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made primarily to stock, the ratios vary similarly from extremely high (for example, electric bulbs) to low (for example, hosiery, hardwood flooring). Examination of the data for major industries (where our criterion is the proportion of total value of shipments accounted for by component industries with high or low concentration ratios) leads to similar negative results.[21]

The *existence* of unfilled-order backlogs at any time is no more a symptom of departure from competition than is the existence of stocks. However, it is still important to consider the role of competition in the context of short-run, primarily cyclical, *changes* in backlogs, delivery periods, and prices. This topic will be taken up in the next section of this paper.

III. Fluctuations of Demand, Delivery Periods, and Prices

Interaction of Changes in Delivery Period and Price. As already suggested, industrial purchasers may often be prepared to pay more for a product if they can get it promptly, but less if their orders are to be filled only after a delay. In other words, the quantity demanded of a given good is likely to be a decreasing function of the length of the delivery period, given the price and other terms of sale. But the average costs of producing a certain output often depend on the delivery period too, increasing when production and shipment have to be accelerated. Hence, producers may ask for price premiums in return for speedier delivery and allow price discounts on longer-term orders. Thus, both the buyer and the seller have schedules of equivalent combinations of delivery period and price, the former for a given quantity demanded, the latter for a given quantity supplied. In the market there is an equilibrium process of weighing and reconciling these preferences of buyers and sellers.

A theoretical analysis of some basic aspects of this situation is given in the appendix at the end of this paper. There a simple criterion is defined for a choice by the firm of a unique profit-maximizing combination of price (p) and delivery period (k). The position is such that no alteration of p and k by the firm can increase profit because the associated changes in sales and costs would offset each other.[22]

Changes in demand, or the cost function, or both, would shift the equilibrium combination and bring about changes in p and k.[23] Given sufficient substitutability and variability of p and k, one would expect an expansion (contraction) of demand to be associated with increases (decreases) in both p and k. If substitutability or variability are low, however, the main burden of adjustment would presumably be shifted to one of the two variables and away from the other. What happens in any particular case depends on the pertinent demand and cost elasticities with respect to p and k and on the "shifts" on the demand and supply side; hence, ultimately, it depends upon the host of factors that determine these parameters. For example, if sales are regarded as much more sensitive to price increases than to delivery-period increases, this in itself would favor the latter over the former changes as a means of reacting to actual and expected increases in demand.

In the following parts of this section it will be shown that, for several major manufacturing industries, changes in U and in U/S are positively correlated with changes in P (price indexes). These findings support the notion that p and k tend to move in the same direction cyclically. Nevertheless, it should be helpful at

can Industry," 85th Cong., (1957). The limitations of concentration ratios as measures of competitiveness are well known, but so also is the fact that, in general, no better measures are available.

[21] For example, the electrical machinery industry is much more concentrated than the nonelectrical, and the weight of production to order in it is almost certainly considerably lower (note the importance of standardized electrical appliances for household use). A similar situation is found in transportation equipment, where the automobile industry, which is working to stock, is far more concentrated than the rest of the group, in which production to order dominates (aircraft, shipbuilding, railroad equipment). On the other hand, most of the nondurable-goods industries, in which manufacture to order is normally negligible or of little importance, also rank low among other industry groups in their over-all concentration levels (foods and beverages, apparel, petroleum, and chemicals). But here, too, there are two conspicuous exceptions: tobacco manufactures and rubber products.

[22] It is a "joint optimum" of p and k, graphically a point determined by two sets of indifference curves for each given quantity demanded and supplied. These sets consist of: (1) the pairs of k and p associated with each given volume of demand, according to the preferences of buyers; (2) the pairs of k and c (average costs) associated with each given volume of supply, as seen by the producer-seller. See Figure 1 (appendix) and related text.

[23] Cf. Figure 2 (appendix) and related text.

this point to give an interpretation of the limiting cases in which the brunt of adjustment is borne either by price changes or by delivery-period changes alone. Let us assume that a firm is already working at its optimum capacity and disregard the possibility of output adjustments. If demand still rises, the two cases are:

1. The firm maintains the existing price with the prospect of receiving orders at a rate exceeding that which it can handle without substantial delivery-period extensions. Here, excess demand will cause an expansion of the backlog, which will presumably be followed by its decumulation at the time when the rate of current ordering falls off and becomes, at the existing price, insufficient to support capacity production.

2. There is an increase in price just sufficient to prevent the inflow of orders from exceeding the rate that supports capacity operation. That is, excess demand is absorbed by the price adjustment. Here the firm is left without an extra large backlog at the time when demand declines but it is in a better position to attract *current* orders by reducing price again and also offering shorter delivery periods (relative to those that can be offered by a firm following the first course).

The two cases imply a sharply contrasting behavior of price and backlog, although both assume the tendency for demand to fluctuate cyclically and both involve some degree of production stabilization. The variation in backlog should be large and that in price small in the processes that resemble (1), and the reverse should be true for the processes that resemble (2).[24]

Price Change versus Backlog Change, by Broad Industry Groups. We are led to expect that the greater the importance of production to order and the longer the delivery lags, the greater will be the role of backlog reactions relative to that of price reactions. This is borne out strongly at least by the limited available evidence for major manufacturing industries.

The tests, the results of which are given in Table 4, are simple. The industries are ranked according to the average levels of their monthly ratios of unfilled orders to shipments (U/S) for 1948–58, from the smallest to the largest average (column 1). Column 7 lists the regression coefficients b computed by least squares from the equations

$$(\triangle P)_t = a + b\ (\triangle U)_{t-j} + u_t, \qquad (3)$$

where $\triangle P$ is the change in the price index for the output of the corresponding industry and $\triangle U$ is the change in the backlog of the industry's unfilled orders (in million dollars, deflated).[25] Quarterly data are used and $\triangle U$ is taken either with simultaneous timing or with a lead of one quarter relative to $\triangle P$, whichever gives a higher correlation. The regression coefficients are small but all are significantly different from zero at the conventional levels. Their ranks (column 8) show a very high inverse correlation with the ranks of the average

[24] Implicit in the argument of this section is the idea that variation of price and delivery period are the only alternatives available to a firm that faces demand exceeding its capacity to produce. For our present purpose, it is convenient to disregard any other possibility, but it is well to remember that the actual choices a company can make are not quite as restricted. Thus, reduction of sales effort could be used instead of, or together with, price increases and lead-time extensions. Cf. Ruth P. Mack, "Changes in Ownership of Purchased Materials," in U.S., Congress, Joint Economic Committee, *Inventory Fluctuations and Economic Stabilization,* Part II, 87th Cong., 1st Sess., (1961), 67.

[25] We have constructed estimates of change in unfilled orders in "constant dollars" by taking monthly differences between deflated new orders and deflated sales (value of shipments). The orders and shipments series for major manufacturing industries come from the Office of Business Economics, U.S. Department of Commerce. Price indexes that are essentially combinations of the appropriate components of the Wholesale Price Index of the Bureau of Labor Statistics served as deflators. Besides the difficulty in matching the backlog and the price data, the comparisons that can be made present a troublesome aggregation aspect. But perhaps the greatest deficiencies for our purposes are those of the WPI price figures: (1) The BLS collects prices as quoted by the sellers. But the sellers' list prices are often kept unchanged over considerable stretches of time, while actual transaction prices are varied by means of special discounts, sales rebates, etc. Despite the BLS efforts to obtain the latter rather than the former price information, many sellers apparently report prices that are overly rigid in the short-run, not necessarily identical with, but tending toward, the list quotations [see papers by Harry E. McAllister and John Flueck in *The Price Statistics of the Federal Government* (New York, 1961), 373–458]; (2) The WPI contains no direct measures of price movement for many items that are important in the data on orders received by certain industries (such as special industrial machinery and tools and nonautomotive transportation equipment). These items are products that have unique features desired by individual buyers and are mostly custom-made. There is often no "primary market" (wholesale) price for such goods, though the BLS index does take into account their transaction-value *weights.*

TABLE 4.—AVERAGE BACKLOG-SHIPMENT RATIOS, AVERAGE LEADS OF NEW ORDERS, REGRESSIONS OF PRICE CHANGE ON BACKLOG CHANGE, AND RELATED MEASURES, EIGHT MAJOR MANUFACTURING INDUSTRIES, 1948–58

				RELATION BETWEEN ΔP AND ΔU, QUARTERLY							RELATION BETWEEN ΔP AND $\Delta(U/S)$, QUARTERLY			
		Average Lead of New Orders Relative to Shipments		Standard Deviation of[d]			Average Change in ΔP Per Million Dollars of Change in ΔU		Ratio of Standard Deviations of ΔP and ΔU		Average Change in ΔP Per Unit Change in $\Delta(U/S)$		Ratio of Standard Deviations of ΔP and $\Delta(U/S)$	
Industry	Average Monthly U/S Ratio[a] (1)	Months[b] (2)	Rank[c] (3)	Price Change (index points) (4)	Backlog Change ($ million) (5)	Change in U/S Ratio (6)	Index Points[e] (7)	Rank[c] (8)	Per Cent[f] (9)	Rank[c] (10)	Index Points[g] (11)	Rank[c] (12)	Ratio[h] (13)	Rank[c] (14)
1. Paper and allied products	0.65	1.7	2	2.46	51.35	.069	.03190	8	4.790	8	23.85	8	36.72	8
2. Textile-mill products	1.63	3.3	3	3.52	362.39	.358	.00664	7	.972	7	6.39	7	11.57	7
3. Other durable goods[i]	1.92	0.9	1	1.46	324.55	.145	.00308	6	.450	4	4.30	6	10.25	6
4. Primary metals	2.99	3.5	4.5	3.29	498.66	.364	.00277	4	.661	5	1.12	3	8.39	5
5. Fabricated metal products	3.55	3.9	6	2.10	308.11	.356	.00305	5	.682	6	1.40	4	5.79	4
6. Nonelectrical machinery	4.20	4.0	7	1.64	677.53	.428	.00110	3	.243	2	1.67	5	3.57	3
7. Electrical machinery	6.04	3.5	4.5	1.53	529.67	.550	.00049	2	.287	3	0.41	2	2.56	2
8. Nonautomotive transport. equip.[j]	16.85	11.5	8	0.87	951.59	.982	.00037	1	.092	1	0.25	1	0.90	1
RANK CORRELATIONS (SPEARMAN COEFFICIENTS)														
9. With average U/S ratio (col. 1)								−.976		−.881		−.905		−1.000
10. With average lead of orders (col. 3)[k]								−.786		−.643		−.697		−.816

[a] Listed from the smallest to the largest (ranks 1, 2, . . . 8). Covers the period 1948–58 (132 observations), except for nonautomotive transportation equipment, for which data cover 1949–58 (120 observations).

[b] Same as the corresponding entries in Table 3, column 5, except that the minus signs are omitted.

[c] From the smallest to the largest.

[d] Based on quarterly data used also for the regression measures presented on the right. Figures in columns 4 and 5 match the corresponding entries in columns 7–10; figures in column 6, those in columns 11–14.

[e] Coefficient b from the regression $\Delta P = a + b\,(\Delta U)_{t-j} + U_t$. Quarterly series (converted from monthly) used throughout. Leads of one quarter ($j = 3$) used for paper, nonautomotive transportation equipment, and fabricated metal products; simultaneous relationships ($j = 0$) assumed for the remaining industries. These timing relations maximize simple correlations between ΔP and ΔU in quarterly terms. See also note c to Table 5.

[f] Equals the ratio of $\sigma(\Delta P)$ in column 4 to $\sigma(\Delta U)$ in column 5 multiplied by 100. Also equals the ratio of the regression coefficient b in column 7 to the corresponding correlation coefficient r in column 5 of Table 5, multiplied by 100.

[g] Coefficient b' from the regression $\Delta P_t = a' + b'\Delta\,(U/S)_{t-j} + U'_t$. Leads of one quarter ($j = 3$) used for paper and fabricated metal products; simultaneous relationships ($j = 0$) assumed for the remaining industries. These timing relations maximize simple correlations between ΔP and $\Delta(U/S)$ in quarterly terms. See also note c to Table 5.

[h] Equals the ratio of $\sigma(\Delta P)$ to $\sigma(\Delta U/S)$ for the periods covered by the appropriate data. (These ratios differ slightly from those obtained by dividing column 4 by column 6 because of the differences in time coverage between the figures in the above columns; see fn. g and h to Table 5.) Also equals the ratio of the regression coefficient b' in column 10 to the corresponding correlation coefficient r in column 7 of Table 5.

[i] Includes professional and scientific instruments; lumber; furniture; stone, clay, and glass; and miscellaneous industries.

[j] Measures refer to 1949–58 because backlog data are not available before 1948.

[k] The coefficients in this line are all adjusted for the "tie" in the ranks of the average order leads (Column 3, lines 4 and 7).

SOURCE: Based on data from the U.S. Department of Commerce, Office of Business Economics (for unfilled and new orders and shipments), and from the U.S. Department of Labor, Bureau of Labor Statistics (for prices, i.e., components of the WPI index, 1947–49 average = 100).

U/S ratios (see the first of the coefficients listed in the rank correlations in the table, line 9). These rankings appear to make good sense in terms of the relevant differential characteristics of the industries included.[26]

Column 9 shows the ratios of the standard deviations of ΔP and ΔU. These ratios represent another measure of the relative role of price and backlog adjustments in that they compare the average size of variations in ΔP and ΔU for different industries. Again there is a high negative correlation between the ranks of the average U/S values and those of the ratios of the standard deviations (see the second entry in line 9).

There is some danger of spurious correlation in these tests. Larger average U/S ratios may be associated with larger absolute values of U, and thus also with ΔU that are larger absolutely and relative to ΔP. However, while U and S depend on the industry size, U/S and P do not. Column 11 lists the regression coefficients b' computed by least squares from equations of the form

$$(\Delta P)_t = a' + b'\Delta(U/S)_{t-j} + u'_t. \quad (3a)$$

The correlation between the ranks of the average U/S values and the ranks of the coefficients b' is also negative and high (line 9).

Column 13 gives the ratios of the standard deviations of ΔP and $\Delta(U/S)$. The ranks of these ratios show a perfect negative correlation with the ranks of the average U/S values (last entry, line 9).

Free from all possibility of spurious correlation are further tests based on the average leads of new orders over shipments (column 2). The correlations between the ranks of these leads and the ranks of the regression coefficients and of the standard deviation ratios are all negative and substantial (line 10).

The analysis in the previous section and the Appendix implies that, given the amplitude of fluctuation in demand, the more the average delivery period fluctuates, the less does the average price and vice versa. This proposition is difficult to test with the available data, but Table 4 provides some evidence that seems at least consistent with it. Thus, in addition to the negative correlations listed in lines 9 and 10 of the table, there are also negative rank correlations between the standard deviations of (1) ΔP and ΔU and (2) ΔP and $\Delta(U/S)$. The Spearman coefficients here are −.452 and −.405, respectively.

These comparisons, however, make no explicit allowance for interindustry differences in amplitudes of demand fluctuations. As will be argued below, greater variability of demand may signify greater uncertainty, which is likely to be associated with more backlog variation and less price variation. In fact, the standard deviations of both the deflated new orders proper and of the first differences in new orders ($\sigma(O)$ and $\sigma(\Delta O)$, respectively) are found to be negatively correlated with $\sigma(\Delta P)$ and positively correlated with $\sigma(\Delta U)$ and $\sigma\Delta(U/S)$.[27] The rank correlations (Spearman coefficients) for the eight industries included in Table 4 are as follows:

	$\sigma(\Delta P)$	$\sigma(\Delta U)$	$\sigma\Delta(U/S)$
$\sigma(O)$	−.667	+.857	+.667
$\sigma(\Delta O)$	−.381	+.500	+.381

The analysis has other related implications that are of interest, notably that, within a given industry, delivery periods and prices should be negatively correlated at any given time. Here cross-sectional tests would be needed, with data for firms grouped by homogeneity of product, which data are lacking.[28]

A Regression Analysis of Lagged Price Ad-

[26] In interpreting the results of Table 4, the relative importance of manufacture to stock should be considered. Thus, the paper industry not only has small backlogs but its finished inventory is even smaller (Table 2). Hence, current price and output adjustments would be expected to be very important here, and they are. The weight of manufacture to stock is probably larger in textiles, other durables, and electrical machinery than in the other industries, but this could not be inferred from our gross measures, perhaps because the role of backlog adjustments is much greater than that of product stock adjustments in all these industries (see Table 7 and text below).

[27] Deflated new orders can be regarded as an index of demand — of the indifference curves in Figure 2. Our theoretical argument suggests that variations in this index are met partly by price and delivery-period adjustments. Thus, the indicated association is between P and U/S, on the one hand, and O, on the other, or between the changes in each of these variables; but actually we find that ΔP and $\Delta(U/S)$, as well as $\Delta(U)$, are positively associated with both ΔO and O.

[28] In the absence of such information, it may be noted that descriptions of trade practices offer examples of price discounts granted the advance buyer (see, for example, *Geographical Differentials in Prices of Building Materials*, Temporary National Economic Committee, Monograph No. 33 (Washington, 1940), 66 and 288).

justments. Correlation coefficients based on equations (3) and (3a) are presented in Table 5, columns 5 and 7. They correspond to the simple regressions of quarterly data introduced in Table 4. In addition, Table 5 contains measures of correlation and regression based on different assumptions about the timing of ΔP relative to ΔU and $\Delta(U/S)$.

Lengthening the unit period from a month to a quarter tends to improve the correlations between ΔP and ΔU considerably (cf. columns (1) and (5)). This may be due to the reduction in the influence of measurement errors and to the elements of smoothing involved in the conversion to quarterly data.

It is plausible to assume that prices react mainly to the more systematic and persistent variations in the demand-delivery conditions. Pursuing this notion, we have applied to the data two types of distributed-lag relations. The simpler one of these takes the form of a regression of ΔP for the current quarter on the ΔU's for the current and previous quarters. The resulting R-coefficients are in several, but not all cases, substantially higher than the maximum simple correlations of quarterly data (cf. columns (5) and (6)). They are all clearly significant, although some of the partial correlation coefficients are not, due to a high autocorrelation of the ΔU series.

As a second distributed-lag approach, equations of the form

$$(\Delta P)_t = a(\Delta U)_{t-j} + b(\Delta P)_{t-1} + c + u_t \quad (4)$$

were fitted to the monthly data.[29] The timing $(t - j)$ is here the lead that maximizes the simple correlation between monthly ΔP and ΔU $(j > O)$. The results are mixed (compare, for example, the R's in column (2) and (6)). All the coefficients a and b are positive and all but one are highly significant, in the sense of being different from zero at least at the 0.01 level by a one-tailed t-test (see columns (3) and (4)). The values of a are very small throughout, however; those of b are low for three, and sizable but not high for four of the industries. This suggests that the price reactions measured here are on the average small and also that they take little time to be completed; their speed is inversely related to the value of b.[30]

Since $\Delta U = O\text{–}S$, systematic movements in this variable may be regarded as indicative of systematic changes in quantities demanded relative to quantities supplied. In this view, the distributed-lag regressions of Table 5 show that increases and decreases in "excess demand" measured in this way tend to be associated with increases and decreases, respectively, in ΔP (both variables being taken with regard to sign). Our measures suggest that the weakest price reactions prevail in the broad area of durable-goods manufacture in which backlogs are typically large and widely fluctuating: the metalworking, machinery, and non-automotive transportation equipment industries. For "other durables," textiles, and paper, in contrast, where average levels of and changes in backlogs are much smaller, the prevalence of stronger price adjustments is indicated.

Since new orders are more variable than shipments and have, in particular, larger cyclical amplitudes, fluctuations in ΔU often reflect strongly those in O. The industries for which

[29] This method derives from the work of L. M. Koyck, op. cit. Least squares estimation of such models is largely used, despite the pitfalls of this procedure. Improved estimation techniques have been worked out, but they are laborious or complicated. [See Lawrence Klein, "The Estimation of Distributed Lags," *Econometrica* XXVI (October 1958), and Robert M. Solow, "On a Family of Lag Distributions," *Econometrica* XXVIII (April 1960).] It was felt that our present purpose and the quality of the data did not justify the cost of application of these techniques. No significant autocorrelation of the residuals u_t was found in the few tests we made (the autocorrelation coefficients for paper and other durables, e.g., are −.01 and .05, respectively). But the standard tests for the residuals are not conclusive with regard to autoregressive schemes and related distributed-lag models [see, e.g., J. Durbin and A. S. Watson, "Testing for Serial Coorelation in Least Squares Regression. II," *Biometrica*, XXXVIII (June 1951), 159; also Zvi Griliches, "A Note on Serial Correlation Bias in Estimates of Distributed Lags," *Econometrica* (June 1951), XXIX (January 1961)].

[30] The sum of the implicit lag coefficients $a + ab + ab^2 + \ldots$ is $a/(1 - b)$. Let r denote the proportion of the "total response" of ΔP to a unit change in ΔU, i.e., of $a/(1 - b)$, that is accounted for by an interval of n months. Then

$$r = \frac{a(1 - b^n)}{1 - b} \Big/ \frac{a}{1 - b} = 1 - b^n \text{ or } n = \frac{\log(1 - r)}{\log b}. \quad (5)$$

For $r = 0.5$, n varies from 0.5 months (primary metals) to 2.0 months (textiles); for $r = 0.9$, the corresponding range of n is from 1.5 to 6.7 months. Most of the impact on ΔP of the change in the demand-supply conditions (as represented by ΔU) spends itself very early in the process and the remainder that tapers off slowly is relatively small; this, of course, is implicit in the adopted lag structure.

ΔU and O show the closest correlations are those facing highly unstable demand and working largely to order, often with long delivery periods, notably the manufactures of capital equipment — nonautomotive transportation equipment, and nonelectrical machinery. This may help to account for the fact that positive correlations similar to those between ΔP and ΔU are also found between ΔP and O.[31] But part of the explanation may also lie in the asymmetrical feature of the recent behavior of measured prices: the dominance of upward price movements intensified in times of high demand and the absence of comparable downward movements in times of low demand.[32]

According to the hypothesis presented earlier in this section and in the Appendix, price and delivery period should be positively correlated over time for a given industry because of common elements in the response of each to fluctuations in demand. However, such correlations should be low wherever price adjustments are very large relative to delivery-period adjustments or vice versa. (Consider, for example, the relations between p and k represented by lines AA, BB, and CC in Figure 2.) They may be found low, too, for those industries in which the reactions in *both* p and k are weak most of the time because input flexibility is high and short-term fluctuations in quantities ordered can to a large extent be met promptly by changes in the rates of output and delivery. Where changes of p and k are typically quite small, it is particularly difficult to separate their systematic components, which should still be well correlated, from those irregular components which are not.

Lacking any better measures, the ratio U/S might be used as a crude indicator of an industry's average delivery period, $\bar{k}$. We are thus led to expect positive, though not necessarily high, correlations between P and U/S, and hence between ΔP and $\Delta(U/S)$. In fact, the coefficients presented in Table 5, columns (7) and (8), are all positive, but medium or low. For all but one industry (nonelectrical machinery), they are smaller than the corresponding measures of the association between ΔP and ΔU, and the differences for most industries are considerable.[33]

Much of what is a real phenomenon in these observed differences is probably due to the greater cyclical variability of U compared with U/S. For the industries covered, both U and S have typically high cyclical conformity, but fluctuations of U tend to be much larger than those of S and they dominate the behavior of the ratios U/S. Thus, there is a high degree of directional agreement between the cyclical movements of U and U/S, but the relative amplitudes of the former are greater than those of the latter. This reflects the large role of output adjustments to changes in the rate of inflow and in the backlog of advance orders.

On the other hand, it must be emphasized that the backlog series proper are strongly cyclical but remarkably smooth; the correspond-

[31] As mentioned earlier (fn. 7), one would expect price *changes* to be associated primarily with ΔO rather than O, yet they turn out to be better correlated with the latter than with the former variable. It may be worth noting that for paper, an industry with relatively stable demand and prompt output adjustments, in which ΔU are small, the correlation of ΔP with O is markedly lower than that of ΔP and ΔU. The coefficients r based on quarterly data (comparable to column (5) of Table 5) are:

	Correlation of ΔP with ΔO	O
Primary metals	.513 (3)	.515 (0)
Fabr. metal products	.460 (3)	.468 (3)
Nonelectr. machinery	.451 (3)	.608 (0)
Other durable goods	.369 (0)	.419 (0)
Textile-mill products	.324 (3)	.716 (0)
Electr. machinery	.305 (3)	.339 (3)
Nonaut. transp. equipment	.160 (3)	.543 (0)
Paper products	.037 (3)	.220 (3)

Another point is that errors of measurement should be relatively larger in ΔU and ΔO than in O. As for the regression coefficients, changes in O are for the most part greater than those in ΔU, so that there is less average change in ΔP per million dollars of change in O than per million dollars of change in ΔU. Multiple regressions with values of O and/or ΔO for the current and previous quarter produced on the whole very little improvement over the simple regressions.

[32] While no major effort was made in this study to isolate the effects of downward price rigidities, we did recompute some of our price-backlog regressions omitting selected subperiods, such as parts of the 1953–54 episode, in which the behavior of ΔP seemed particularly "perverse" on chart inspection. These experiments, however, failed to reveal any meaningful systematic differences.

[33] The ranking of the industries in terms of the two sets of coefficients, however, is similar. The ranks of entries in columns (5) and (7) show a correlation of +.643; the ranks of entries in columns (6) and (8), a correlation of +.750. (It may be noted that the R's in column (8) are in some cases only a trifle higher than the r's in column (7), and that the same can be said in these instances of the R's and r's in columns (6) and (5)).

TABLE 5. — RELATIONS BETWEEN PRICE CHANGE AND CHANGES IN BACKLOGS AND IN BACKLOG-SHIPMENT RATIOS, WITH SIMPLE AND DISTRIBUTED LAGS, SEVEN MAJOR INDUSTRIES, 1948–58

	Relations Between Price Change (ΔP) and Backlog Change (ΔU)						Relations Between ΔP and $\Delta(U/S)$	
	Simple Lag [a]	Distributed Lags [b]			Simple Lag [c]	Lags of 0 and 1 Quarters	Simple Lag [c]	Lags of 0 and 1 Quarters
			Regression Coefficient [d] of					
Industry [e]	Correlation Coefficient r (1)	Mult. Correl. Coefficient [f] R (2)	ΔU_{t-j} (3)	ΔP_{t-1} (4)	Correlation Coefficient r (5)	Mult. Correl. Coefficient [g] R (6)	Correlation Coefficient r (7)	Mult. Correl. Coefficient [h] R (8)
1. Paper and allied products	.549(5)	.747(5)	.0119 (.0029)	.5723 (.0695)	.666(3)	.824	.650(3)	.723
2. Textile-mill products	.656(1)	.872(0)	.0032 (.0004)	.7075 (.0427)	.683(0)	.786	.553(0)	.599
3. Other durable goods [i]	.558(0)	.742(0)	.0012 (.0002)	.5577 (.0595)	.685(0)	.696	.430(0)	.443
4. Fabricated metal products	.311(0)	.458(0)	.0018 (.0006)	.3475 (.0795)	.447(3)	.478	.240(3)	.274
5. Nonelectrical machinery	n.a.	.681(0)	.0005 (.0002)	.5994 (.0628)	.453(0)	.455	.467(0)	.467
6. Primary metals	.432(1)	.480(1)	.0028 (.0006)	.2152 (.0782)	.419(0)	.449	.133(0)	.163
7. Nonautomotive transport. equip.[j]	n.a.	.245(0)	.0003 (.0001)	.0446* (.0898)	.404(3)	.437	.284(0)	.310

NOTE: Columns 1–4 are based on monthly data and columns 5–8 on quarterly data.

* Not significant (see text).

[a] The lags of ΔP relative to ΔU (in months) are given in parentheses. These timing relations maximize simple correlations between ΔP and ΔU in monthly terms.

[b] Based on regressions of ΔP_t on ΔU_{t-j} and ΔP_{t-1}. See text.

[c] The lags of ΔP relative to ΔU or $\Delta(U/S)$, converted from quarters to months, are given in parentheses (0 = simultaneous timing; 3 = one-quarter lag). The correlation coefficients in column 5 correspond to the regression coefficients in Table 4, column 7; the correlation coefficients in column 7 correspond to the regression coefficients in Table 4, column 11.

[d] Calculated standard error is shown in parentheses underneath each coefficient.

[e] Ranked by the multiple correlation coefficients in column (6), from largest to smallest. Electrical machinery, one of the industries covered in Table 4, is omitted here. It shows correlations between ΔP and ΔU that are much lower than those for the other industries (e.g., a simple correlation in quarterly terms of .171; cf. other entries in column 5).

[f] The lags of ΔP relative to ΔU (the j's) are given in parentheses.

[g] Based on regressions of ΔP_t on ΔU_t and ΔU_{t-3}. The number of observations N (the number of quarterly intervals covered by all three series) is forty-three for each industry, except textiles and nonautomotive transportation equipment, for which it is forty-two and thirty-eight, respectively. (The same N's apply to the corresponding simple correlations in column 5.)

[h] Based on regressions of ΔP_t on $\Delta(U/S)_t$ and $\Delta(U/S)_{t-3}$. The number of observations N (the number of quarterly intervals covered by all three series) is forty-two for fabricated metal products, thirty-nine for primary metals and nonautomotive transportation equipment, and forty-one for each of the remaining industries. (The same N's apply to the corresponding simple correlations in column (7).) Continuous periods of coverage are applied here, as throughout this study, with a single exception: in primary metals, the observations for II/1952 and III/1952 were omitted because of the violent and entirely atypical up-and-down movement of $\Delta(U/S)$ in these quarters, reflecting effects of the steel strike, primarily upon shipments (see text below). There is, of course, no reason to expect a significant and regular price reaction to a particular event of this sort.

[i] Includes professional and scientific instruments; lumber; furniture; stone, clay, and glass; and miscellaneous industries.

[j] Measures refer to 1949–58 because backlog data are not available before 1948.

SOURCE: See source to Table 4.

ing U/S ratios are far more erratic. For example, U is not significantly affected by various sporadic influences, such as strikes, to which S is very sensitive. Deflations with S seem to result in compounding of observation errors, a frequent by-product of statistical procedures of this kind. This becomes especially important when ΔU and $\Delta(U/S)$ are compared, since differencing imparts particular emphasis to the short-period variations of the series.[34] In brief, it is likely that the measured correlations between ΔP and $\Delta(U/S)$ understate substantially the actual association between changes in the average prices and delivery periods because of the influence of large measurement errors.

Data compiled by the Purchasing Agents Association (PAA) of Chicago provide at least a partial remedy for the two major shortcomings of our statistical results: (1) the reliance on seller-reported prices which are unduly rigid in the short run (see fn. 25); and (2) the reliance on indirect indicators of changes in the

[34] Short-term changes in $\Delta(U/S)$ are typically small in comparison with the ratios U/S proper — more so than ΔU in comparison with U. In addition, ΔP are also quite small relative to P. Hence, even small errors in the U/S and P series are likely to be large relative to $\Delta(U/S)$ and ΔP, respectively. Thus, errors of $\pm$ 0.1 index point in a price index P, whose lowest observed standing was 80, would amount to at most 0.125 per cent. But if the typical ΔP were, say, 1–2 points, the errors would vary between 10 and 20 per cent of ΔP (1.0 $\pm$ 0.2; 2.0 $\pm$ 0.2).

average delivery periods rather than on any direct measures. The "vendor performance" index ($\widetilde{D}$) is a monthly series of differences between the percentage of PAA survey members reporting slower and the percentage reporting faster deliveries to their companies by the suppliers (vendors). The price index ($\widetilde{P}$) is, similarly, a net diffusion index showing differences between the percentage of members reporting higher and the percentage reporting lower buying prices each month. The coefficient of correlation between $\widetilde{D}_t$ and $\widetilde{P}_t$ (sixty quarterly observations, 1946–60) is .66 — of the same order as the highest simple correlations between the quarterly first-difference series ΔP and ΔU (Table 5, column (5), lines 1–3). To the extent that the PAA sample includes products of industries for which the correlations between ΔP and ΔU were found to be low (for example, metal products), the measures based on the major industry series do understate price flexibility.[35]

A backlog diffusion index ($\widetilde{U}$) showing differences between the percentage of firms reporting increases and that reporting decreases in unfilled orders can also be constructed from the PAA data. This index parallels very closely the vendor performance series; the correlation between $\widetilde{U}_t$ and $\widetilde{D}_t$ (monthly, 1946–60) is .93. Chart 1 shows the three PAA series ($\widetilde{D}$, $\widetilde{U}$, and $\widetilde{P}$, as curves 1, 2, and 4, respectively) along with the aggregative series on ΔU and ΔP based on the OBE and BLS data (curves 3 and 5).[36] It will be noted that the PAA diffusion index for prices is distinctly more cyclical and less irregular than the monthly change in the BLS price index for manufactured goods.

Measures and Implications of Differential Variability of Orders, Output, and Shipments. The positive cyclical conformity of unfilled orders is itself indicative of their production-stabilizing role, but there is also direct evidence that the variability of new orders systematically exceeds the variability of shipments. The evidence is very strong indeed and its implications for backlogs are clear-cut.

Table 6 contains representative data from a larger collection of measures derived by the decomposition of time series on new orders, shipments, and outputs into three elements, Cy (the cycle-trend), Se (the seasonal), and I (the irregular). Each monthly value of the original series (Or) is assumed to be a product of the three, that is, $Or = Cy \times Se \times I$, and the seasonal adjustment reduces the series to $Cy \times I$. The table shows averages of monthly percentage changes for each of these derived series, designated by bars, $\overline{Or}$, $\overline{Se}$, etc.

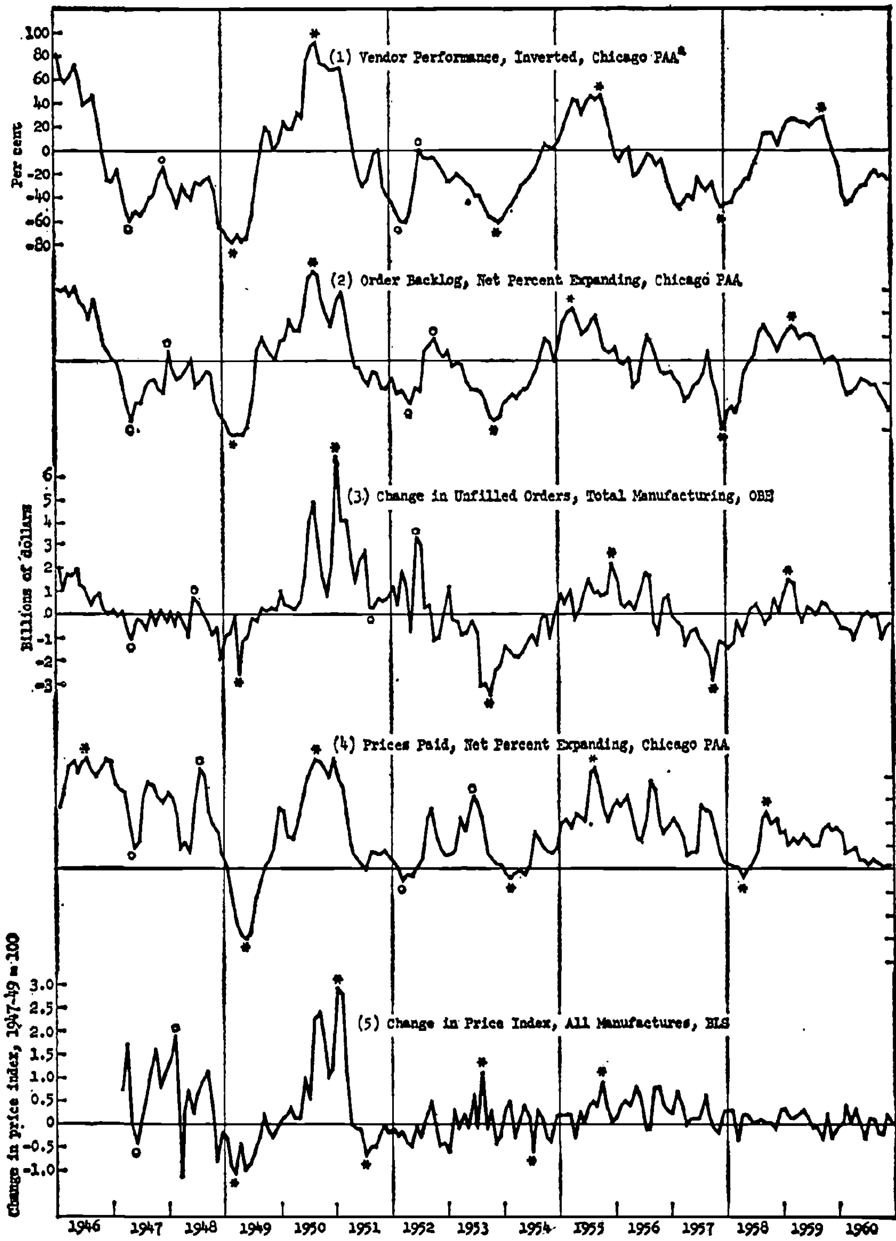
With hardly a single exception, these average monthly amplitude measures are smaller for shipments than for new orders. This is true of each industry, group of industries or of products, each of the component movements, and combinations of them. Hence, the ratios of the

[35] However, this inference rests on the assumption that the PAA index includes prices only of fabricated or semifabricated items sold by manufacturers. (The BLS series presumably does satisfy this requirement.) Unfortunately, little information is available about the coverage of the PAA sample, and it was not possible to ascertain to what extent the price diffusion index shown in Chart 1 is indeed free of raw materials. We do know that the PAA series cover a broad range of industries but that they are, at least in one respect, more restricted than the OBE series. The former data cover manufacturers who supply industrial concerns, the latter all manufacturers regardless of their role as suppliers.

[36] Two additional points merit some attention. First, the backlog index $\widetilde{U}$ refers to changes in the unfilled orders of the purchasing agents' own companies, while the vendor performance index refers to changes in the average speed of deliveries made by the suppliers from whom the agents procure their requirements. It is logical to expect this relation to be less close than the direct association between backlogs and delivery periods of the same companies (which is the association one has in mind when treating backlog movements as largely reflections of changes in average delivery lags). Actually, the high correlation of the two PAA indexes suggests that the backlogs of the buying companies (that is, of the survey members) move very similarly to the backlogs of the selling companies (vendors). For an analysis of relations of this type, see Ruth P. Mack and Victor Zarnowitz, "Cause and Consequence of Changes in Retailers' Buying," *The American Economic Review*, XLVIII (March 1958), 18–49.

Second, the Chicago indexes may differ from the corresponding national series because of their regional origin. Moreover, even for the same aggregates, diffusion indexes and rates of change are different, albeit as a rule highly correlated. (See Geoffrey H. Moore in *Business Cycle Indicators* (Princeton for NBER, 1961), I, 282–293.) When all this is considered, the similarity in the cyclical change in the PAA backlog index and the first differences in the Commerce estimates of unfilled orders is quite pronounced (series 2 and 3 in Chart 1). Most of the divergences between these series are due to the intensity of the irregular movements in backlogs. The coefficient of correlation between the quarterly change in unfilled orders and the PAA vendor performance index is .692 (series 3 and 1).

CHART 1. — DIFFUSION INDEXES OF DELIVERY PERIODS, ORDER BACKLOGS, AND PRICES PAID, AND CHANGES IN MANUFACTURERS' UNFILLED ORDERS AND IN PRICES, 1946–60



NOTE: Asterisks identify peaks and troughs of specific cycles. Circles identify minor turns.
[a] Percentage reporting slower deliveries minus percentage reporting faster deliveries. See text.

TABLE 6.—MEASURES OF CYCLE-TREND, SEASONAL, AND IRREGULAR COMPONENTS FOR SELECTED SERIES ON MANUFACTURERS' NEW ORDERS AND SHIPMENTS

		New Orders						Shipments					
Industry	Period [a]	$\overline{Or}_o$ (1)	$\overline{Se}_o$ (2)	$\overline{CyI}_o$ (3)	$\overline{I}_o$ (4)	$\overline{Cy}_o$ (5)	$(\overline{I/Cy})_o$ (6)	$\overline{Or}_s$ (7)	$\overline{Se}_s$ (8)	$\overline{CyI}_s$ (9)	$\overline{I}_s$ (10)	$\overline{Cy}_s$ (11)	$(\overline{I/Cy})_s$ (12)
1. Average, 32 industries [b]	1920–58	n.a.	n.a.	20.2	18.6	4.5	3.7	n.a.	n.a.	7.2	6.3	2.5	2.7
2. Composite index, 14 industries [c]	1949–58	9.4	5.4	6.4	5.8	2.0	2.8	5.4	4.1	3.1	2.8	1.1	2.6
3. Average, 7 indus., high variability [d]	1949–58	32.9	15.6	26.0	24.7	4.7	4.8	15.5	9.8	10.1	9.2	2.7	3.6
4. Average, 7 indus., low variability [e]	1949–58	14.8	9.7	10.0	9.5	2.6	3.9	9.7	7.8	5.2	4.8	1.7	3.2
5. Electric overhead cranes	1925–46	50.1	19.6	43.1	40.5	8.6	4.1	28.3	10.3	24.7	23.9	6.7	3.6
6. Freight cars	1941–56	154.2	98.0	143.7	157.6	21.8	7.2	17.4	8.5	14.0	11.2	7.0	1.6
7. Paper [f]	1934–55	7.2	5.7	4.3	3.7	1.7	2.2	6.5	5.7	3.0	2.6	1.3	2.0
8. Southern pine lumber	1929–56	10.9	7.6	7.7	7.2	2.6	2.7	n.a.	7.0	n.a.	4.9	2.2	2.3
9. Furniture	1923–46	36.8	26.4	18.1	17.5	4.8	3.7	13.1	10.3	8.0	7.2	2.7	2.7

(continued)

TABLE 6 (concluded)

		Amplitude Ratios, Shipments/New Orders					
Industry	Period [a]	$\overline{Or}_s/\overline{Or}_o$ (13)	$\overline{Se}_s/\overline{Se}_o$ (14)	$\overline{CyI}_s/\overline{CyI}_o$ (15)	$\overline{I}_s/\overline{I}_o$ (16)	$\overline{Cy}_s/\overline{Cy}_o$ (17)	$(\overline{I/Cy})_s/(\overline{I/Cy})_o$ (18)
1. Average, 32 industries [b]	1920–58	n.a.	n.a.	.36	.34	.56	.73
2. Composite index, 14 industries [c]	1949–58	.57	.76	.48	.48	.55	.93
3. Average, 7 indus., high variability [d]	1949–58	.47	.63	.39	.37	.57	.75
4. Average, 7 indus., low variability [e]	1949–58	.66	.80	.52	.51	.65	.82
5. Electric overhead cranes	1925–46	.56	.53	.57	.59	.78	.77
6. Freight cars	1941–56	.11	.09	.10	.07	.32	.22
7. Paper [f]	1934–55	.90	1.00	.70	.70	.76	.91
8. Southern pine lumber	1929–56	n.a.	.92	n.a.	.68	.85	.85
9. Furniture	1923–46	.36	.39	.44	.41	.56	.73

[a] Identifies the earliest and the latest year covered by the series or (in case of groups) by any of the series in the group.

[b] Includes, in addition to the series identified in notes d and e and lines 5–9, series for the following industries or products: iron and steel, lumber, stone and clay, transportation equipment, textiles, paper and printing (all Dept. of Commerce indexes, 1920–33); also, nonelectrical machinery, woodworking machinery, foundry equipment, oak flooring, and paper board (these are mostly trade association data for various periods). There are thirty-two series in the new orders and thirty series in the shipments group (twenty-four shipments and six production series). The industrial coverage of the two groups is very similar but not identical.

[c] Composite (aggregative) indexes, 1949 = 100, by Standard and Poor's. Covers the fourteen industries identified in notes d and e.

[d] The seven industries with the above-median values of $\overline{CyI}_o$: aircraft, textiles, auto parts, cement, metal fabricating, steel, and floor covering (listed from the highest to the lowest $\overline{CyI}_o$ measure). Standard and Poor's, 1949 = 100.

[e] The seven industries with the below-median values of $\overline{CyI}_o$: electrical equipment, machine tools, industrial machinery, shoes, building materials, lumber, and paper. Order of listing and source as in fn. *d*.

[f] Excludes building paper, newsprint, and paperboard.

Note: All measures are average monthly amplitudes computed by averaging the monthly percentage changes without regard to sign. For the meaning of the symbols, see text. Subscripts *o* and *s* denote new orders and shipments, respectively. The seasonal component ($\overline{Se}$) refers to moving seasonal factors computed by the ratio-to-the-moving-average method. The irregular component ($\overline{I}$) refers to the monthly ratios of the seasonally adjusted series to its Spencer graduation (a fifteen-month weighted moving average). The Spencer graduation itself represents the cycle-trend series from which $\overline{Cy}$ is computed.

The measures were supplied by the Univac time series analysis program developed by Julius Shiskin in Moore, ch. 17. Our symbols *Or*, *Cy* and *Se* correspond to his *O*, *C* and *S*, respectively.

SOURCES: for lines 5–9: Electric Overhead Crane Institute, American Railway Car Institute, American Paper and Pulp Association, Southern Pine Association, Seidman and Seidman.

corresponding amplitude measures for shipments and new orders (columns 13–18) have the common characteristic of being less than one; but apart from that, they vary greatly. The *smallest ratios*, indicating the *largest reductions* in variability, are found for goods made on contracts with long delivery periods (for example, freight cars, line 6). The largest ratios, indicating the smallest reductions in variability, are for goods sold largely from current output, on short delivery and with low average backlog levels (for example, paper, line 7), and for goods produced in large measure to stock (for example, southern pine lumber, line 8).

The degree of stabilization achieved also differs by the type of movement (*Se*, *Cy*, *I*). The ratios $\overline{I}_s/\overline{I}_o$ (column 16) are smaller throughout than the ratios $\overline{Cy}_s/\overline{Cy}_o$ (column 17). Work on orders received is ordinarily scheduled to smooth out the very short fluctuations in incoming business, which is indeed much easier to accomplish than a reduction of the longer cyclical variations.[37]

Throughout the manufacturing sector, changes in delivery periods and backlogs had very strong stabilizing effects in the period under consideration. This is shown by the amplitude ratios for comprehensive aggregates and group averages in Table 6, lines 1 and 2. It is also demonstrated in Table 7, which covers a different set of data and employs different amplitude measures. Here we compare the average relative amplitudes of cyclical movements for (1) output and deflated new orders ($\bar{Z}$ vs. $\bar{O}$) and (2) output and deflated shipments ($\bar{Z}$ vs. $\bar{S}$), by the major industries given in the available OBE data.

The ratios $\bar{S}/\bar{O}$, which reflect backlog adjustments, are often low (.53 for total durables) and all smaller than one. On the other hand, the ratios $\bar{Z}/\bar{S}$, which reflect stock adjustments, tend to be close to, and are more often than not larger than, one. The ratios $\bar{Z}/\bar{O}$ $(= \bar{S}/\bar{O} \times \bar{Z}/\bar{S})$ differ very little from the corresponding $\bar{S}/\bar{O}$ figures (cf. columns (4)–(6). Also taking into account timing relations — deflated new orders lead output, while the latter are approximately synchronous with deflated shipments (see columns (7) and (8) — the summary conclusion is that the net effects of backlog changes on production are stabilizing throughout and on the whole strong, whereas the net effects of finished-stock changes are often "destabilizing" and as a rule weak.

It should be noted that industries for which no unfilled orders are reported are not separately represented in our measures (although they are included in the figures for total nondurables, Table 7, line 9). For these industries one would expect shipments to be more closely correlated with new orders than with output, the opposite situation to that of industries that work predominantly to order.[38]

Uncertainty and Related Considerations. The future time path of sales (orders received) is, of course, uncertain; even the probabilities of the various possible paths are unknown to the firm, let alone the actual outcome. Even the knowledge of the present — the properties of the relevant cost and demand functions — is, as a rule, quite imperfect. To reduce the area of ignorance in these matters is costly, and the costs of obtaining the information must be weighed against the returns expected from it.[39]

The hazards of uncertainty and the requirements of information are very large indeed for a manufacturer who would use pricing policy to meet cyclical demand fluctuations in the manner described in the first part of this section. He would have to undertake much more than the usual (but already difficult) task of projecting sales within the existing price structure, for his forecasts would have to incorporate the response of orders to the changes in that structure due to his own active price policy. This response may be unstable because of its dependence on changing business conditions and it may involve substantial and variable lags. And where there is a prospect of competitors' reactions to the firm's pricing decisions, these countermoves and their effects on the firm's sales would also need to be taken into account. Finally, the "sunk" costs of publicizing a new

[37] It may be noted that, on a month-to-month basis, $\overline{Se}$ and $\bar{I}$ are typically larger than $\overline{Cy}$. Since the cyclical factor is cumulative in the short run, while the irregular is not, the ratio of $\bar{I}$ to $\overline{Cy}$ declines when it is computed for two- or three-month and longer spans. However, for many of our new order series (but only for a few shipment series), at least five or six months are necessary for the ratio $\bar{I}/\overline{Cy}$ to fall below one.

[38] It can be argued that our data for individual industries or products underrepresent staple manufactures and therefore also the relative importance of stock adjustments. In this connection, it may be worth giving some further attention to the two items in Table 6 for which the role of advance orders should be relatively weak (according to the Q/U ratios in Table 2 and other relevant information). These examples show some stabilization attributable to stock adjustments.

	Paper, Excl. Building Paper etc., 1934–55 (line 7)			*Southern Pine Lumber, 1929–56 (line 8)*		
	New Orders	*Shipments*	*Output*	*New Orders*	*Shipments*	*Output*
$\overline{Se}$	5.7	5.7	n.a.	7.6	7.0	4.7
$\bar{I}$	3.7	2.6	1.8	7.2	4.9	4.2
$\overline{Cy}$	1.7	1.3	1.2	2.6	2.2	2.1

In particular, for the lumber series, output is considerably more stable seasonally than shipments, apparently reflecting counterseasonal use of stock. However, even in these cases most of the reduction in $\bar{I}$ and $\overline{Cy}$ occurs between new orders and shipments rather than between shipments and output and thus is presumably due to backlog rather than to finished-inventory adjustment.

[39] The returns depend essentially on the quality of the information, and they are themselves uncertain. For a theory of the "Economics of Information," see the paper so entitled by George J. Stigler in *The Journal of Political Economy*, LXIX (June 1961), 213–225.

TABLE 7. — AMPLITUDE AND TIMING OF OUTPUT, NEW ORDERS, AND SHIPMENTS, BY MAJOR MANUFACTURING INDUSTRIES, 1948–58

Industry	Average Relative Amplitude of Cyclical Movements [a]: New Orders, Deflated $\bar{O}$ (per cent) (1)	Ship-ments, Deflated $\bar{S}$ (per cent) (2)	Produc-tion $\bar{Z}$ (per cent) (3)	Ratio of Average Relative Amplitudes of Cyclical Movements [b]: $\bar{S}/\bar{O}$ (4)	$\bar{Z}/\bar{S}$ (5)	$\bar{Z}/\bar{O}$ (6)	Average Lead (−) or Lag (+), in Months: New Orders vs. Production (7)	Production vs. Shipments (8)
1. Durable goods, total	38	20	20	.53	1.00	.53	−6.7	−0.4
2. Primary metals	51	48	47	.92	1.02	.94	−3.1	−1.0
3. Fabricated metal products	47	19	17	.35	1.12	.40	−3.4	−0.1
4. Electrical machinery	50	34	26	.52	1.31	.68	−1.6	−0.1
5. Nonelectrical machinery	42	32	28	.67	1.14	.76	−4.5	+1.2
6. Motor vehicles and parts	57	39	41	.72	.95	.68	−3.7	+0.4
7. Nonautomotive transport. equip.	197	70	71	.36	.99	.36	−8.2	−1.5
8. Other durable goods [c]	27	16	17	.63	.94	.59	−3.0	+2.3
9. Nondurable goods, total	14	11	11	.79	1.00	.79	−4.8	+2.5
10. Textile-mill products	56	21	20	.36	1.05	.37	−4.1	+2.4
11. Leather and leather products	27	16	18	.67	.89	.59	−2.9	+2.2
12. Paper and allied products	27	24	23	.85	1.04	.88	−4.0	+1.5

[a] For each successive expansion and contraction in the given series, the amplitude was measured between the average standings of the series in the three-month period centered on the initial and terminal turns. All amplitudes were expressed in percentages of the initial-turn levels. Entries in columns 1–3 represent averages of these expansion and contraction amplitudes taken without regard to sign.

[b] Figures in column (4) are ratios of the corresponding entries in columns (2) and (1); those in column (5) are ratios of the corresponding entries in columns (3) and (2); and those in column (6) are ratios of the corresponding entries in columns (3) and (1).

[c] Includes professional and scientific instruments; lumber; furniture; stone, clay, and glass; and miscellaneous industries.

Symbols used: $\bar{O}$ = average cyclical amplitude of deflated new orders.
$\bar{S}$ = average cyclical amplitude of deflated shipments.
$\bar{Z}$ = average cyclical amplitude of production index.

SOURCE: New orders and shipments: current value aggregates of the U.S. Department of Commerce, Office of Business Economics. Deflated by price indexes constructed from the appropriate components of the Wholesale Price Index of the U.S. Department of Labor, Bureau of Labor Statistics. Production: components of the Federal Reserve Index of Industrial Production. All series seasonally adjusted.

price may be a significant factor advising against frequent price adjustments in a fluctuating market.

The policy of letting backlogs accumulate and decumulate cyclically requires no such heroic efforts to face up to uncertainty and reduce ignorance. The seller adopts a relatively passive attitude of accepting the fluctuations of demand instead of trying to minimize them and the corresponding output variation by sharply cyclical pricing. He just needs to keep more or less in step with his competitors in the price and delivery terms quoted. This behavior implies that the firm acquires unfilled orders on a large scale at the same time as the industry as a whole does, that is, when the demand for their output is strong and diffused so that firms throughout the industry are working near or at capacity. In this phase, extensions of delivery periods will be an industry-wide phenomenon and generally acceptable to the buyers. Indeed, during a boom customers often place orders for longer periods ahead on their own initiative, spurred on by expectations of price increases or shortages. The bargaining position of the seller is then generally strong and he can gain considerable discretion over the delivery dates. (It seems probable that the delivery period or "lead time" is often less formally or strictly established than the price). Inasmuch as all this applies more or less equally to its competitors as well, the individual firm has no reason to fear that any particular penalties — cancellation of past or denial or reduction of future orders — would be imposed on it by customers in reaction to the extensions of lead times. Thus, while it is true that the sensitivity of sales to the relative delivery period (D_k, cf. the Appendix) is not necessarily easier to estimate than the sensitivity of sales to the relative price (D_p), there is much less need for a firm to know D_k when following a policy of backlog accumulation than to know D_p when relying on price adjustments.

Concentrated ordering that looks to more distant delivery dates must surely be seen as "overbuying" in the current phase and an indication of probable "underbuying" to follow sometime in the future. But this again will be recognized as an industry-wide phenomenon.

And it is precisely in those industries where demand is generally expected to fluctuate that producers would have good reason to appreciate the advantage of increased production stability offered by backlog accumulation. In fact, various expressions of business opinion leave little doubt that manufacturers in many cyclically sensitive durable-goods industries regard large order backlogs as highly desirable.[40]

The fact that it is durable goods that are mainly produced to order (Table 2) provides some support for the hypothesis that backlog adjustments are most important in industries in which demand is more unstable. Further evidence is contained in Table 6. On the assumption that the greater variability of cyclical and irregular movements in new orders is associated with greater uncertainty (seasonal movements, however large, being on the whole much more predictable), we have divided a group of fourteen industries into two subgroups with above-median and below-median $\overline{CyI}_o$ values, respectively, and present separate averages of the amplitude measures for each subgroup in lines 3 and 4 of Table 6. It is clear that the group with greater variability achieved a higher degree of stabilization of shipments vs. new orders than the group with lower variability. Going a step further, we have ranked the fourteen industries by the values of these average amplitude ratios. These ranks are positively correlated using Spearman's coefficients (rank r) as follows:

Variables	rank r	Variables	rank r
$\overline{CyI}_o$ vs. $\overline{Se}_o/\overline{Se}_s$	.53	$\overline{CyI}_o$ vs. $\overline{I}_o/\overline{I}_s$	.68
$\overline{CyI}_o$ vs. $\overline{CyI}_o/\overline{CyI}_s$	.57	$\overline{CyI}_o$ vs. $\overline{Cy}_o/\overline{Cy}_s$	.67

If our assumption is accepted, then, these results are clearly consistent with the hypothesis. The ranks of industries by $\overline{CyI}_o$ and by Cy_o are highly correlated (rank $r = .81$), so that one can also say that the role of the backlog factor tends to be greater, the larger the *cyclical* variability.

Competitive and Noncompetitive Behavior. The model of a perfectly competitive market has ordinarily been interpreted in dynamic terms to mean that excess demand is corrected instantaneously by price adjustments, so that equilibrium is, in effect, continuous. Strictly speaking, this implies simultaneity of demand and supply, or zero delivery period. But price adjustments still retain their exclusive role of the equilibrating medium if the model is slightly relaxed so that the delivery period (k) is assumed to be positive but treated as a constant. Yet it is not satisfactory to *postulate* this point; rather, the possibility of *variable* k's must be recognized. Variations over time in the average k for a given industry are compatible with a stable *structure* of the k-p relations, which may be enforced by competition (that is, with stability of the contour maps in Appendix Figure 1 for the different firms in the industry). If buyers are willing to wait for delivery but not willing to pay higher price (that is, if demand is elastic with respect to p, inelastic with respect to k), then backlogs are likely to appear or increase as demand rises. In the opposite case, price rather than backlog reactions would be dominant.

There is no necessary presumption, therefore, that the competitive nature of the market as such will prevent sizable increases of delivery periods and backlogs in the case of an industry-wide boom. Such increases may, and apparently do, occur in industries in which the degree of competition is high, but there they will be strictly market-determined, due to excess short-

[40] The above discussion of costs and benefits of backlog accumulation points up the inadequacy of the view of cost adopted in the Appendix (eq. 2), which can serve only as a simple first approximation. The reduction of current costs due to a marginal extension of the delivery period (C_k) will presumably become larger with the transition to higher capacity-utilization levels — with increasingly less flexible inputs. But when the firm begins to receive orders for future delivery *beyond its capacity output*, then, by accepting them, it lengthens the average delivery period on its aggregate unfilled orders. Its average production costs of *the current period* (C) need not be affected thereby at all. But the change in the time profile of the stream of output and shipments, which is involved in such an expansion of the backlog, certainly does have the effect of reducing the firm's operating costs over a longer stretch of time, as brought out in the text. A promising approach to a generalization of the cost function, which is pertinent here, has been offered recently by Armen Alchian in "Costs and Outputs," *The Allocation of Economic Resources: Essays in Honor of Bernard Francis Haley* (Stanford, 1959), 23-40. In Alchian's formulation, the present worth, capital value concept of cost is used instead of the rate of cost concept. So defined, cost is a function of total contemplated volume of output (V) and the delivery dates, as well as of the output rate. These costs — the change in equity — are, of course, always affected by changes in the delivery schedule or the time profile of the output stream which cumulates to V. Costs *decrease*, other things being equal, as the delivery periods *increase*.

run demand and not related to any policies of the individual seller (paralleling, in this respect, the cyclical increases in price levels).[41]

Lags of price adjustments due, say, to contractual arrangements must also be considered. And if the demand curve rose steadily over a period of time rather than by separate shifts, more persistent lags would he likely hecause price, though increasing, would then lag behind the rise of the equilibrium or clear-the-market level and thus continue below it.[42]

In an industry in which prices are set by firms with considerable "monopoly power," the process of large-scale backlog expansion, besides feeding on the sustained pressure of demand on capacity, may also be aided by deliberate policies of "conservative" pricing. Sellers may see a conflict between higher pricing and large backlog accumulation and helieve that the best strategy is to proceed cautiously on the former so as not to jeopardize the latter. Such a price policy is not justified by the immediate situation during a boom, hence the hypothesis presumably applies only to firms that look well ahead in their present decisions. But in some markets the effects of a firm's action today often extend over a whole series of future periods.[43] Awareness of this leads to longer-term policies, and these may well counsel restraint in pricing. This applies particularly to noncollusive oligopoly where aggressive price policy, which must include undercutting in the slack period, is risky in view of the uncertain reactions of the rivals and may often be inhibited by fear of retaliation or of costly warfare. Letting the delivery periods vary may appear far less hazardous.

If competition in factor markets is also restricted, the interrelation of product and factor markets may provide an additional reason against a policy that would rely principally on price adjustments. Higher-wage demands by labor unions may be prompted hy price increases and hard to resist; if wage increases, once granted, are viewed as virtually irreversible, then raising the price now and lowering it in an ensuing slump would seem an imprudent course to follow. On the other hand, delivery periods are subject to changes that are definitely reversible — nothing more than the end of the boom is needed to reduce them again to a more nearly "normal" length.

Recent writing provides some examples of extreme emphasis on the dependence of short-run price behavior on changes in costs, sometimes to the point of excluding from explicit consideration the influence of demand (which assumes that changes in demand are met almost exclusively by backlog and/or stock adjustments).[44] The possibility of a joint relationship

[41] Kenneth J. Arrow suggests that the inequality of market supply and demand per se leads to deviations from competition; the competitive model applies under equilibrium conditions ("Toward a Theory of Price Adjustment" in *The Allocation of Economic Resources*, 40–51). He submits that price discrimination can be and probably is practiced by entrepreneurs even in relatively unconcentrated industries in times of excess supply, and that prices can be raised by them individually with little risk when excess demand prevails throughout the industry. That the competitive price theory is basically static is not questioned. But Arrow's extreme view that "the inequality of supply and demand leads to a condition of partial monopoly" tends to blur important distinctions due to real differences in competitiveness. Interpretations in terms of the effects of uncertainty and lagged adjustments have, to this writer, considerably more appeal.

[42] See, e.g., Kenneth J. Arrow and William M. Capron, "Dynamic Shortages and Price Rises: The Engineer-Scientist Case," *The Quarterly Journal of Economics*, LXXIII (May 1959), 299–301. It may be well to place some emphasis on the view that the case of persistent excess demand due to a continuous rise in demand is compatible with a high degree of competition, for this possibility is often disregarded. Cf. John Kenneth Galbraith, "Market Structure and Stabilization Policy," this REVIEW, XXXIX (May 1957), 127: "The price adaptation [in a competitive industry, e.g., staple cotton textiles] proceeds *pari passu* with the increase in demand; it is completed *pari passu* with the completion of the movement in demand."

[43] In contrast they would be limited to the present under conditions of perfect competition. Cf. George J. Stigler, *The Theory of Price* (New York, 1952), 168–169.

[44] Cf. Joseph V. Yance, "A Model of Price Flexibility," *American Economic Review*, L (June 1960), 401–418. On the connection between cost-determined pricing and backlog accumulation, see section 1, fn. 3.

In some studies of price reactions that do attempt to estimate the influence of short-run demand changes, the measurement of such changes is open to serious doubt, which may have much to do with the negative conclusions reached (that response is lacking or even perverse). See Wesley J. Yordon, Jr., "Industrial Concentration and Price Flexibility in Inflation: Price Response Rates in Fourteen Industries, 1947–1958," this REVIEW, XLIII (August 1961), 287–294. To represent demand change in the current quarter, Yordon uses "deviation of 'average weekly hours' during the three previous months from the twelve-year average for the quarter" (*Ibid.*, fn. 8). This seems a very roundabout and probably not very sensitive type of measure, although workweek adjustments do represent a common means of varying labor input in response to changes in demand.

should be recognized. Table 8 presents the results of some regressions of ΔP on ΔU and on the change in average hourly earnings, ΔW. It shows that the inclusion of ΔW, while im-

TABLE 8. — RELATIONS BETWEEN PRICE CHANGES AND CHANGES IN BACKLOGS AND IN WAGES, FIVE MAJOR INDUSTRIES, 1948–58

Industry	Partial Correlation Coefficients $r_{12.3}$	Partial Correlation Coefficients $r_{13.2}$	Multiple Correlation Coefficient $R_{1.23}$
Paper and allied products	.737	.518	.801
Textile-mill products	.697	.525	.781
Primary metals	.348	.613	.696
Nonelectrical machinery	.271	.505	.648
Fabricated metal products	.360	.510	.640

NOTE: Variable "1" is ΔP_t; variable "2" is ΔU_{t-3} for paper and fabricated metals, ΔU_t for other industries; variable "3" is ΔW_{t-3} for paper, ΔW_t for other industries. Quarterly series used throughout: t denotes current quarter, $(t-3)$ previous quarter. The timing of ΔU and ΔW relative to ΔP is that which maximizes the multiple correlation coefficients. The regressions cover forty-three quarters for textiles and fabricated metals, forty-four quarters for each of the other industries (in Table 5 the use of ΔU variables made it necessary to work with forty-two and forty-three quarters).

For the source of the ΔP and ΔU data, see Table 4. The ΔW series are derived from monthly statistics of the U.S. Department of Labor, Bureau of Labor Statistics.

portant in all cases, does not eliminate the influence of ΔU. In fact, price changes in paper and textiles are apparently more strongly affected by "demand pressures" as measured by ΔU than by the direct "cost push" (ΔW). The influence of wage changes is relatively stronger in the regressions for the other industries. But it may be questioned whether the factors ΔU and ΔW should really be treated on a par as potential determinants of price change.[45] Moreover, there are good reasons to expect list prices to be more sensitive to cost than to demand changes, and the wholesale price indexes used in our regressions reflect to a large extent sellers' list quotations (see fn. 25 above).

Lower concentration ratios prevail among the component industries in paper, textiles, and other durables than in metal products, machinery, and transportation equipment. This being the case, the results of our analysis (Tables 5 and 8) give some support to the idea that departures from competition contribute to the importance of backlog adjustments.[46]

IV. Summary

In the period since World War II, unfilled orders held by manufacturers in most major durable-goods and some nondurable-goods industries have been several times as large as monthly shipments and have fluctuated widely relative to them. Many products of these industries face extremely unstable, sporadic, or individualized customer demand. They are manufactured to order at all times because the expected costs of carrying unsold stocks of such items are high. Variations in order backlogs permit some stability in production rates in these industries, just as variations in finished-goods inventories permit output stability in industries that produce largely to stock. Indeed, it appears that backlog changes have a strong stabilizing effect in many industries, while changes in finished stocks have relatively weak effects.

Fluctuations in the ratio of unfilled orders to shipments reflect, at least roughly, fluctuations in average delivery periods. Earlier delivery will often cause costs to the producer; delayed delivery, costs to the buyer. Hence, other things equal, an inverse relation between price and delivery period would be expected. However, if demand increases and is such as to give rise to pressures upon the industry's capacity to produce, the typical result is an increase in price as well as a lengthening of the average delivery period (backlog accumulation). The second effect only partially offsets the first: if a larger part of the rise in demand is absorbed by additions to the volume of unfilled orders, less of it will go into price increases.

[45] Since labor costs are an important part of price, it is only natural for the simultaneous changes in the two to be positively correlated. While it is easier to think of ΔW influencing ΔP in the short run than vice versa, some elements of a "feedback" are presumably present. Thus, when prices rise and profit margins do also, owing to a strong and increasing demand for the product, wage increases may be demanded and, under the circumstances, promptly gained, too. Moreover, such demand pressures will cause overtime work, and our wage-cost variable is computed from average hourly earnings data which include overtime as well as straight-time earnings. To avoid the feedback difficulty, one could take ΔW with a quarterly lead, but (except for paper) the effect of this would be to reduce drastically the importance of the wage variable as a determinant of ΔP. On the other hand, if any feedback effect of ΔP_t upon ΔU_t exists at all, it is probably very small.

[46] The evidence is suggestive but, of course, far from conclusive because of its limitation to a few highly aggregative series. In our analysis, backlog accumulation is traced to the working of several factors and no reason is found to link it to noncompetitive behavior alone. (Cf. Galbraith in this REVIEW, XXXIX (May 1957), where backlog accumulation has been attributed squarely to oligopolistic pricing during a boom.)