but because both the labor and the production figures may not accurately measure even what they purport to measure. BLS, however, checks its estimates against census or social security data and revises them when revision seems appropriate, although some of the older figures were not so reconciled. The quality of the basic production data in most cases seems to be good. We may also have mistakenly assumed that the labor material, which except in one instance comes from BLS, pertains to the same industrial area as the production material, which with the same exception comes from a different source. We tried to avoid this error by studying the descriptions of the compilers before matching data from different sources. In the case of railroads, neither error is present; the figures are counts, not estimates, and the labor and traffic figures are reported by the same group of enterprises.

It would take a very special combination of errors, however, to lead us into illusion on some points. We find, for example, that labor cost declined in 76 of 89 first segments in production. Suppose that in reality there was no characteristic direction of change; cost rose in 45 instances and fell in the other 44. Then there must be at least 76 minus 44 or 32 errors in the direction of change. If there are errors in both directions, i.e, if some of the 13 apparent rises were really falls, then there must be more than 32 errors altogether.

In the next segment we find a smaller preponderance of declines, and there a smaller number of errors could lead us to improper conclusions. We also find, however, that the number of declines diminishes progressively. Suppose that the number of rises and declines in cost is really about the same in every segment. Then the errors must be distributed in such a way as to produce an illusion of progressive decline. Other suppositions— e.g., that the true division between rises and falls fluctuates erratically from stage to stage—would not require this progressive change in the error, but would imply a large number of errors.

It is therefore worth considering what our findings about labor cost might mean if total cost behaves like labor cost. During the earlier stages of an expansion in an industry's production, profit margins must usually widen if prices are not reduced. Indeed, some reduction in price is compatible with broader margins. But eventually rising cost will in most cases absorb a larger percentage of revenue unless prices are raised. Even at the peak of output, however, margins are likely to be larger than they were at the trough, since costs are lower and prices have probably risen. As production recedes from its peak, margins usually fall unless prices are raised. But before the

trough is reached, cost ratios, prices, or both have begun to decline in perhaps half of all contractions.

From a business cycle point of view, the sequence of change has a rather different aspect. At the beginning of a general economic expansion, to be sure, widening margins, falling prices, or mixtures of both are common. But in many industries cost very soon begins to rise and profit margins can be protected only by raising prices. At the peak of business activity, cost ratios, prices, or both will generally be higher than they were at the trough. Immediately after a business recession begins, the further increases in cost must be reflected in smaller margins for many industries; the economic climate of a developing depression is hardly favorable to higher prices. But in later stages, declines in cost permit wider margins in most industries unless the declines are fully reflected in prices.