86TH CONGRESS
1st Session
JOINT COMMITTEE PRINT

STUDY PAPERS NOS. 2 AND 3

STEEL AND THE POSTWAR INFLATION

BY

Otto Eckstein and Gary Fromm

AN ANALYSIS OF THE INFLATION IN MACHINERY PRICES

BY

Thomas A. Wilson

MATERIALS PREPARED IN CONNECTION WITH THE

STUDY OF EMPLOYMENT, GROWTH, AND PRICE LEVELS

FOR CONSIDERATION BY THE

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

NOVEMBER 6, 1959

Printed for the use of the Joint Economic Committee

UNITED STATES
GOVERNMENT PRINTING OFFICE
47588 WASHINGTON : 1959

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington 25, D.C. - Price 25 cents

These are part of a series of papers being prepared for consideration by the Joint Economic Committee in connection with their Study of Employment, Growth, and Price Levels. The committee and the committee staff neither approve nor disapprove of the findings of the individual authors. The findings are being presented in this form to obtain the widest possible comment before the committee prepares its report.

LETTERS OF TRANSMITTAL

OCTOBER 30, 1959.

To Members of the Joint Economic Committee:

Submitted herewith for the consideration of the members of the Joint Economic Committee and others are study papers 2 and 3, "Steel and the Postwar Inflation," and "An Analysis of the Inflation in Machinery Prices."

These are among the number of subjects which the Joint Economic Committee has requested individual scholars to examine and report on to provide factual and analytic materials for consideration in the preparation of the staff and committee reports for the study of "Employment, Growth, and Price Levels."

The papers are being printed and distributed not only for the use of the committee members but also to obtain the review and comment of other experts during the committee's consideration of the materials. The findings are entirely those of the authors, and the committee and the committee staff indicate neither approval nor disapproval by this publication.

PAUL H. DOUGLAS,
Chairman, Joint Economic Committee.

OCTOBER 27, 1959.

Hon. PAUL H. DOUGLAS,
Chairman, Joint Economic Committee,
U.S. Senate, Washington, D.C.

DEAR SENATOR DOUGLAS: Transmitted herewith are the second and third in a series of papers being prepared for the "Study of Employment, Growth, and Price Levels" by outside consultants and members of the staff. The authors of these papers are myself and Gary Fromm and Thomas A. Wilson. Mr. Wilson is a member of the study staff and Mr. Fromm is at Harvard University, Cambridge, Mass.

Additional papers in the series will contain further studies of price changes, as well as studies of potential policies designed to reduce instability in the price level. Other volumes will deal with the objectives of employment and economic growth. All papers are presented as prepared by the authors, for consideration and comment by the committee and staff.

OTTO ECKSTEIN,
Technical Director,
Study of Employment, Growth, and Price Levels.

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STUDY PAPER NO. 2

STEEL AND THE POSTWAR INFLATION

(BY OTTO ECKSTEIN AND GARY FROMM)

STUDY PAPER NO. 2

STEEL AND THE POSTWAR INFLATION

(By Otto Eckstein and Gary Fromm)

I. Introduction

The period of inflation, 1953–58, has alarmed observers, producing much gloom about the future trends of prices. The two earlier postwar bursts of inflation, 1946–48 and 1950–52, were easily understood as the results of wars; the most recent inflation coincided with heavy outlays for national security, but since these rose little as compared with the preceding period of relative price stability, the causes for the recent inflation must largely be sought elsewhere.

Even the most cursory look at the behavior of the prices of the different portions of the national output in this period (see table 1) quickly pinpoints the inflation: costs of services, of government, of machinery, and of commercial and industrial construction rose 12 to 20 percent, while the average prices of the other sectors rose substantially less.

TABLE 1.—*Implicit price deflators for gross national product, percentage change, 1953–58*

	Percent change
Total gross national product	11. 8
Personal consumption expenditure	8. 3
Durable goods	5. 8
Nondurable goods	6. 4
Services	11. 8
Gross private domestic investment	-----
New construction	13. 6
Residential nonfarm	9. 7
Other	17. 7
Producers durable equipment	20. 2
Government purchases of goods and services	20. 1

Source: U.S. Income and Output, table VII-2.

In an inflation of this sort, concentrated in a few sectors, with the average price level of the economy rising only 2 or 3 percent a year, it is particularly difficult to devise proper policies. Where excessive total demand is pulling the entire price structure of an economy upward, policy must clearly seek to bring demand down to levels matching total supply. But where the imbalances between demand and supply in various markets are uneven and ambiguous, it becomes extremely difficult to wring the inflation out of the system without serious side effects on the level of employment and the rate of growth.

In order to gain a more complete understanding of this type of inflation, the "Study of Employment, Growth, and Price Levels" has undertaken several studies of specific sectors in which prices rose. The two papers presented in this volume are devoted to the inflation in industrial goods prices, particularly to the two sectors in which this part of the inflation was centered, the steel industry and the machinery industry. The inflation in public and private services and in construction, is analyzed in subsequent study papers.[1]

These papers are based on the assumption that proper anti-inflationary policy must be based on an understanding of the specifics of the inflationary process. Once the sectors in which the inflation was concentrated have been identified and the causes of their price rises have been analyzed, it should be possible to evaluate the potential effectiveness of alternative policies.

II. The Inflation in Industrial Prices

The pattern of rise of industrial prices from 1947 to 1958 can be seen most clearly from table 2, which presents the relative significance of the different components of the industrial price index. The period is divided into three parts, 1947–51, 1951–55, and 1955–58. The first period covers the inflation associated with the Korean war; the second was one of price stability, while the third is the period of "creeping inflation" of recent years.

In the first period, the wholesale price index as a whole rose 22 percent, with prices of all industries rising considerably. From 1951–55, the index rose 1 percent and from 1955–58 it rose 8 percent. The period of stability represented offsetting rises in metals, machinery, motive products, minerals, and tobacco, and falls in various soft goods. In the last period, the price rises became more concentrated: three-fourths of that increase was in the metals and machinery portion of the index, even though it represents just one-third of the index. Most other prices rose relatively little with the exception of pulp and paper and structural nonmetallic minerals.

In the machinery industries, price increases were quite generally diffused. Analysis of this set of prices can be found in the succeeding paper by Thomas Wilson.[2]

Iron and steel accounted for the largest part of the increase in the index of prices of metals and metal products. In relation to the index as a whole, the iron and steel component directly accounted for 22 percent of the increase, even though it represents only 8 percent of the weighted items that together constitute the index.

III. The Strategic Importance of Steel Prices

Quite apart from the direct impact of steel prices on price indexes, the steel industry plays a uniquely strategic role in the price and wage structure of the economy. Steel is an important input into many other industries. Thus, any price increase in steel ripples through the economy in the form of cost increases, leading to higher prices in other industries. Steel wages are determined in key wage bargains, often setting the pattern for other industries including, at times, automobiles, metalworking, fabricating, aluminum, and cement. With

[1] See the forthcoming papers by George W. Bleile, Markley Roberts, Werner V. Hirsch, and Harold M. Levinson.

[2] Thomas A. Wilson, "An Analysis of the Inflation in Machinery Prices," Study Paper No. 3.

TABLE 2.—*The rise in industrial prices, a component analysis of change in the wholesale price index, excluding food and farm products* [1]

Component	1947–51				1951–55				1955–58				
	Index, 1947	Percent change	Relative importance, 1947	Percent contribution to total change	Index, 1951	Percent change	Relative importance, 1951 [1]	Percent contribution to total change	Index, 1955	Index, 1958	Percent change	Relative importance, 1955	Percent contribution to total change
All commodities other than farm and food	95.3	21.6	100.00	100.0	115.9	0.9	100.0	100.0	117.0	126.0	7.7	100.00	100.0
Textile products and apparel	100.1	10.5	13.94	6.7	110.6	−13.8	13.30	−161.6	95.3	93.5	−1.9	10.84	−2.7
Hides, skins, and leather	101.0	19.1	2.98	2.6	120.3	−22.0	3.10	−59.6	93.8	100.6	7.2	1.87	1.8
Fuel, power, and lighting material	90.9	17.4	12.38	9.9	106.7	1.1	11.41	10.8	107.9	112.7	4.4	11.79	6.9
Chemicals and allied products	101.4	8.5	7.58	3.0	110.0	−3.1	7.20	−20.2	106.6	110.4	3.6	8.48	3.9
Industrial chemicals	98.8	22.2	(2.83)	(2.8)	120.7	−2.2	(2.95)	(5.9)	118.1	123.5	4.6	(3.53)	(2.1)
Rubber and products	99.0	49.5	2.24	5.1	148.0	−2.8	2.88	−7.1	143.8	145.0	.8	2.49	.3
Lumber and wood products	93.7	32.2	3.78	5.6	123.9	−.2	4.04	−1.5	123.6	117.7	−4.8	3.57	−2.2
Pulp, paper, and allied products	98.6	21.3	4.91	4.8	119.6	−.3	5.07	−.4	119.3	131.0	9.8	4.99	6.4
Metals and metal products	91.3	34.5	16.79	26.5	122.8	11.0	17.80	178.1	136.6	150.4	10.1	18.60	24.7
Iron and steel	89.7	37.3	(7.34)	(12.5)	123.2	14.1	(7.81)	(95.9)	140.6	168.8	20.1	(8.45)	(22.3)
Machinery and motive products	92.5	28.6	20.22	26.5	119.0	7.9	20.77	148.8	128.4	149.8	16.7	22.73	49.7
Motor vehicles	91.3	23.6	(7.19)	(7.8)	112.9	8.9	(7.01)	(56.3)	122.9	139.7	13.7	(7.78)	(14.0)
Furniture and other household durables	95.6	19.3	5.54	4.9	114.1	1.6	5.45	7.2	115.9	123.2	6.3	5.40	4.5
Nonmetalic minerals, structural	93.9	21.0	1.97	1.9	113.6	9.3	1.93	17.7	124.2	136.0	9.5	2.75	3.4
Tobacco manufacturing and bottled beverages	97.2	11.2	3.37	1.7	108.1	12.5	3.14	30.4	121.6	128.2	5.4	3.12	2.2
Miscellaneous	100.8	4.1	4.30	.8	104.9	−12.3	3.90	−42.6	92.0	94.2	2.4	3.37	1.1

[1] This table is computed as follows: The relative importance weight of each item is multiplied by the percent change in the item and then divided by the sum of these products. The beginning of period relative importance weights are used in each instance, except in the middle period where the computation had to be carried out in 2 stages because of the revisions in the index at the end of 1954.

Source: Bureau of Labor Statistics, Wholesale Prices and Price Indexes.

most of the creep in prices of commodities concentrated in the hard-goods industries and with steel prices moving upward at a pretty steady trot, no analysis of the recent inflation can be complete without explicit consideration of the role of steel.

In the following sections, two tasks are assayed. First, the impact of the cost-push from steel prices on other prices is estimated. Second, the nature of the inflationary process in steel is analyzed in an effort to determine whether a high level of demand, the possession and exercise of market power, or the rise in the cost of purchased materials were the primary causes of the movements in steel prices and wages.

IV. The Magnitude of the Cost-Push From Steel

In order to come at least to a partial quantitative evaluation of the significance of steel prices for the economy's price structure, the technique of input-output analysis has been employed. The input-output form of economic accounts provides, for each industry, distributions of purchases from and sales to all other industries as well as sales to sectors of final demand such as consumers, etc. By taking account of all the steel input per dollar of sales of each other industry, that is, both the direct purchases of steel as well as the steel content of other purchased inputs, this technique permits the computation of the total effect of a rise in steel prices on the unit costs of all other industries. If we assume that the other industries neither absorb the rise in steel costs, nor add a markup of their own, then prices in these other industries can be estimated to rise pari passu with costs. In the short run, no doubt there is some cost absorption. But over the 5- and 10-year periods that are being analyzed here, containing such large increases in steel prices, the assumption of a cost pass-through cannot be far off the mark. Even if some cost absorption or marking up occurred, it seems reasonable to assume, as a first approximation, that these operated as offsetting influences in the aggregate. Particularly prosperous industries might add a markup, declining industries might absorb costs. Given the general economic conditions over the period, including the relative constancy of profit margins, the net markup or absorption must have been close to zero.[3]

In order to bring out the overall effect on goods prices, the direct and indirect effects of the greater-than-average increases in steel prices on several wholesale price indexes have been computed. Estimates of the total impacts on the prices of individual industries' prices are also stated.

The analysis proceeds as follows:

1. Each commodity's weight in the price index has been multiplied by the measure of the total direct and indirect sales of the steel industry which are required for a dollar of sales of the producing industry.[4]

2. The sum of these effects represents the total input of steel into the index, including the steel content of steel-using industries. As a

[3] Also see technical appendix for further discussion of the assumptions.

[4] The input-output coefficients are the A_{ij} of the inverse matrix, divided by the diagonal coefficients. The latter adjustment is necessary to convert the coefficient from a final demand to a total sales basis. See W. Duane Evans and Marvin Hoffenberg, "The Inter-Industry Relations Study of 1947," Review of Economics and Statistics, May 1952, pp. 97–142, especially p. 140 and table 6. For the general theoretical framework of input-output analysis, see Wassily Leontief, "The Structure of American Economy," second edition, especially pp. 45–48, 188–201. Also see Sidney Weintraub, "Forecasting the Price Level, Income Distribution and Economic Growth," where the importance of computations of the type carried out here is stressed.

total, steel represents 10.9 percent of the wholesale price index, of which 5.1 percent is the direct steel weight.[5]

3. Given the total weight of steel in the wholesale price index, it was assumed that steel prices behaved the same as the remaining components of the index and the resultant changes in the index that would have occurred were then computed.[6]

4. These hypothetical changes are contrasted with the actual changes in the index. Figure 1 shows these movements. It should be noted that the baseline for this comparison is not that steel prices stay constant—only that they behave like the average of all other prices in the index (fig. 1).

The result is very striking: if steel prices had behaved like the rest of the index, the total rise from 1947 to 1958 would have been 14 points instead of the actual increase of 23 points, that is, the extraordinary behavior of steel accounted for 40 percent of the rise over the

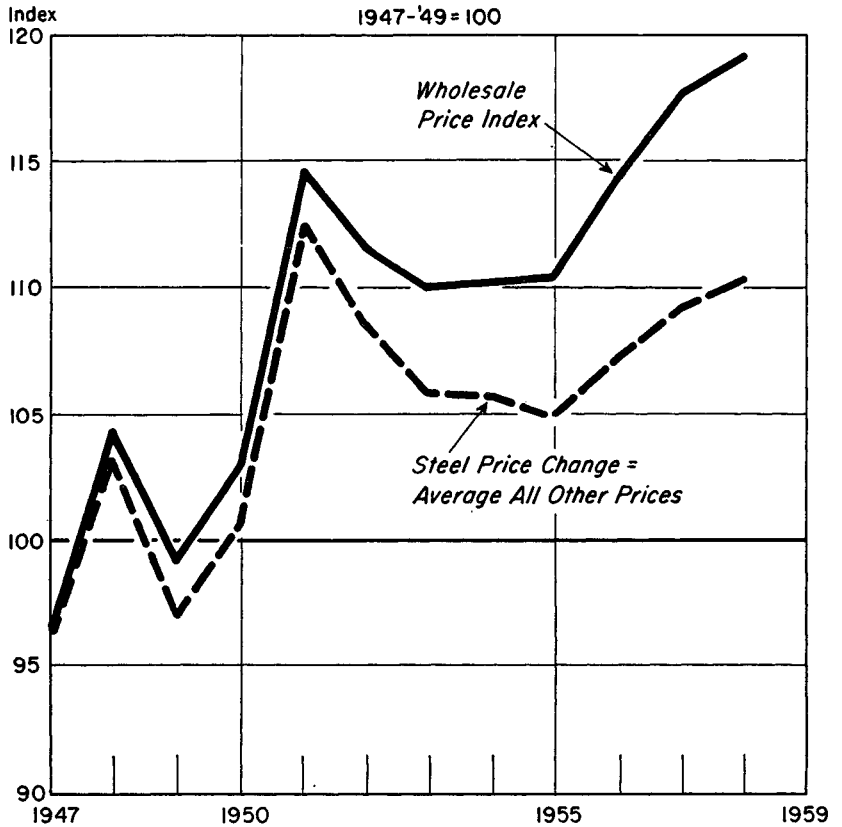

FIGURE 1.—Wholesale price index—Comparison of all items in actual index with index if steel prices had risen only as much as average of all other prices.

[5] The 1947-49 weights of the Wholesale Price Index were employed. The 1951 revision raised the direct weight of steel to 6 percent. Thus use of the old weights understates the results.

[6] This was done as follows: Given the price changes in steel for each year and the total weight in the index, the contribution of steel to the index was computed. This contribution was subtracted from the actual changes in the index to reveal the movements in the index if steel prices had remained constant. The remaining increase of the index was divided by the fraction which the components of the index other than steel constitute; this yields its average price rise. This average rise is the same as the rise in the index if steel had behaved like the rest, since both steel and the others, which together constitute the entire index, are postulated to move in this average manner. See technical appendix I for a more detailed account.

11 years. Most of the divergence has occurred since 1951, the year which saw the post-Korean peak in the index. If steel prices had changed in the same way as the average of other prices in the index, the wholesale price index would *now* be *below* the peak of 1951. (See fig. 1 on preceding page.) The fall from 1951 to 1953 would have been 6.8 points instead of 4.7; the rise from 1953 to 1958 would have been 4.8 points instead of 9.1; and the index in 1958, therefore, would have been 6.4 points lower. Similar results hold for the wholesale price index excluding farm products and foods, as can be seen from figure 2. Over the entire period, the rise would have been 18 points instead of 31, or 40 percent less. The rise since 1953 would have been 5.4 points instead of 12 (fig. 2).

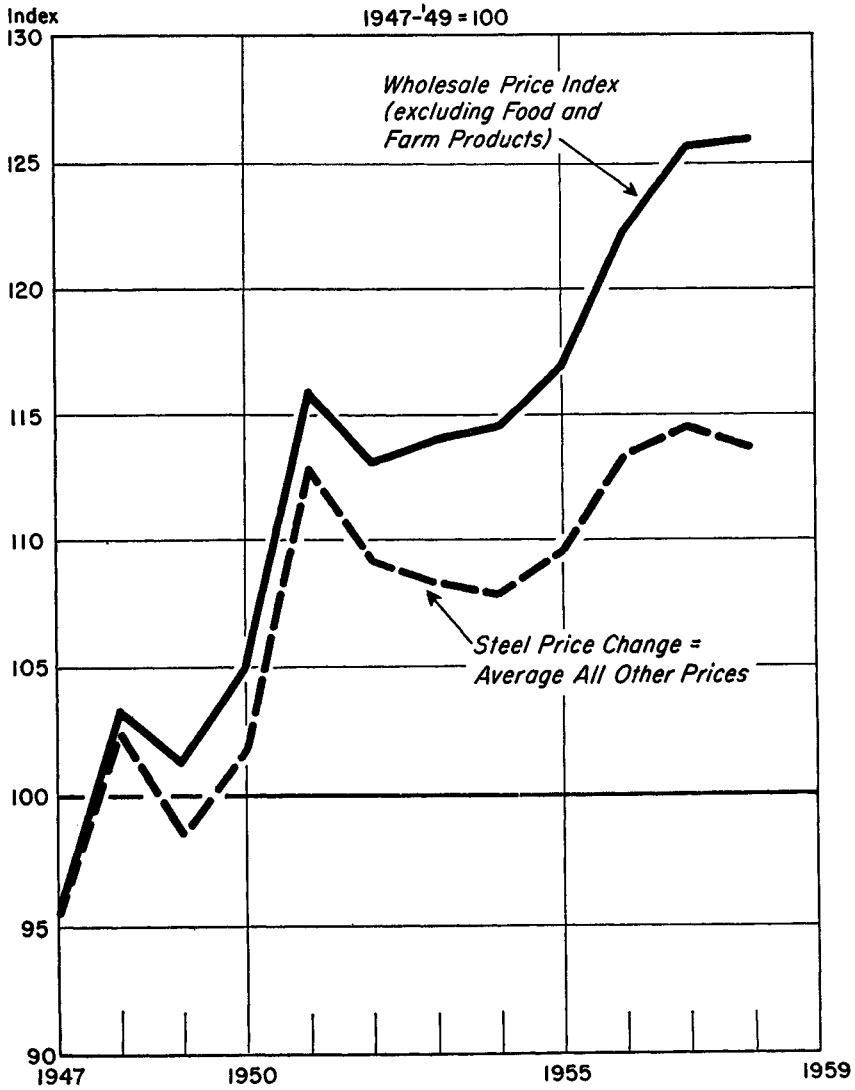

FIGURE 2.—Wholesale price index (excluding food and farm products)—Comparison of items in actual index with index if steel prices had risen only as much as average of all other prices.

Given the keen public consciousness of inflation, the movement in the wholesale price index is an important part of reality; this index measures the changes in the average price at which the transactions at all stages at wholesale are conducted. Hence it is a very comprehensive index of goods prices. However, there is one peculiarity of the index which tends to make it exaggerate the significance of primary materials. The weights represent a cross section of transactions at successive stages of production. Thus steel appears in the index, and also is reflected in metal fabricating. From the point of view of final product prices—which is just one conceptual approach to inflation, and not necessarily the best one—this involves double counting.

In order to measure the impact of steel prices on final product prices at the wholesale level, the direct and indirect effects of steel on the finished goods index, one of the sectoral wholesale price indexes, have also been computed by the input-output technique outlined above. The total steel input into the index is 7.5 percent, all of which is indirect. Figure 3 shows the movement in that index if steel had behaved like the average of the wholesale price index other than steel.[7] This index rose 25 points from 1947 to 1958. If steel prices had risen as much as the rest of the wholesale price index, finished goods prices would have risen only 19 points, or by 23 percent less. Over the period 1953–58, these prices would have risen less by 38 percent. A similar computation for finished goods other than foods echoes these results. The rise in this index over the entire period would have been 23 points instead of an actual rise of 31, or 25 percent less (fig. 4),[8] and the rise would have been 31 percent smaller from 1953 to 1958 (figs. 3 and 4).

Table 3 presents a summary of the impact of steel price increases on the wholesale price indexes, while table 4 does so for the prices of various selected specific industries and economic sectors. It can readily be seen that the effect, especially since 1953, has been considerable. This is particularly the case in those areas in which steel constitutes a significant percentage of total inputs. These high steel content industries, it should be noted, are virtually the only sectors, with the exception of rubber, which evidence a strong rise in their price indexes in the 1953–58 period. Thus it can be firmly stated that the effect of steel price increases on specific sectors and on the total economy has been strongly inflationary.

[7] Since steel is largely an intermediate material, the norm for purposes of the present computation should not be finished goods other than steel, but either intermediate goods or the wholesale price index as a whole. Materials other than steel, both crude and intermediary, rose considerably less than the index as a whole, but steel is a very large item in comparison to them. The comparison used here, using the index as a whole, if it has a bias, understates the effect of steel.

[8] Jules Backman has made some computations which purport to show that the input of steel into consumer prices is extremely small. Using the consumer price index, he finds that there is a very small steel content in the items which constitute that index, and he concludes that the impact of steel prices on consumer prices must be extremely small. While no currently available index is an ideal measure of inflation from every point of view, the Consumer Price Index is particularly poorly suited to reflect the significance of steel. Capital goods are completely excluded from the index, though in the long run they enter into consumer prices. Similarly, the cost of Government purchases are not included. The costs of new housing and consumer durables are included, but weighted according to their significance in the budget of moderate income families in large cities. All of these factors serve to understate the importance of steel prices in the inflation. See his "Steel Prices, Profits, Productivity, and Wages," in Administered Prices, hearings before Subcommittee on Antitrust and Monopoly, Senate Judiciary Committee, 85th Cong., 2d sess., pt. 4.

It should be kept in mind, however, that the wholesale price indexes used here exclude services, retail trade, and construction, and hence make steel loom larger than it does in GNP.

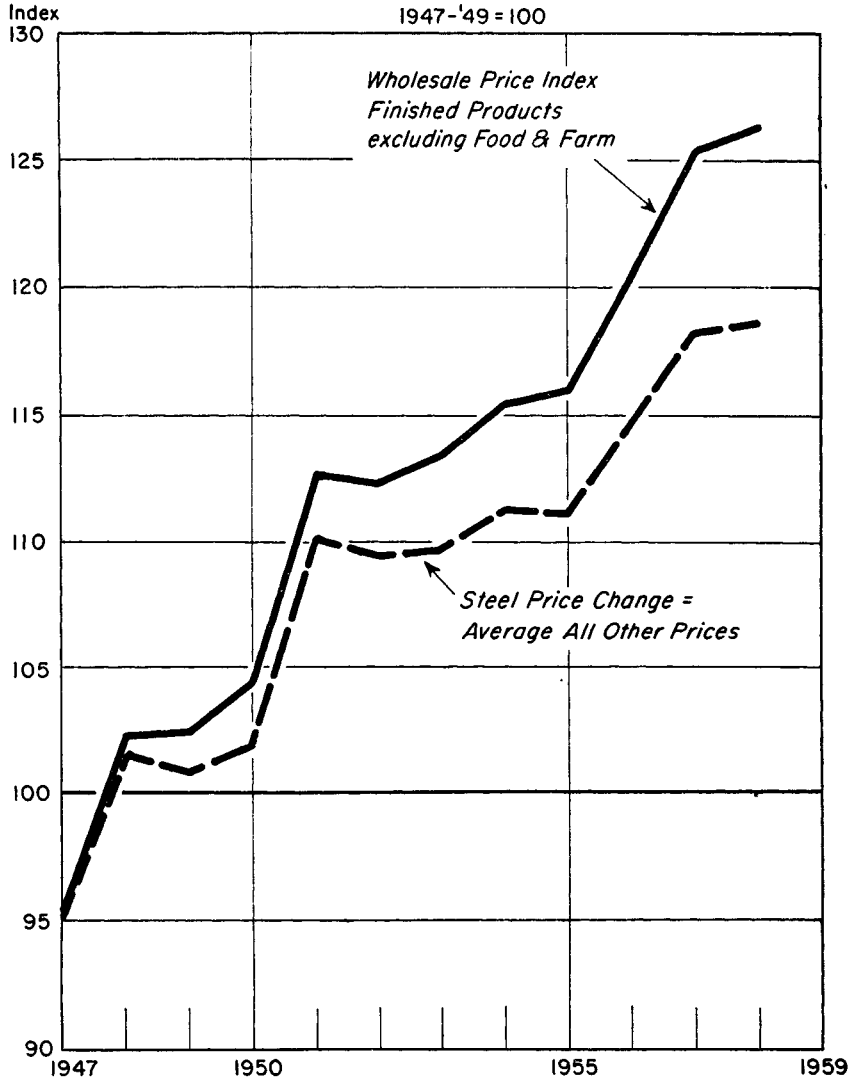

FIGURE 3.—Wholesale price index (finished products)—Comparison of all items in actual index with index if steel prices had risen only as much as average of all other prices.

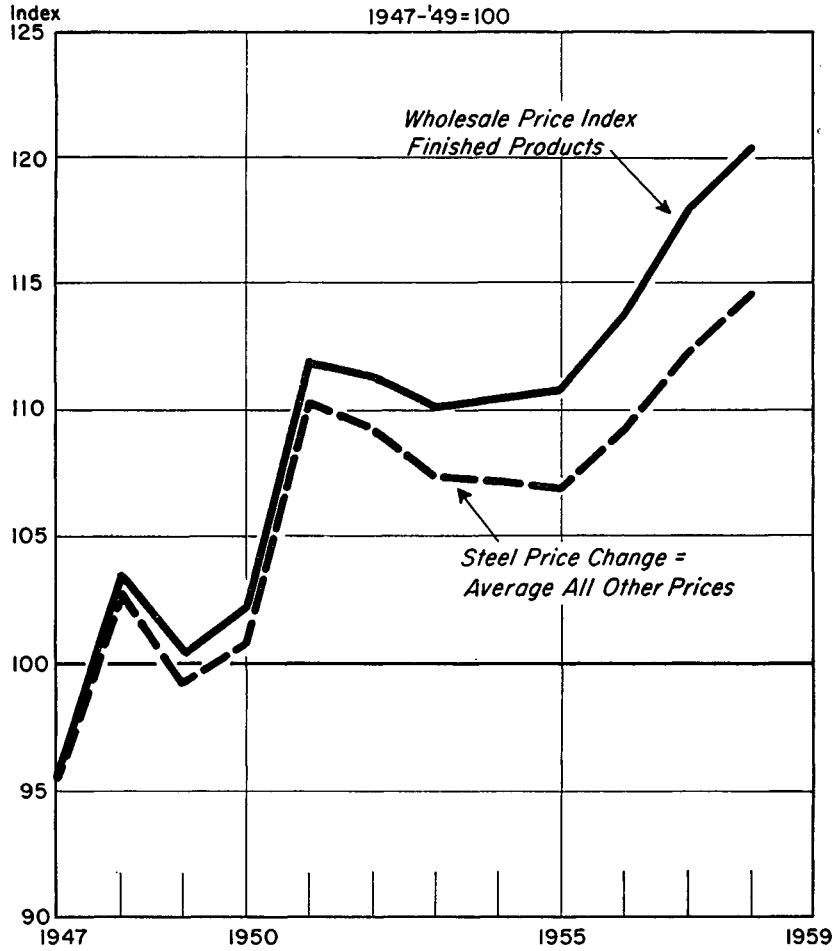

FIGURE 4.—Wholesale price index (finished products excluding food and farm)—Comparison of all items in actual index with index if steel prices had risen only as much as average of all other prices.

TABLE 3.—*Inflationary impact of steel price increases on wholesale price indexes, 1947–58*

Name of index	Indexes, 1947-49=100					Percent increase caused by steel change greater than all other change [2]		
	1947	1953		1958				
		Actual	If steel [1]	Actual	If steel [1]	1947–58	1947–53	1953–58
Wholesale price index:								
All items	96.4	110.1	105.8	119.2	110.2	39.5	31.4	51.6
All items except farm products and foods	95.3	114.0	108.4	126.0	113.8	39.8	30.0	55.0
Finished goods, all items	95.9	110.2	107.4	120.4	114.7	23.2	19.6	38.2
Finished goods, all items except farm products and foods	95.4	113.3	109.6	126.2	118.5	25.0	20.7	31.0

[1] Index if steel prices rise only as much as all other prices in the particular index except for finished goods, where steel was set equal to WPI.
[2] Derived by, e.g. (119.2−110.2)/(119.2−96.4)=0.395. Similarly [(119.2−110.1)−(110.2−105.8)]/(119.2−110.1)=0.516.

Source: Bureau of Labor Statistics. Economic sector indexes: 1947–55, October 1955, and wholesale prices and price indexes, July 1958, p. 28.

TABLE 4.—*Inflationary impact of steel price increases on specific industries and economic sectors, 1953–58*

Industry	Price index of specific industries				
	1953 actual	1958		Change in index, 1953–58	
		Actual	If steel prices behave like average nonsteel, wholesale price index [1]	Actual	If steel prices behave like average nonsteel, wholesale price index [1]
Farm products	97.0	94.9	94.7	−2.1	−2.3
Processed foods	104.6	110.9	110.3	6.3	5.7
Apparel	99.3	99.3	98.7	0	−.6
Hides, skins, and leather	98.5	100.6	100.1	2.1	1.6
Petroleum, etc	112.7	117.7	117.3	5.0	4.6
Chemicals	105.7	110.4	109.6	4.7	3.9
Rubber	125.0	145.0	143.8	20.0	18.8
Lumber and wood	120.2	117.7	116.8	−2.5	−3.4
Pulp and paper	116.1	131.0	130.5	14.9	14.4
Metals and products:					
Nonferrous metals	125.1	127.7	126.7	2.6	1.6
Containers, hardware, fabricated nonstructural	128.5	157.4	144.3	30.5	17.4
Plumbing and heating	115.4	122.5	115.4	7.1	0
Fabricated structural	115.7	133.9	120.3	18.2	4.6
Machinery and motive products:					
Agriculture, construction, miscellaneous	124.7	151.1	140.1	26.4	15.4
Metalworking	131.1	170.1	163.7	39.0	32.6
General purpose	125.3	160.0	154.3	34.7	29.0
Motor vehicle	118.9	139.7	134.0	20.8	15.1
Electrical machinery	123.7	152.5	148.0	28.8	24.3
Appliances	108.4	104.7	101.5	−3.7	−6.9
Radio and TV	84.8	94.4	92.9	9.6	8.1
Nonmetallic minerals	118.2	136.0	135.1	17.8	16.9
Miscellaneous	97.8	94.2	91.2	−3.6	−6.6

[1] Except farm products and foods.

The question that immediately arises is whether a similar argument could be made about other industries. After all, whenever an index changes in its level and in its components, the sum of the inflationary effects of the items that rose more than the average will exceed the total change in the index, since the below-average increases in the

other items serve to keep the rise in the totals index down. To test the significance of other industries, the effect of the price rises in rubber, an industry which also experienced large price increases (though not so large as steel), was also computed. Figure 5 shows the result. If rubber prices had behaved like the rest of the wholesale price index, the total increase, 1947–58, would have been 22.3 points instead of 22.8, or less by 2.6 percent; for the more recent 5 years, the rise would have been 8.8 instead of 9 points, or less by 3.3 percent (fig. 5).

What about autos, another frequently cited key industry? From table 2, it can be seen that its direct contribution to the index, 1953–58, is slightly more than half the direct contribution of steel. It has a much smaller indirect impact, however, since over two-thirds of its sales are to final users. Thus, its total contribution is only a fraction, certainly less than half the impact of steel.

In general, it can be said that only areas which enjoy both a large weight, direct and indirect, in the wholesale price index and have a price increase substantially greater than the average, may influence the upward movement of the price index significantly. Steel in the postwar period uniquely fulfills both of these requirements.

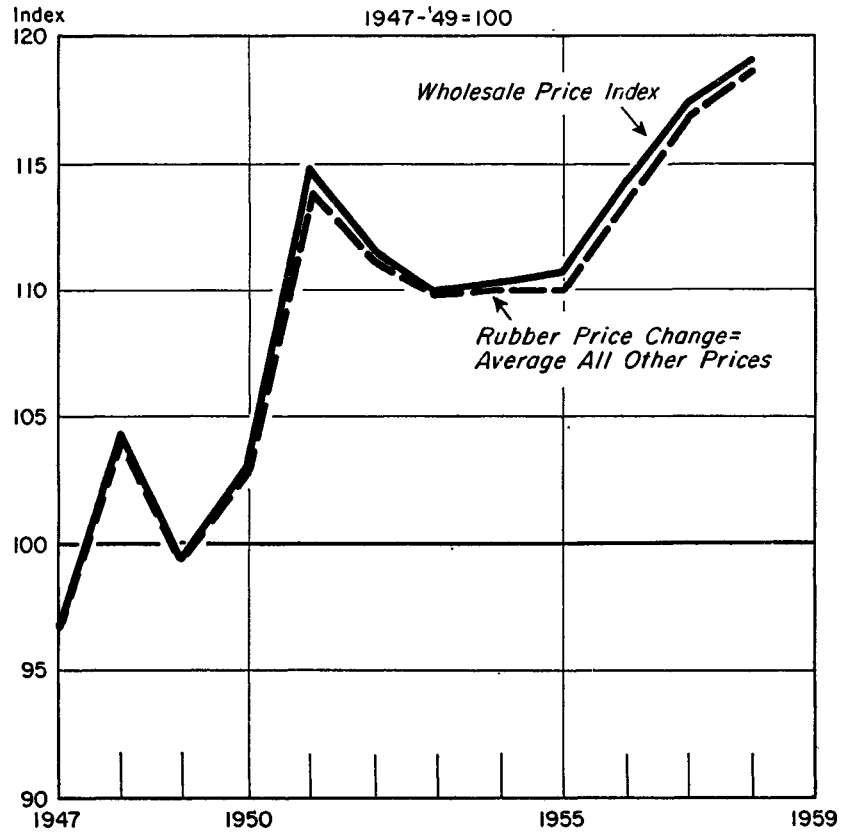

FIGURE 5.—Wholesale price index—Comparison of all items in actual index with index if rubber prices had risen only as much as average of all other prices.

The assumptions which underlie the inferences and analyses stated above are discussed in some detail in technical appendix 2 at the end of the paper. It should be kept in mind, however, that the input-output computation has only measured the effect of steel prices on price indexes through increases in costs and is therefore a conservative estimate. It makes no allowance for any markups on costs or for the further inflationary effects of raising the general price expectations of producers. It also ignores the pattern-setting effects of steel wages on other wages and the resultant further diffusion of cost increases.

It should also be stressed, however, that wholesale prices of goods do not cover the whole economy. All of retail trade is excluded as is much of wholesale, communication, construction, finance, transportation, services and Government activities. These excluded sectors constitute well over half of total GNP. Thus, our results apply only to the rise in goods prices at wholesale, which constitutes no more than a fraction of the total inflation in the economy.[9]

Also, the analysis traces through the impact of total steel prices on other prices. It would be incorrect to identify all of this increase with the steel industry, since to some extent the industry paid more for the materials, freight, etc., which it purchased from other industries. About one-third of the price increase in steel is attributable to rising costs of industry purchases.

V. The Mechanism of Inflation in the Steel Industry

As is usual in any historical episode of this sort, no one simple explanation accounts for the extraordinary behavior of the price of steel. Nevertheless, economic analysis can yield the material for a judgment of the relative importance of different factors. Using the incisive concepts of Bent Hansen, Ralph Turvey, and others,[10] the factor and product markets are analyzed separately. Some attention is also given to productivity changes and to the problem of financing expansion of capacity.

A. THE LABOR MARKET

1. Steel wages compared to other high-wage industries

Wages in the steel industry rose substantially more than the wages in other industries during the postwar period, as is revealed in table 5. Among the industries listed in the former table are those with the

[9] To put the inflation within the steel industry into the perspective of the total inflation in the gross national product, some crude computations utilizing the approach pioneered by Charles L. Schultze are also presented Charles L. Schultze, "Recent Inflation in the United States, Study Paper No. 1"). This approach considers the GNP to be the sum of the values added in each industry and decomposes the rise in the average price of GNP—the GNP deflator—into the individual rises of the deflators applicable to each value-added.

The value-added per ton in steel rose about 120 percent from 1947 to 1958, while the GNP deflators rose 35 percent. The value-added in the steel industry averages about 2 percent of total GNP; using this as a weight, if the price of steel value-added had behaved like the average of the rest of GNP, the deflators would have risen by 5 to 6 percent less over the period, 1947-58. This contrasts with the total contribution of steel prices to finished goods prices at wholesale of 23 percent. The difference is easily reconciled: value-added in the goods-producing industries constitutes only a fraction of total GNP; also, goods prices rose less than services, government, etc.

However, while goods value-added is only little more than a third of GNP, and steel value-added no more than 2 percent, these are the sectors which have been generally accepted as spearheading the movements in both prices and wages. If wholesale goods prices had risen less by the substantial percentages attributable to steel, there would have been large, secondary repercussions in the price and wage movements in the other sectors of GNP.

[10] Bent Hansen, "The Theory of Inflation," especially chs. 2, 7, and 10, and Ralph Turvey, "Some Aspects of the Theory of Inflation in a Closed Economy," Economic Journal, September 1951. Also see Charles L. Schultze, "The Recent Inflation in the United States, 1955-57," Joint Economic Committee, 86th Cong., 1st sess., "Study of Employment, Growth, and Price Levels," vol. 1, chs. 2 and 5.

highest weekly and hourly earnings as of 1958. A perusal of the tabulated figures in table 6 will show that steel wages have risen relatively to those in other industries in the American economy. Of the 13 listed in 1939, 7 had higher wages than steel; in 1958, only 2 of the same industries received greater remuneration.[11]

TABLE 5.—*Wage increases in manufacturing and selected industries, 1947–58, 1947–53, and 1953–58*

[Percent]

Industry	1947–58	1947–53	1953–58
Steel	100.1	52.8	30.9
All manufacturing	66.4	45.1	14.7
Durable goods manufacturing	76.7	45.0	21.9
Autos	71.4	45.6	19.2
Machinery except electrical	75.0	44.1	21.4
Electrical machinery	68.0	37.5	22.2

NOTE.—Percent increases of annual averages of hourly earnings (including overtime): BLS data published in Monthly Labor Review.

TABLE 6.—*Average hourly earnings including overtime, selected periods*

[Dollars per hour]

	1939	1947	1953	1958	1959, May
Mining		1.511	2.20	2.56	2.67
Bituminous coal	0.886	1.636	2.48	3.02	3.27
Building construction	.932	[1] 1.681	2.48	3.10	3.17
Special trade contractors	(2)	[1] 1.772	2.59	3.22	3.31
Electrical work	(2)	(2)	2.84	3.55	3.66
All manufacturing	.632	1.237	1.77	2.13	2.23
Durable goods manufacturing	.696	1.292	1.87	2.28	2.39
Nondurable goods manufacturing	.582	1.171	1.61	1.94	2.00
Malt liquors	.916	1.459	2.19	2.83	2.93
Apparel and finished textiles	.527	1.125	[3] 1.33	1.51	1.52
Miscellaneous duplicating and printing	(2)	(2)	2.63	2.93	2.99
Synthetic rubber	(2)	1.431	2.15	2.75	2.90
Petroleum and natural gas production	.873	1.473	2.21	2.69	2.80
Petroleum refining	.965	1.566	2.32	2.83	2.97
Tires and inner tubes	.946	1.604	2.23	2.74	2.94
Flat glass	(2)	(2)	2.38	2.93	3.17
Blast furnaces, steel works, rolling mills	.838	1.439	2.16	2.88	3.10
Metal working machinery	(2)	1.386	2.11	2.56	2.71
Motor vehicles and equipment	.915	1.473	2.14	2.55	2.68
Aircraft and parts	.745	1.378	2.00	2.51	2.62
Shipbuilding and repairing	(2)	1.458	2.08	2.58	2.71
Laboratory and scientific, engineering institutions	(2)	(2)	2.10	2.52	2.60

[1] Through 1947 data refers to privately financed projects and only onsite workers. Beginning 1948, data related to both publicly and privately financed projects, including both on- and off-site workers.
[2] Not available.
[3] New series. Not comparable with data published through 1950.

Source: 1939–57, "Employment, Hours, and Earnings," Department of Labor, Bureau of Labor Statistics, various issues, 1958, Monthly Labor Review.

2. Restoration of "normal" wage relationships

It has been argued that the large wage increases in steel since 1947 represented a catching-up process after World War II, during which steelworkers' wages were controlled more effectively than those in many other industries. Catching up always presupposes some normal base period; and the results hinge on the period selected. Table 7 gives the percentage increases of wages in steel and in manufacturing as a whole for several periods. Steel wages rose considerably more

[11] Of the 17 industries listed in 1947, 9 had greater average hourly earnings than steel, while in 1958 only 3 of these earned larger amounts. Fourteen of twenty-two industries in 1951 had higher wages; in 1958, only six were so fortunate.

than the average during the thirties but lagged during World War II, with the change over the entire period, 1929 to 1947, almost equal to the average for all manufacturing. Thus, if 1929 is the "normal" period which provides the basis for catching up, then wages in other industries had caught up with steel by 1947 (in fact, by 1942). A base of 1939, the prewar year in which steel wages were highest in relation to other wages, does show the catching up process, with the "normal" relationship restored by 1958. Generally, however, the "catching-up" concept is one of only limited significance since it presupposes that in fact some "normal" period and relationship between the various wages actually exists. The economy is continually undergoing changes which necessarily force a periodic revision of relative prices and wages. There is no particular reason why 1929, 1939, or any other year should be chosen as an indicator of normality. Figure 6 shows the relative position of steel wages compared to manufacturing wages for every year since 1920; it can be seen that the ratio of steel wages to manufacturing wages is now at its highest point since World War I. But it still remains to explain these relationships (fig. 6).

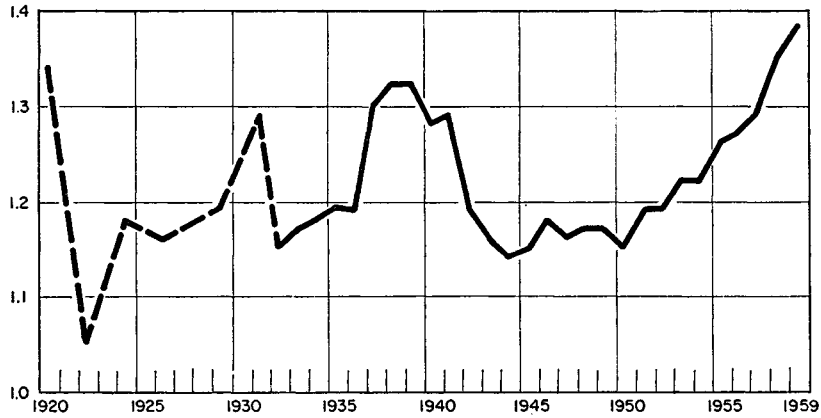

FIGURE 6. Ratio: Average hourly earnings of steel works and rolling mills to all manufacturing.[1]

[1] 1959, first quarter only.

TABLE 7.—*Percent increases in wages, steel and all manufacturing, selected periods*

[Percent]

Period	Steel	All manufacturing
1929–39	24.3	11.8
1939–47	71.7	95.4
1947–58	100.0	66.4
1929–47	113.5	118.5
1929–58	327.3	258.7

Source: Bureau of Labor Statistics.

3. Demand factors and the labor market

In a dynamic free market economy, prices and wages play the role of equilibrating the forces of supply and demand. The increase in the relative advantage of steel wages could be explained by the natural workings of economic laws if it could be shown that the steel industry had to compete for an adequate number of employees. The increases in steel wages, however, cannot be explained by the tightness in the labor market. The following table compares the percentage change in employment and wage rates in the steel and manufacturing industries for selected periods. The small difference in the relatively unfavorable employment experiences contrasts with the large difference in wage changes.

TABLE 8.—*Changes in employment and wages, steel and all manufacturing*

Date	Percentage change			
	Production workers		Average hourly earnings	
	Steel	Manufacturing	Steel	Manufacturing
1947–53	8.1	8.1	50	43
1953–57	−4.0	−6.7	24	17
1947–57	3.7	.9	86	67

In the economy as a whole, total employment rose by 13 percent over the decade, by 6 percent over the shorter period. Thus, there was no need to attract a particularly large number of new employees to the industry. Nor can the rise in steel wages be explained by tightness in the labor markets of the localities in which it competes for workers. Table 9 shows the classification of the labor markets in the steel centers. The biggest centers were areas of moderate to considerable labor surplus over most of the period, and had the same or lower classifications than the country as a whole.[12]

[12] Falling employment coupled with rapidly rising relative wages can be explained by demand factors if the absolute level of the wage is low. For example, in a period of worsening labor shortage, low-paying industries may lose workers to better paying industries, even though the gap between their wages is narrowing. But since steel wages are higher than most other wages and the overall labor markets in which steel is located were not particularly tight, this explanation cannot be accepted for this case. For a more detailed discussion of this and related points, see Franklyn D. Holzman, "Inflation: Cost Push and Demand Pull," abstracted in Econometrica, April 1959, pp. 300–301.

TABLE 9.—*Classification of labor markets in the steel centers*

	Employment [1] 1955	1955				1956						1957						1958						1959			
		May [2]	July	September	November	January	March	May	July	September	November	January	March	May	July	September	November	January	March	May	July	September	November	January	March	May	July
Birmingham	19.8	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	D	D	D	D	D	D	D
Chicago	87.9	C	C	C	C	B	B	B	B	C	C	B	B	B	B	C	C	C	E	E	F	F	F	D	C	C	C
Buffalo	[3] 39.5	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	D	D	D	F	E	C	C
Cleveland	19.8	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	C	E	E	D	D	D	D	C	D	C
Youngstown	48.8	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	C	E	E	D	D	D	F	D	F	C
Allentown	[4]	C	C	B	B	B	B	B	B	B	B	B	B	B	B	C	C	D	E	E	D	D	D	E	E	D	D
Johnstown	[4]	F	F	F	E	D	D	D	D	D	C	C	C	C	C	B	B	D	D	D	E	E	E	D	D	F	D
Pittsburgh	[3] 144.6	D	D	D	C	C	C	C	C	C	C	C	C	C	C	C	C	C	D	D	D	D	D	E	D	D	C
Baltimore	[3] 30.3	----	----	----	----	----	----	----	----	----	----	B	B	B	B	B	----	C	D	D	D	D	D	D	D	D	C
Wheeling	----	----	C	C	C	----	----	C	B	B	B	C	C	C	C	C	----	D	E	F	F	E	E	E	E	E	E
Steubenville	[3] 26.2	----	C	C	C	----	----	C	C	C	C	C	C	C	D	D	----	D	F	F	F	F	F	F	F	F	E
Detroit	23.6	----	C	C	C	----	----	D	D	D	D	C	C	C	D	D	----	D	F	F	F	F	F	F	F	F	E
Total U.S. unemployment (in millions)	----	----	2.37	2.15	2.40	2.88	2.83	2.61	2.83	2.00	2.46	3.24	2.88	2.72	3.01	3.19	3.18	4.49	5.20	4.90	5.29	4.11	3.83	4.72	4.36	3.39	3.74
Classification U.S. labor force as a whole:																											
Percent of civilian	----	3.8	3.7	3.2	3.6	4.4	4.3	3.8	3.9	3.3	3.9	4.2	3.9	4.2	4.2	4.3	5.1	5.8	7.0	7.2	7.3	7.2	5.9	6.0	5.8	4.9	5.1
Labor force (seasonal adjustment)	----	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	D	D	D	D	C	D	C	C	C

[1] In thousands.
[2] Earlier data are not comparable because of change in classifications.
[3] Total primary and fabricated products.
[4] Because there is only 1 major plant in these areas, exact figure cannot be divulged. The range for Allentown, July 1959, 20,000–25,000, and Johnstown, 15,000–20,000.

Description of classifications	Unemployment, total labor force (percent)
A—Overall labor shortage	Less than 1.5.
B—Low labor supply	1.5 to 2.9.
C—Moderate labor surplus	3.0 to 5.9
D—Relatively substantial labor surplus	6.0 to 8.9.
E—Relatively substantial labor surplus	9.0 to 11.9.
F—Relatively substantial labor surplus	12.0 or more.

4. The structure of the labor and product markets in steel

There is no need to give a detailed description of the markets which the steel industry faces, since the facts are well known. The United Steelworkers bargain for almost the entire labor force in the industry.[13] The wage pattern for the entire industry is set in a central negotiation. The situation is probably best characterized as a bilateral monopoly. The importance of the structure of the product market for wage behavior has been stressed by Dunlop [14] and others. In steel, this market is relatively concentrated. The four largest firms accounted for 65 percent of shipments of blast furnace products. The eight largest firms accounted upward of 80 percent of shipments in these industries. The figures for castings are lower, but constitute only a fifth of industry shipments.[15] The high requirements of capital and the limited access to raw materials are considered "high entry barriers" by Bain in his authoritative study,[16] although he does not place the aggregate entry barriers in steel in the most extreme category compared to some other industries such as autos, tobacco, soap, etc.

Potential market power is clearly present in the steel industry, leaving only the question whether it was used to raise wages and prices in recent years. In our judgment, this has been the case.

5. The influence of Government on steel wages

No analysis of steel wages would be complete without consideration of the role of the Federal Government. In three of the four bargaining crises since World War II, there was extensive intervention. In 1945–46, when wage and price controls were still in effect, a Presidential factfinding board recommended an 18½-cent wage increase, a figure that had earlier been rejected by the companies, but was accepted in February 1946 when tied to an Executive order raising the price of steel by $5.[17] The settlements of 1947 and 1948 occurred without Government intervention, though the subsequent price increases were criticized. In 1949, an ad hoc Presidential fact-finding board was appointed, sidestepping the use of the new Taft-Hartley machinery. The substantial "package" recommended by this board was rejected by the companies, but after a 30- to 40-day strike, one of the companies broke the deadlock, signing for a package which was not identical but had the same general features and cost as the factfinding recommendations. Harbeson and Spencer conclude, "the gains for the steelworkers would have been much less" [18] without Presidential intervention, given the recession conditions at that time.

In 1952, wage and price controls were again in effect. The Wage Stabilization Board recommended a very generous 30-cent package, which was rejected by the companies. After a long dispute between the White House and the companies, culminating in the seizure of

[13] The exceptions include workers operating steel facilities for the Ford Motor Co., who are members of the UAW.

[14] J. T. Dunlop, "Wage Determination Under Trade Unions," MacMillan & Co.: London, 1957.

[15] Concentration in American Industry," Report of the Subcommittee on Antitrust and Monopoly, Committee on the Judiciary, 85th Cong., 1st sess., p. 54.

[16] J. S. Bain, "Barriers to New Competition: Their Character and Consequences in Manufacturing Industries," 1956, tables XIV and XV and the review article by R. B. Heflebower, American Economic Review, p. 366. The entry barriers on which steel does not score so high are economies of scale and product differentiation.

[17] For an account of Government intervention in collective bargaining in the steel industry, see Frederick H. Harbeson and Robert C. Spencer, "The Politics of Collective Bargaining: the Postwar Record in Steel," The American Political Science Review, September 1954, pp. 705-720. Also see "Emergency Disputes and National Policy," M. Bernstein, H. L. Enarson and Fleming, eds. 1955, ch. III, "The Politics of an Emergency Dispute: Steel, 1952," by Enarson.

[18] Op. cit., p. 712.

the industry, a court ruling declared the seizure illegal. A 55-day strike was fought, more about the issue of the union shop than wages. The final settlement included most of the original package recommended by the Board.

The next several settlements occurred without a strike and without Government intervention. In 1956, after a strike of 36 days, the largest package ever negotiated was accepted. This package specified a wage increase of 29 cents over the 3 years of the contract, plus 17 cents of fringe benefits, plus a cost-of-living clause which has cost 17 cents over the period—or a total of over 60 cents. Officially, the Government maintained a hands-off policy during this negotiation, but there were widespread newspaper stories [19] that the industry was pressured behind the scenes to settle in an election year.

There can be little doubt that the effect of Government has been to increase the rate of increase of wages. It is difficult to weigh this factor in relation to the effect of independent market power. However, even if the effect of Government is weighted heavily, the market structure of the labor and product markets are necessary permissive conditions for the operation of the wage-price spiral in the absence of excess demand.

It is true that the timing of the big contract negotiations has fallen repeatedly in periods of economic expansion. Thus, if the companies engage in "permanent high plateau" thinking and sign long-term contracts on the basis of the phase of the business cycle then prevailing, demand factors can be interpreted as pulling up wages.[20]

Even on that interpretation,[21] the behavior of steel wages did not accord with the competitive market theory, since it was the state of the product market, not of the labor market, which was the crucial demand factor in the steel situation. Also, if prices and wages behaved according to market principles, the increases would have been reversed after the overoptimistic evaluation of the state of the market was proved wrong.[22]

6. Conclusion on wages

Bargaining between a strong union and a management with strong market power in the product market, persuaded of their ability to pass higher employment costs on in higher prices and being pressured by

[19] New York Times, Sunday, July 26, 1959: "Steel: Key Role Looms for White House," by A. H. Raskin: "The only big steel strike of the Eisenhower administration was the 5-week tie-up in 1956. At that time the White House avoided any public move but it supplied the decisive push for an accord through a series of behind-the-scene maneuvers * * *. Secretary of Labor James P. Mitchell arranged a private meeting between David J. McDonald, president of the union, and the heads of the biggest steel companies. When the companies refused to meet the settlement terms the union had in mind, a few telephone calls from George M. Humphrey, then Secretary of the Treasury and now chairman of National Steel, persuaded them to go higher. The resulting contract brought the union the greatest gains in history—a total of 62½ cents an hour over 3 years. The companies raised prices $21 a ton during the same period."

[20] The expectations of the steel companies have been too sanguine at times. Ten leading companies submitted statements of their market prospects to the Kefauver committee, as seen at the time of price increases of July 1957. Seven gave a very optimistic outlook for their sales; the rest based their decisions exclusively on other factors. See "Administered Prices, Steel," report of the Subcommittee on Antitrust and Monopoly of the Senate Judiciary Committee, 85th Cong., 2d sess., Rept. No. 1387.

[21] For a general defense of the view that demand factors and monetary expansion through an increased velocity of circulation predominated in the recent inflation, see R. T. Selden, "Cost-Push versus Demand-Pull Inflation, 1955–57," Journal of Political Economy, February 1959, pp. 1–21, reprinted in Joint Economic Committee "Hearings on Employment, Growth and Price Levels," Part 4—The Influence on Prices of Changes in the Effective Money Supply, pp. 700–719.

[22] The earlier studies by Rees and Ulman do not contradict the present arguments. Rees, who stresses demand factors as opposed to the impact of unionism, explicitly confines his conclusions to periods of rapid inflation. His analysis covered only the period up to 1948. Ulman, in questioning Rees' position, looks at the record 1946–56 and stresses the positive impact of the union on wages. His emphasis differs from that of this paper by stressing the effect of unionism, whereas this paper stresses the effect of the combined market power of union and management. See Albert Rees, "Postwar Wage Determination in the Basic Steel Industry," American Economic Review, June 1951, pp. 389–404 and "The Union and Wages in Basic Steel: Reply," American Economic Review, June 1958, pp. 426–433, and Lloyd Ulman, "The Union and Wages in Basic Steel: A Comment," ibid., pp. 408–426.

Government to settle their differences on favorable terms are the major explanations of the wage movements.

B. PRODUCTIVITY

Had productivity risen rapidly enough, it would have served as an offset to the higher wages, keeping unit wage costs from rising, or at least from rising more than the average for the economy.[23] However, the rise in output per man-hour, the only available measure of productivity in steel (see table 10), was slightly less than in manufacturing as a whole. The rise in output per man-hour in steel was 27 percent from 1947 to 1957, compared to 32 percent in all manufacturing.[24 25]

TABLE 10.—*Productivity indexes, output per man-hour*

[1947=100]

	Manufacturing,[1] all employees	Total private economy,[2] all employees	Private nonfarm,[2] all employees	Basic steel [2]		Bituminous coal,[1] wage earners
				All employees	Wage employees	
1947	100.0	100.0	100.0	100.0	100.0	100.0
1948	102.5	102.9	101.0	100.7	100.8	100.0
1949	104.7	104.9	104.1	100.6	104.5	114.5
1950	113.1	113.2	100.2	112.8	112.9	114.5
1951	114.6	118.2	114.6	110.6	110.8	120.0
1952	116.4	122.1	117.4	110.1	113.9	129.0
1953	120.3	127.2	120.9	114.6	116.0	129.0
1954	123.7	130.4	123.7	110.5	115.7	149.2
1955	130.9	136.6	129.5	126.8	129.3	159.9
1956	131.4	137.8	129.7	127.4	131.8	164.3
1957	132.4	141.5	132.1	126.5	132.2	166.9
1958	[3]	141.8	131.0	120.6	131.9	[1] 178.3
Fiscal year ending—						
June 1958				118.5	127.9	
June 1959				136.9	145.2	

[1] Statistical Abstract, 1958, 1959.
[2] "Statistics Bearing on the Steel Dispute," U.S. Department of Labor, 1959.
[3] Not available.

The moderate rise in output per man-hour in steel (which was about in line with or slightly below the average pace in manufacturing), in combination with wage increases above the average, has made for larger than average increases in employment costs per unit of output. In some other industries in which wages also rose more than the average, such as interstate trucking and bituminous coal mining, these were matched by greater than average improvements in output per man-hour.

No definitive explanations can be offered here for the relatively slow rate of increase in productivity, considering the large volume of investment during the decade. Probably a major factor is the in-

[23] It would not have offset the pattern-setting effects of steel wages, however.
[24] Source: Bureau of Labor Statistics. In 1958, both steel and all manufacturing productivity fell because of the recession. There has been a rapid increase of productivity during the recovery, both in steel and all manufacturing, but data are not yet available for comparison. For "fiscal year" figures for 1958 and 1959 in steel and the private economy, see the fact finding report by Secretary of Labor James P. Mitchell, "Background Statistics Bearing on the Steel Dispute," U.S. Department of Labor, August 1959, p. 9 reproduced below.
[25] Comparisons of productivity figures for production workers only, a comparison that corresponds more closely to the wage data used above, show the same pattern as productivity figures for all employees. Joint Economic Committee figures show that the rise between 1947-49 and 1957 was 39 percent in all manufacturing, while the fact finding report finds an increase in steel of 31 percent. In 1958, the figure for steel fell 0.3 percent, all manufacturing rose 7 percent. Probably the figures for 1959 will show a correspondingly larger increase in steel. Source: Joint Economic Committee "Hearings on the January 1959 Economic Report of the President," 86th Cong., 1st sess., p. 786, and "Background Statistics * * *" (ibid.), p. 9.

stability of the demand for steel products: the major consumers, autos, machinery, and construction, all are relatively unstable—in the case of autos not only because of fluctuations in demand, but also because of the system of producing the model year's output in a fraction of a year.[26] Inventory fluctuations also accentuate the instability of the industry, since purchasers can operate out of stocks. Further, the total rate of utilization of capacity was somewhat lower toward the end of the period than at the beginning, which depresses output per man-hour. If the emphasis on work standards in the steel negotiations of 1959 is any indication, labor practices must also be a factor.

C. OTHER COST CHARACTERISTICS: MATERIAL COSTS, TAX COSTS, ETC.

An income statement in ratio form is presented in table 11. This table shows the changes in the relative significance of the several elements of unit costs. Comparing 1947 with 1957, 2 years of comparable prosperity, we find the following:

TABLE 11.—*Income statement in ratio form, 1939 and 1947–58*

	Year												
	1939	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
Percent of revenue:													
Employment costs	39.0	36.7	34.8	34.9	33.0	32.3	35.7	34.0	36.7	33.5	33.3	35.5	38.2
Materials, supplies, freight	44.3	47.6	48.4	47.3	45.7	46.3	49.7	46.3	46.3	43.6	45.8	43.3	41.7
Depreciation, depletion, and amortization	4.8	3.5	3.7	3.7	3.4	3.2	4.1	4.7	4.7	5.2	4.9	4.9	5.4
Interest charges on debts	1.3	.2	.2	.3	.3	.2	.4	.4	.4	.4	.4	.4	.6
State, local, miscellaneous taxes	3.3	1.3	1.2	1.5	1.4	1.4	14.	1.5	1.5	1.5	1.5	6.9	1.9
Estimated Federal taxes	2.0	4.2	4.7	5.1	8.1	10.8	4.4	7.6	5.6	7.9	6.8	7.0	5.9
Profits as margin on revenue	5.1	6.5	6.7	7.1	8.0	5.8	5.0	5.6	6.0	7.8	7.3	7.3	6.3
Total net capital charge as margin [1]	11.3	10.0	10.6	11.1	11.7	9.2	9.5	10.7	12.8	13.4	12.5	12.6	12.3
Total gross capital charge as margin [2]	16.7	15.6	16.7	17.7	21.3	21.3	15.4	19.7	20.1	22.8	20.9	21.3	20.1

[1] Net capital charge is defined as profits plus interest plus depreciation.
[2] Gross capital charge is defined as net capital charge plus all taxes.

Source: Annual reports of American Iron and Steel Institute.

(1) Despite the rise in wages and fringe benefits, employment costs accounted for a slightly lower fraction of total costs;

(2) Materials, supplies, and freight, the largest cost item, fell significantly as a percent of sales. Thus, while materials costs rose, of course, they rose less than other costs and served to moderate the total increase at least to a small extent;

(3) Depreciation costs rose considerably, as did State and local taxes and interest charges;

[26] The industry also does relatively little research. According to a study conducted by the Bureau of Labor Statistics and the Census Bureau for the National Science Foundation, the primary metal industries were among the lowest in the percentage of their sales dollar spent on research and development in the last decade. Bureau of Labor Statistics Bulletin No. 1148, "Scientific Research and Development in American Industry, A Study of Manpower and Costs," p. 27, and National Science Foundation, "Science and Engineering in American Industry," NSF 56–16, and "Reviews of Data on Research and Development," NSF, 58–10.

It may well be that basic steel processes are not "researchable." It should be pointed out, however, that the Soviet Union is betting considerable resources that it is. For example, the number of metallurgists being trained is a multiple of the number the United States is training and Russia is presumably planning to use them in her industry. Also, the planned ratio of engineers and scientists to total employees in the Soviet industry for 1950 was 1:40, while the actual American ratio was about 1:50. See Nicholas DeWitt, "Soviet Professional Manpower," National Science Foundation, 1955, especially p. 250. See also testimony of Daniel Hamberg before the Joint Economic Committee, "Hearings on Employment, Growth and Price Levels," pt. 7—The Effect of Monopolistic and Quasi-monopolistic Practices.

(4) Federal taxes constituted the largest increase;

(5) Net income, or profits,[27] has risen somewhat over the decade, from 6.5 to 7.3 percent.

Thus, over the period 1947–57, the items that have risen most as a proportion of revenue are taxes, depreciation, interest, and profits. Materials have fallen considerably, employment costs slightly. These comparisons would be somewhat different for other base periods, as can be seen from the table, but the pattern is affected only moderately. The major exceptions are these: a 1939 base period shows local taxes, interest payments, and depreciation to have been larger items and Federal taxes to have been smaller; a 1951 base period, a very atypical year, shows much larger Federal taxes and the low point in employment costs and depreciation; a 1958 terminal year shows high employment costs, partly because profits and Federal taxes are depressed by the recession.

Tables 12 and 13 analyze the composition of the total increase in revenue per ton, an approximation to the change in price. They show the contribution of the several items of cost and profit to the total change in the revenue per ton. Over the period 1947–58, employment costs accounted for 40 percent of the increase, materials, supplies and freight, 35 percent; depreciation, depletion, and interest, 9 percent; taxes, 10 percent; and profits, 6 percent. Using 1957 as the terminal year, a year of comparable prosperity, profits account for a larger share of the rise materials for a smaller share. The large contributions of employment costs and material costs to the total are explained by their large absolute size in comparison to the other items. Thus, while employment costs and materials costs rose less percentagewise than capital costs, profits, and taxes, they represent a larger share of the total increase in unit costs because of their absolute size in the total composition of costs.

TABLE 12.—*Revenues, costs, and profits per ton in the steel industry, 1947, 1953, 1957, and 1958*

	1947	1953	1957	1958	Increase			
					1947–53	1953–57	1953–58	1947–58
Revenue per ton	$78.98	$117.87	$138.33	$146.88	$38.89	$20.46	$29.01	$67.90
Employment cost per ton	29.02	40.11	49.04	56.10	11.09	8.93	15.99	27.08
(Materials, supplies, and freight) per ton	37.66	54.55	59.85	61.26	16.89	5.30	6.71	23.60
(Capital costs and interest) per ton	3.04	5.99	7.37	8.87	2.95	1.38	2.88	5.83
Taxes per ton	4.41	10.63	12.03	11.40	6.22	1.40	.77	6.99
Profits per ton	4.85	6.59	10.04	9.21	1.74	3.45	2.62	4.36

[27] There are some differences of coverage, such as income from nonoperating sources.

TABLE 13.—*Analysis of increase of revenue per ton in steel industry, 1947–58*

[Percent]

	1947–53	1953–57	1953–58	1947–58
Revenue per ton	100.0	100.0	100.0	100.0
Employment costs	28.5	43.6	55.1	39.9
(Materials, supplies, and freight) per ton	43.4	25.9	23.1	34.8
(Capital costs and interest) per ton	7.6	6.7	9.9	8.6
Taxes per ton	16.0	6.8	2.7	10.3
Profits per ton	4.5	16.9	9.0	6.4
Total	100.0	100.0	[1] 100.0	100.0

[1] Will not add because of rounding.

D. PROFITS AND PRICES

1. Profit margins

Given the rising costs, some price increase is likely, but the magnitude of the rise depends on the behavior of profit margins. Figures 7 and 8 show profit margins in steel, manufacturing and durable manufacturing, in recent years, before and after tax. It can be seen that

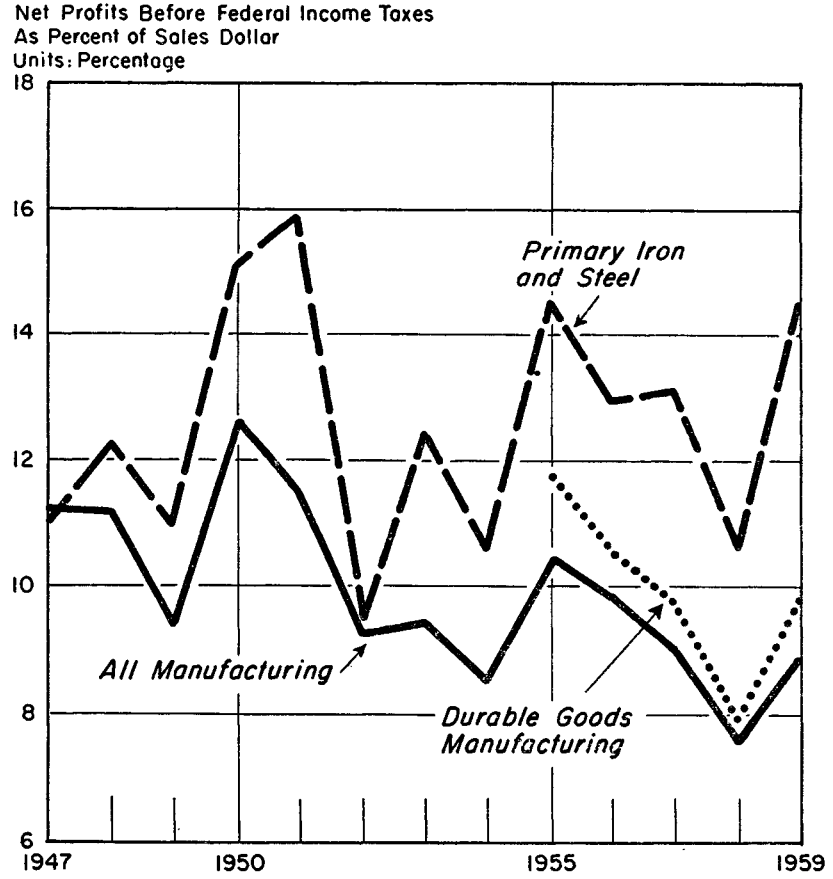

FIGURE 7. Profit margins in steel, manufacturing, and durable manufacturing before Federal income tax.[1]

[1] 1959, first quarter only.

margins in steel are higher than the average—which is easily accounted for by the greater capital intensity in steel—and that the gap between steel and all manufacturing has been widening. The variability in margins is due to the fluctuations in the rate of utilization of capacity. Figure 9 relates margins to this rate. While the relationship between them is far from straightforward, there is some evidence that profit margins have been somewhat higher for given rates of utilization than was true earlier.

This behavior of margins suggests, at the least, that the industry was able to take its markup on the rising employment and other

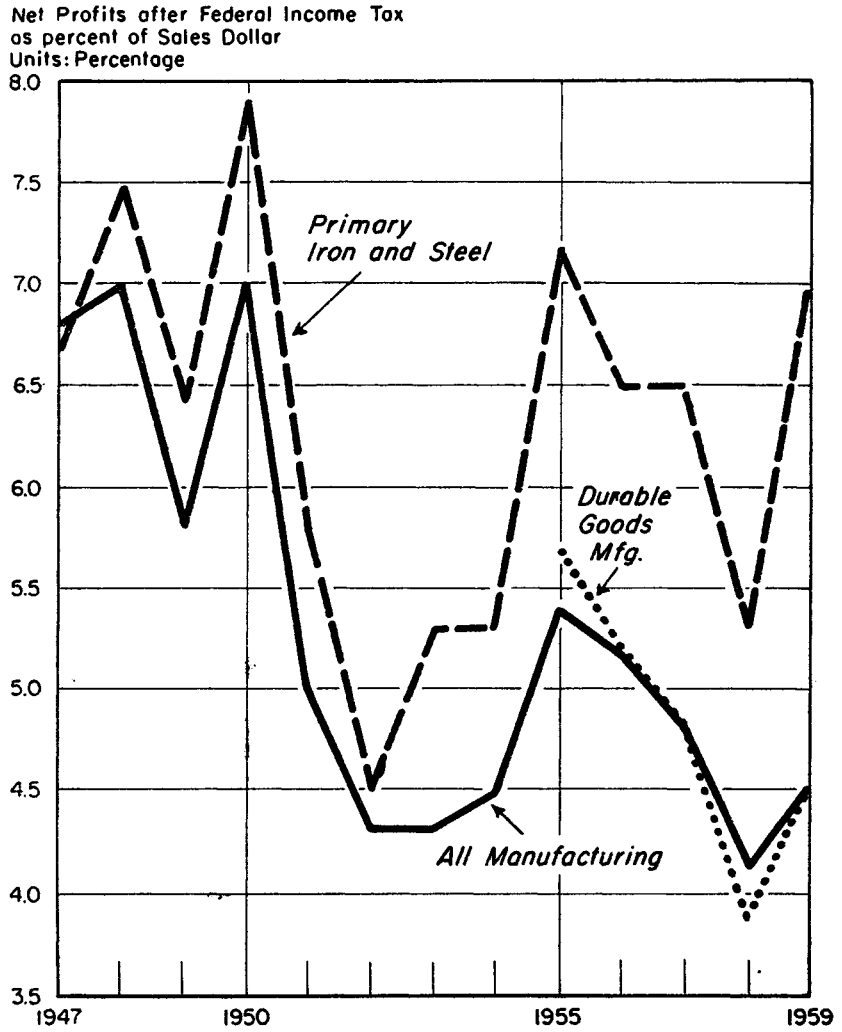

FIGURE 8. Profit margins in steel, manufacturing, and durable manufacturing after Federal income tax.[1]

[1] First quarter only.

costs. There may even have been some widening. Other industries, whose demand experience was at least equally favorable, did not succeed in maintaining constant margins [28] (figs. 7 and 8).

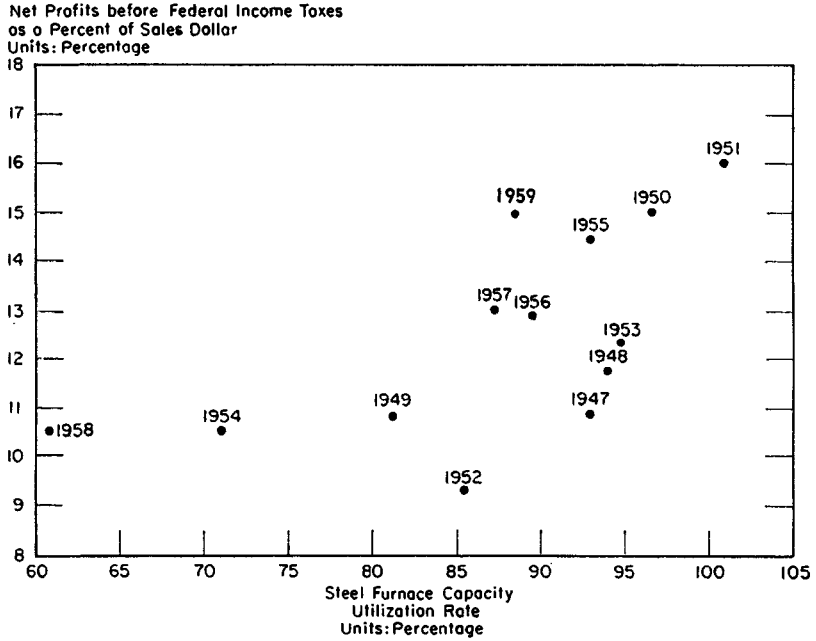

FIGURE 9. Profitability and capacity utilization.[1]

[1] 1959, first half only.

[28] The constancy in the profit margin in steel has to be interpreted in the context of the liberalization of depreciation practices under the tax laws. The gross return on capital, defined as profits plus depreciation allowances, has been rising as a margin on sales.

2. Rates of return

Figures 10 and 11 show similar results for the rates of return on equity. The patterns over time are quite similar to the behavior of margins. Contrasting steel and other industries, it can be seen that the rate of return on equity in the steel industry has improved relative to other industries, but has exceeded the average of all manufacturing in only a few years—including the first two quarters of 1959 [29] (figs. 10 and 11).

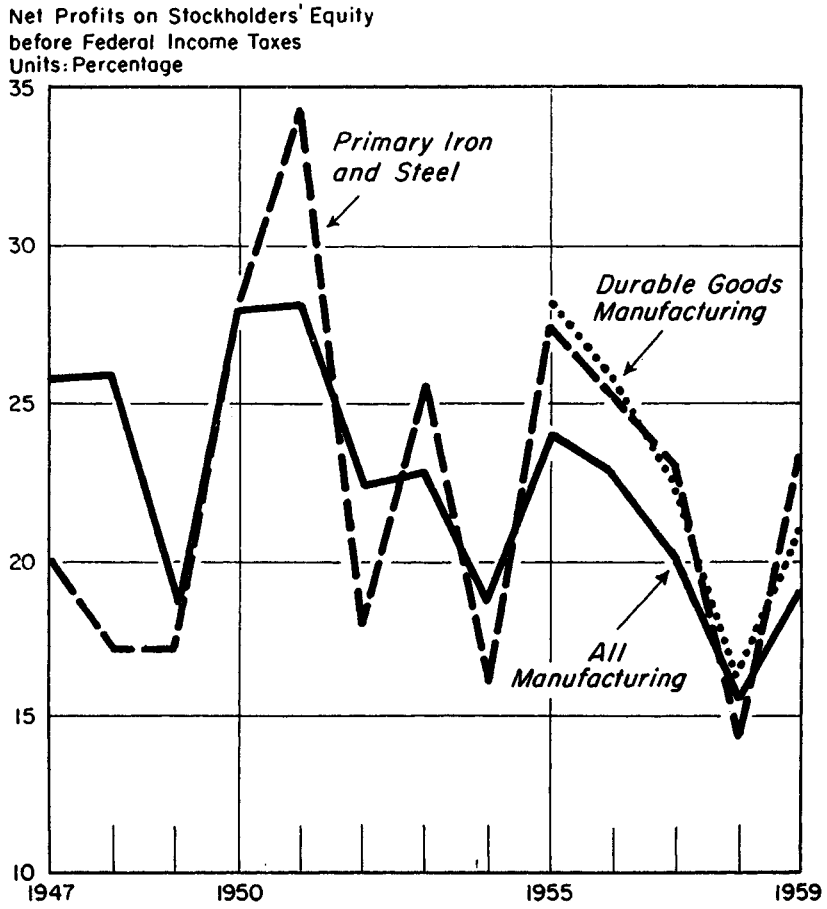

FIGURE 10. Gross return on stockholders' equity.[1]

[1] 1959, first quarter only.

[29] It should be realized, however, that the expectation of a strike in the industry caused major steel consumers to stockpile considerable inventories in the first half of 1959 thus inordinately raising capacity utilization rates and profits.

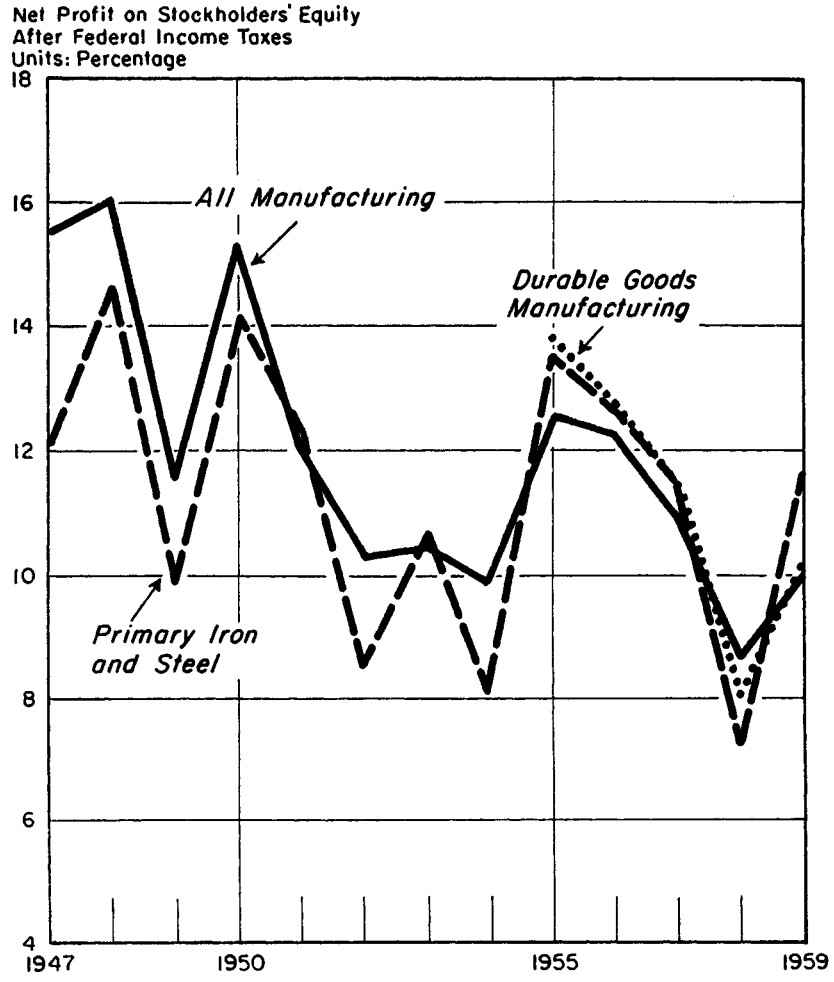

FIGURE 11. Net return on stockholders' equity.[1]

[1] 1959, first quarter only.

Plotting rates of return against rates of utilization of capacity (fig. 12), there again is some slight evidence that the relationship has been improved for the industry as a whole, i.e., that the target rates have been raised [30] (fig. 12).

[30] For further evidence on this point, particularly for the United States Steel Corp., see John M. Blair, "Administered Prices: A Phenomenon in Search of a Theory," American Economic Review, May 1959, pp. 431–450, especially p. 443.

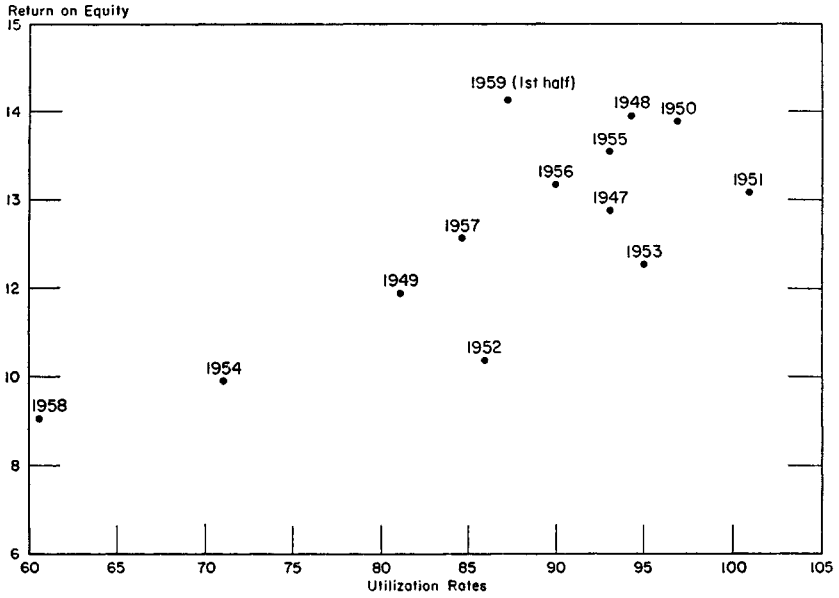

FIGURE 12. Net rate of return on equity versus utilization rates.

3. The significance of demand factors

Can this relatively successful profit history of the steel industry be explained by the pull of demand? Three indicators of the state of demand will be considered: (1) changes in output, (2) the rates of utilization of capacity, and (3) the backlog of orders. Output in steel rose somewhat less than GNP [31] or than the output of manufacturing over the period. Probably the best indicator of the state of the product market is the rate of utilization of capacity, a measure of the relation between potential supply and current demand.[32] Figure 13 shows the quarterly and annual utilization rates: while the rates reached levels only slightly below 100 percent in the last quarters of 1955 and 1956, the general experience in the latter years of the last decade was significantly worse than in the early years. Not only were the values at the peaks of prosperity somewhat lower, but the extent and duration of recessions has worsened (fig. 13).

The amount of unfilled orders is another indicator of the state of demand and of the consequent pull on profits and prices. While their absolute dollar volume reached similar values in peak periods, the ratio of orders to sales, a measure of the backlog of orders, has been deteriorating over the period. (See figs. 14 and 15.)

[31] See app. II, below.

[32] It only measures the short-run demand situation, however. In the long run, supply is determined by investment, and the influence of market power may make itself felt through a relative low level of capacity. Thus this kind of evidence can reflect demand pull, but cannot reject the influences of market power on prices.

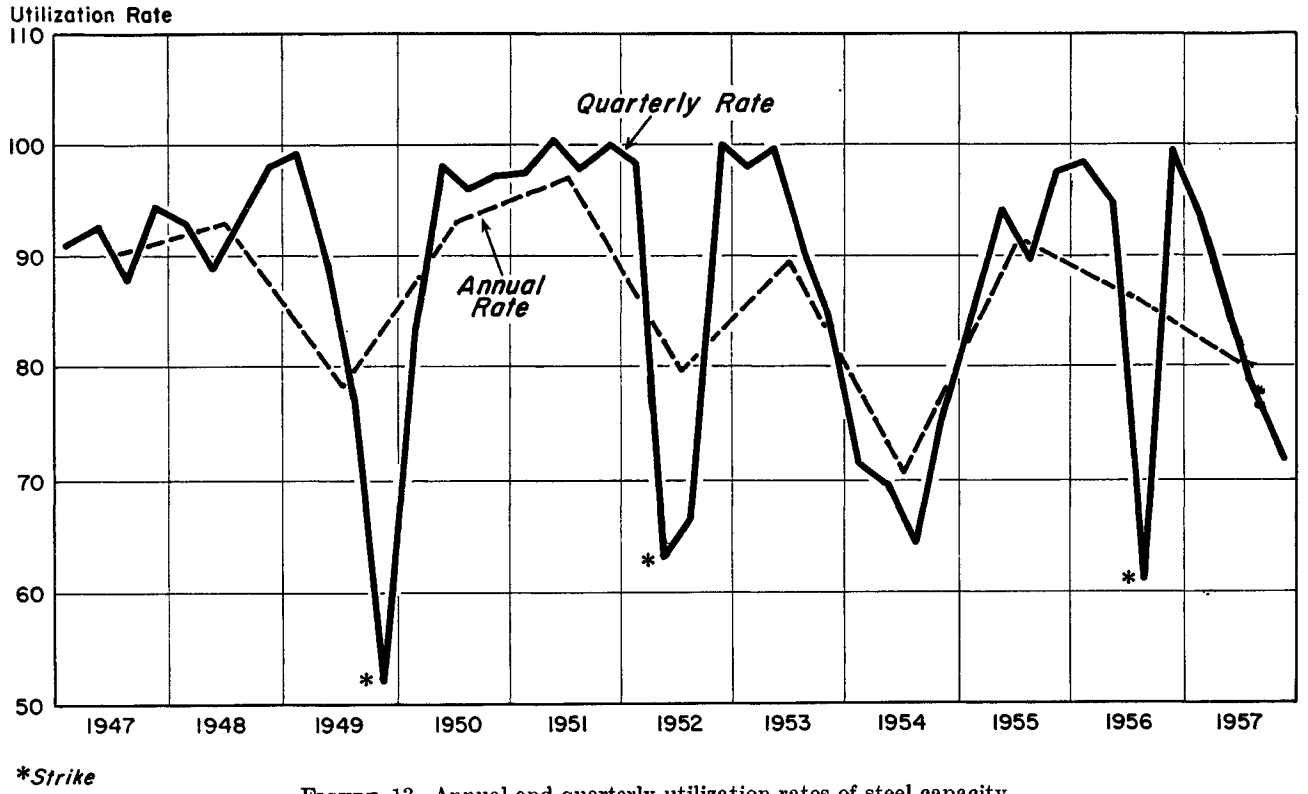

FIGURE 13. Annual and quarterly utilization rates of steel capacity.

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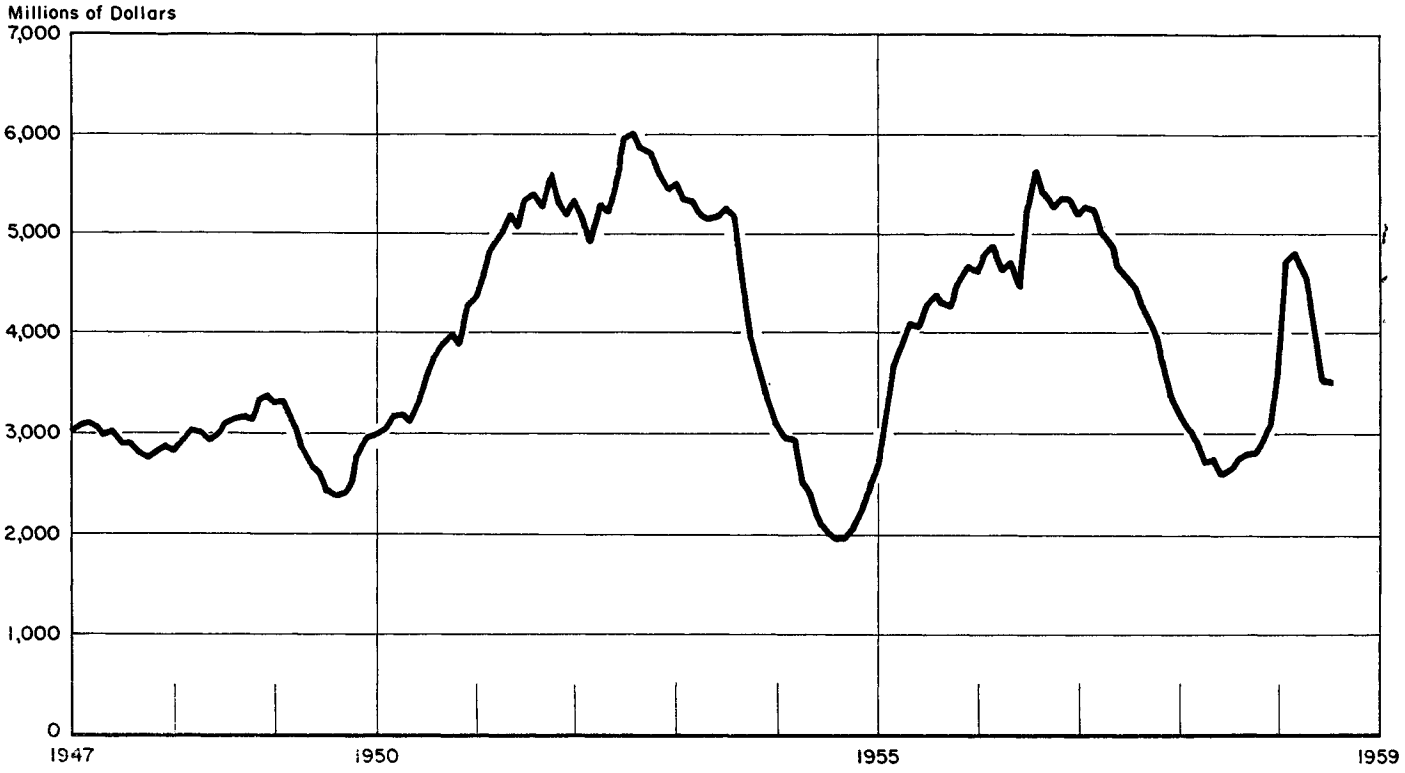

FIGURE 14. Unfilled orders, monthly.

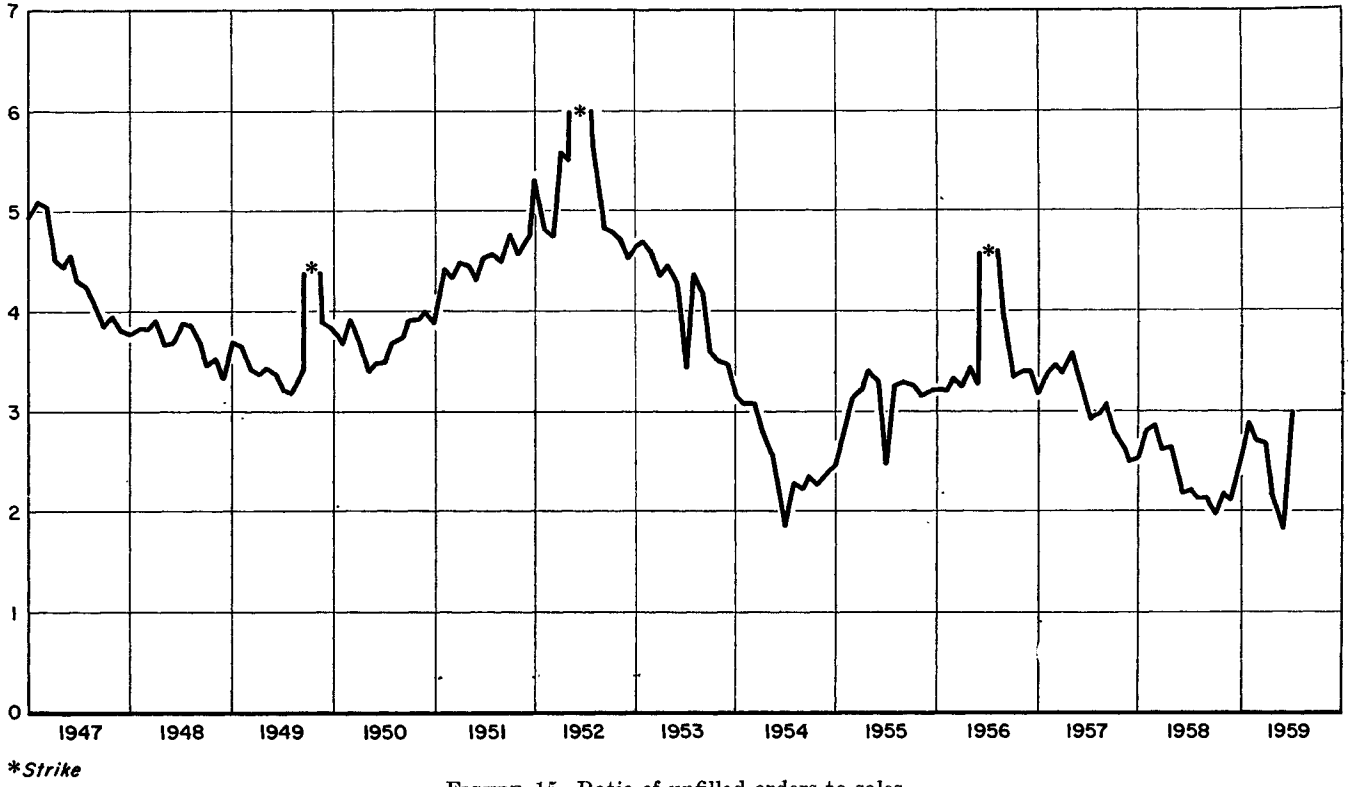

FIGURE 15. Ratio of unfilled orders to sales.

A study of inflation of machinery prices, an industry which experienced genuine classical demand inflation in 1955–57, revealed that the influence of orders on prices was highly significant. For steel, there was no significant relationship between orders and prices, suggesting that demand was a weaker factor in steel.[33]

Thus, while demand may have exerted some pull on prices in peak periods, this pull should have been weakening, and cannot suffice to explain the steady upward trend in prices. Moreover, the failure of prices to fall when demand fell far short of capacity argues that the demand theory is largely irrelevant for this industry in periods of contraction.[34] At best, therefore, the state of the product market can explain some modest part of the total price increases.

E. FINANCING NEW CAPACITY

The technology of steel is such that the manufacturing process is one that is highly capital intensive. Inflationary forces, which have been particularly severe in capital-goods industries, thus have greatly increased the cost of replacing obsolete capacity and supplementing existing facilities. Since 1947, construction costs and prices of producers' finished goods have witnessed an almost continuous rise including during recent years. It is true that steel's own contribution to this phenomenon has not been negligible, but gross revenues must still be raised and paid to the suppliers of the required equipment. This continual increase of replacement and expansion costs has been a constant source of pressure on the industry's prices.

Dunlop has made the need to meet rising capacity costs the central feature of an explanation of the inflation in steel. He has argued that management's desire to finance expansion largely from internal sources had led it to set prices high enough to yield greater profits. The resultant higher profits stimulated large wage demands which frustrated the industry's attempts to raise profits. This futile process could go on through endless rounds of price and wage increases.[35] It is difficult to ascertain to what extent this factor dominated the motivation of the companies in setting the prices that resulted in such favorable profit margins. It was certainly an important factor. This explanation is consistent both with the demand and market structure theories. Market power may have given the companies the discretionary power to raise prices as they have done. On the other hand, high costs of new capacity would limit entry of new firms even in a competitive industry, and if its demand were close to full utilization, would lead to large price increases.

F. SUMMARY ON THE CAUSES OF THE INCREASE OF STEEL PRICES

A review of these figures and the detailed analysis of employment costs, equipment replacement, productivity, and profits lead to the

[33] Thomas A. Wilson, "An Analysis of the Inflation in Machinery Prices" Study Paper No. 3.

[34] But see the comments of Martin J. Bailey on the prevalence and significance of secret price shading in recession. "Administered Prices in the American Economy," Compendium of Papers on the Relationship of Prices to Economic Stability and Growth, Joint Economic Committee, 85th Cong., 2d sess., pp. 89–105.

[35] John T. Dunlop, "Policy Problems, Choices, and Proposals," in the American Assembly, Wages Prices, Profits, and Productivity, May 1959.

proposition that prices in the steel industry, relative to other prices, have risen at a rapid rate since 1952, primarily due to the operation of four factors:

(1) An extraordinary rise in wages which is the result of bargaining between a strong union and a management with strong market power in the product market. Government intervention has probably accelerated this process.

(2) A conscious effort to maintain and perhaps increase profit margins in the industry, giving the steel companies at the least a proportionate share of the income gains scored at the expense of the rest of the economy.

(3) A rapid increase in the costs of replacing facilities and providing additional capacity together with management's attempt to raise the required funds for the desired expansion through internal financing.

(4) A state of demand which, while not strong enough to account for the exceptional price and wage rises, nevertheless was strong and inelastic enough to permit these increases to occur without immediate and telling decline in the demand for steel.

VI. Conclusion

This paper has examined the inflationary impact of the rise in steel prices of the last decade and has analyzed some of the causes of this price increase. Without repeating all the detailed conclusions of the paper, let us recapitulate briefly:

A. The impact of the increase of steel prices on other industrial prices is large. If steel prices had behaved like other industrial prices, the total wholesale price index would have risen by 40 percent less over the last decade and less by 52 percent since 1953. Finished-goods prices would have risen less by 23 and 38 percent, respectively.

B. The increase in steel prices is due to the extraordinary rise in wages combined with only an average rate of increase of productivity, and to the increase in profits, in taxes, and in depreciation charges.

C. Neither the increase in steel wages nor the increase in steel prices can satisfactorily be explained by demand factors alone. The wage and price behavior of the steel industry represents an important instance of inflation caused to a substantial degree by the exercise of market power. This type of inflation cannot be controlled by policies aimed solely at restricting total demand.

D. The rise in steel prices is a critical part of the inflation in industrial goods prices in recent years. It is not more than a part of the story of inflation in this period, other important elements being the runup in machinery prices, the rise of construction costs, the increase in service prices, and perhaps equally important, the failure of prices in other fields to fall.

E. In the coming years, the nature of the inflationary hazards facing the economy will continue to change as they have in the past. Continual economic analysis and a wide range of flexible policies, suited to the specifics of the changing process which determines the path of the price level, are necessary if price stability is to be promoted without affecting the growth of the economy adversely.

APPENDIXES

Technical Appendix I

THEORETICAL FORMULATION OF THE INPUT-OUTPUT COMPUTATION

The theory which underlies the computation of section is presented below: [1]

I

Let

$$P_j = P_1 a_{1j} + P_2 a_{2j} + \ldots + P_n a_{nj} + R_j \quad (j = 1, \ldots, n) \tag{1}$$

where P_j is the price of j, a_{1j} is the unit input of 1 per unit of output of j, and R_j is the total value added per unit plus the total steel cost per unit.

Thus,

$$R_j = a_{sj} P_s + a_{kj} w_j + \pi_j, \tag{2}$$

where the subscript s refers to the steel industry, a_{kj} is the amount of labor required per dollar of output of j, w_j is the wage rate in j and π_j is the profit rate including depreciation in j. This formulation "opens" the input-output model with respect to both households and the steel industry.

Solving equation system (1) for prices, we get

$$P_j = A_{1j} R_1 + A_{2j} R_2 + \ldots + A_{nj} R_n, \tag{3}$$

and substituting for the R's we get,

$$P_j = (A_{1j} a_{s1} + A_{2j} a_{s2} + \ldots + A_{nj} a_{sn}) P_s + A_{1j} a_{k1} w_1 + A_{2j} a_{k2} w_2 + \ldots + A_{nj} a_{kn} w_n + A_{1j} \pi_1 + A_{2j} \pi_2 + \ldots + A_{nj} \pi_n. \tag{4}$$

Therefore,

$$\frac{\Delta P_j}{\Delta P_s} = A_{1j} a_{s1} + A_{2j} a_{s2} + \ldots + A_{nj} a_{sn}. \tag{5}$$

But, as Dorfman, Samuelson, and Solow have shown,[2] the expression on the right-hand side of (5) equals A_{sj}. Thus

$$\Delta P_j = A_{sj} \Delta P_s. \tag{6}$$

This is the expression measuring the "cost-push" from a given increase in the price of steel on the price of j.

II

Suppose a price index consists of the base period prices $P_1^o, P_2^o, \ldots, P_n^o, P_s^o$ and the weights $b_1, b_2, \ldots, b_n, b_s$. The effect of an increase of the price of steel on this index is

$$\Delta I_s = \frac{\Delta P_1}{P_1^o} b_1 + \frac{\Delta P_2}{P_2^o} b_2 + \ldots + \frac{\Delta P_n}{P_n^o} b_n + \frac{\Delta P_s}{P_s^o} b_s, \tag{7}$$

or

$$\Delta I_s = \Delta P_s \left[\frac{A_{s1}}{P_1^o} b_1 + \frac{A_{s2}}{P_2^o} b_2 + \ldots + \frac{A_{sn}}{P_n^o} b_n + \frac{1}{P_s^o} b_s \right] \tag{8}$$

With each individual base-year price expressed as an index equal to 1.00, (8) becomes

$$\Delta I_s = \Delta P_s \left[\sum_{i=1}^{n} A_{si} b_i + b_s \right] \tag{9}$$

[1] This appendix contains an adaptation of standard input-output theory to the special application of this paper. The pioneer general statement can be found in Wassily Leontief, "The Structure of American Economy, 1919-39," pp. 188-192; also see Robert Dorfman, Paul A. Samuelson, and Robert M. Solow, "Linear Programing and Economic Analysis," pp. 230-237.

[2] Ibid. p. 235.

Calling the expression in parentheses, the total weight of steel, direct and indirect, B_s,

$$\Delta I_s = B_s \Delta P_s. \tag{10}$$

III

The procedure to compute the movement of the index that would have occurred if steel behaved like the rest of the index is the following:

Suppose the actual change in the index between two periods is ΔI_a. It is composed of the change due to the rise in steel plus the change due to the rest of the index, i.e.,

$$\Delta I_a = \Delta I_s + \Delta I_h = B_s \Delta P_s + B_h \Delta P_h. \tag{11}$$

The sum of weights equals 1, i.e.,

$$B_s + B_h = 1. \tag{12}$$

Knowing B_s, we compute B_h. Then, given ΔI_a, B_s, ΔP_s and B_h, ΔP_h can be computed from (11). If steel behaved like the rest of the index, the index would rise by ΔP_h.

We define the change in the index that would have occurred as

$$\Delta I' = B_s \Delta P_h + B_h \Delta P_h = \Delta P_h. \tag{13}$$

The results summarized in figures 1 to 5 and table 2 contrast $\Delta I'$ with ΔI_a.

TECHNICAL APPENDIX II

The Applicability of Input-Output Analysis to the Cost-Push Computation

The computation of section 4 was performed on the basic premise that the behavior of the economy conforms to the assumptions of input-output analysis. Each industry produces output with essentially constant returns to scale and with constant input proportions, i.e. the a_{ij} of the 1947 input-output table are said to be pertinent for the 11-year period following that date.[1]

Because the price of steel has risen so drastically, one might expect that substitutes of other materials had decreased the steel input coefficients in the economy. The use of reinforced concrete in construction, of aluminum in automobiles,[2] of plastics are some examples, and many others can be cited. On the other hand, there have also been many increases in the uses of steel.

A rough check on the quantitative significance of steel over time can be obtained by comparing the growth of its output with the growth of real GNP. Comparing the periods 1947–49 with 1955–58, periods long enough to reduce the impact of inventory fluctuations and of durable goods sales fluctuations in recessions, we find that steel production rose by 33 percent, real GNP by 38 percent.

A more sensitive test of the stability of average input-output relationships has also been carried out: a crude index of input-output coefficients for the major steel-user industries has been computed. Annual data from the American Iron and Steel Institute on shipments of steel to major users have been divided by production indexes for those industries. The resultant input-output ratios are given in table 14. If all the indexes were 1.0, the input-output coefficients would be perfectly stable; numbers below 1.0 show a decline of steel as an industry input.

The results can be summarized as follows:

1. Most of the coefficients for the major users remain relatively stable;
2. The coefficients are relatively low in recession years, when part of the need for steel is met out of stocks.
3. Contrasting the values for 1947–49 with 1956–58, the relative use of steel in autos—the biggest consumer—has risen slightly; the use in construction and fabricating—the next two largest purchasers—has fallen slightly; the coefficients for the remaining users show considerable variation, some, including shipbuilding and railroads, showing an increase, others including machinery, containers, agriculture, and aircraft showing decreases.

[1] This assumption is vital to the analysis but the a_{ij} need not be strictly unchanged as long as the deviations for the individual sectors are compensatory.

[2] Longer automobiles have lessened the quantitative importance of the substitution effect against steel in this sector.

APPENDIX TABLE 1.—*Ratios of indexes of steel shipments to consuming industries to output of consuming industries* [1]

[1947–49=100 [2]]

	Percent of total steel shipments		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	Average 1956–58
	1947	1958													
Agriculture	2.1	2.1	0.93	0.92	1.18	1.16	1.06	0.91	0.91	0.91	1.04	0.86	0.87	0.83	0.85
Aircraft	.1	.1	1.14	.89	.96	1.07	1.83	.95	.89	.48	.52	.64	.42	.28	.43
Automotive	15.8	17.6	.96	1.00	1.04	1.08	1.07	1.05	1.14	1.06	1.20	1.11	1.09	1.01	1.08
Construction and maintenance	11.3	15.2	1.01	.97	1.02	.96	1.12	.91	1.09	.88	.87	.96	1.17	.83	.99
Containers, tin	9.1	5.8	1.04	1.03	.92	1.01	1.07	.96	.96	.98	.99	.95	.95	1.00	.97
Machinery, tools	5.1	5.5	.99	1.03	.98	1.03	1.10	.87	.92	.83	1.02	.99	.90	.74	.89
Pressing, forming, stamping (fabricating)	4.7	5.0	.99	1.11	.89	1.09	.99	.81	.97	.84	1.07	1.08	.80	1.07	.98
Railroads	8.3	2.6	1.14	1.07	.81	1.31	1.41	1.18	1.44	1.38	1.83	1.46	1.17	.82	1.20
Shipbuilding	.6	1.4	.54	1.17	1.41	.77	1.32	1.37	1.17	.81	.95	1.17	1.80	1.13	1.37

[1] Steel shipments to consuming industries, 1947–49=100: "American Iron & Steel Institute, 1958," pp. 96–97. Outputs of consuming industries: Aircraft (and parts), autos (trucks and parts), containers (tin cans), machinery, railroads (and equipment), shipbuilding (and repair), and pressing, forming, and stamping (the average of "structural metal parts" and "stamping and miscellaneous metal products"); Federal Reserve Board of Industrial Production, 1947–49=100; agriculture (gross private product, farm) and construction (new construction, total): "Economic Report of the President," January 1959.

[2] Components will not add up to 100 percent due to omissions such as "warehouse and distributors" (19.0 percent in 1958), "contractors' products" (6 percent) and others, for which no comparable output data are available.

While these tests are crude and do not verify the stability or instability of individual input-output coefficients,[3] they do show that whatever decline there may be in the quantitative importance of steel must be very small, no more than a few percent. The substitutions against steel appear to be largely offset by the growth of new uses. Thus, the use of the input-output coefficients of 1947 is not likely to introduce a large bias into the results of the computation.

The other key supposition that is essential is that prices are equal to the sum of costs, including capital costs plus profits, and that an increase in unit costs leads to an equal price increase.

Evans and Hoffenberg have argued that this theory of pricing is probably much too crude to be a reasonable description of pricing decisions in the short run, when both demand and strategic competitive considerations have a strong influence. But "these cautions * * * apply with less force to an analysis of the expected consequences of broader changes in factor costs over longer periods, or to efforts to identify factors that may prominently affect or determine price changes for a given sector. They apply hardly at all to a de facto analysis of causal interconnections in historical price movements." [4]

We consider these conclusions to be applicable to our analysis. As a year-by-year estimate of the influence of steel prices on other prices, the errors are probably substantial, with considerable cost absorption likely in recession years, and price increases greater than cost increases in peak periods. But over periods of 5 or 10 years, where the cost structure has moved upward by a substantial percentage, prices must move roughly with costs, as long as there are no dramatic changes in profits.

Two further considerations strengthen this conclusion. First, the relative constancy of the proportion of steel used by the major steel-using industries, as well as the small decline in the ratio of steel production to gross national product, suggests that the higher prices did not lead to a deterioration of total demand of the degree likely to lead to cost absorption. Second, it must be kept in mind that our compilation does not seek to explain price movements; it only estimates the difference in price changes caused by steel prices. Other factors were also acting on prices during the period, of course; we only isolate the "cost-push" coming from the steel industry.

[3] One further approximation is necessary. Strict implementation of the model in appendix I would require computation of a special inverse matrix corresponding to equation system (3), with the steel industry in the exogenous sectors of the economy. The inverse actually used was the conventional one, which treats steel as endogenous. Since steel is a primary material, the differences between the two inverse matrices must be small.

[4] W. Duane Evans and Marvin Hoffenberg, "The Nature and Uses of Interindustry Relations Data and Methods," in "Input-Output Analysis: An Appraisal," National Bureau of Economic Research, Studies in Income and Wealth, vol. 18, p. 99.

STUDY PAPER NO. 3

AN ANALYSIS OF THE INFLATION IN MACHINERY PRICES

(BY THOMAS A. WILSON)

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One hypothesis that has been put forward as a partial explanation of the 1954–58 inflation is that of sectoral demand pressure.[1] According to this theory, the *distribution* of demand as well as its aggregate level has important inflationary implications. If demand rises fast enough in a particular sector or sectors of the economy, inflationary pressures can arise even though the level of aggregate demand is itself not excessive.

In this paper we shall give a brief theoretical outline of how sectoral demand pressure can cause inflation, and shall go on to test the hypothesis that demand pressure played a significant role in the recent inflation of machinery prices. We shall also try to explain downward price rigidity in this sector, and attempt to demonstrate that a general capital goods inflation over a long period can be largely "self-justifying" (in the sense that it may not set corrective forces into motion). The implications of a capital goods inflation for general price level stability and for economic growth will also be discussed.

I. A Theory of Inflation Generation as a Result of Sectoral Demand Pressure

Sectoral demand pressure may be defined as follows: It is a state of demand which presses upon productive capacity in many of the product lines produced within a sector. It may be a part of general economywide demand pressure, or it may exist in relative isolation. If demand pressure occurs, then one or (more likely) both of two things must happen: (1) the prices of the sector's products must rise at a faster rate than they otherwise would have, and (2) there will occur nonprice rationing of the scarce goods. Since we are interested primarily in the effects of price increases in the sector, we shall not discuss the latter case.

If a given increase in aggregate demand is concentrated in a particular sector and demand pushes on capacity in that sector, unfilled

[1] "World Economic Survey 1957," United Nations, Department of Economics and Social Affairs, New York, 1958, pp. 29–33.
Otto Eckstein, "Inflation, the Wage-Price Spiral, and Economic Growth," Joint Economic Committee, "The Relationship of Prices to Economic Stability and Growth," U.S. Government Printing Office, 1958, pp. 361–374.
Alvin H. Hansen, "A Neglected Factor in Inflationary Pressure," "Review of Economics and Statistics," May 1959, p. 184.
Charles Schultze, "Recent Inflation in the United States," Joint Economic Committee, "Study of Employment, Growth, and Price Levels," Study Paper No. 1, U.S. Government Printing Office, 1959.

orders will pile up and prices of the sector's products may rise. This price increase can lead to general inflationary pressure, if a large part of the economy is characterized by downward price and wage rigidity in the short run.[2]

The sectoral price increase will have the following more general inflationary effects:

(1) The direct effect of the sectoral price rise on the general price level; i.e., the rise in the wholesale, consumer, or other general price index directly resulting from the price rise of some of its components.

(2) Indirect effects of the "current chain" type. Since the outputs of the excess demand sector are, in part, current inputs into other sectors, the price rise in this sector means cost increases in other sectors. These cost increases may be absorbed by substitution in favor of other inputs or by reduced profits, but some will probably be "passed on" in higher prices of the other sectors' products. These new price increases in turn have further repercussions on industries which take the products as inputs. Hence, an increase in one sector's prices can lead to a chain of price increases that permeate the economy.

(3) Wage effects. It is possible that the firms in the excess demand sector will be "softer" on wage demands than they would be in the absence of demand pressure. If the unions in this sector achieve high wage increases, unions in other industries may demand more than they otherwise would have, in an attempt to keep their relative wage position intact. Insofar as they are successful, costs rise faster in these industries. In addition, price increases in a sector that produces products that are components of the consumer price index will have a direct influence on other sectors that have cost-of-living escalator clauses in their wage contracts.

(4) Indirect effects via capital costs. In addition to the current chain effects mentioned above, sectoral price increases may have general inflationary implications by increasing the costs of investment goods. This is a particularly important effect of a machinery inflation, and will be discussed more fully below.

THE TRANSMISSION OF DEMAND PRESSURE TO THE CAPITAL GOODS SECTOR

Demand pressure in the capital goods sector can occur if (1) an increase in aggregate demand includes large chunks of Government purchases of "hard" goods, exports of capital goods, and domestic investment of an "autonomous" nature; or (2) if an increase in aggregate demand causes demand pressure in other sectors; or both.

The pressure of demand in a particular sector or sectors will tend to be transmitted to the capital goods sector, even though the economy as a whole is running at undercapacity. The sectors facing demand pressure will attempt to expand capacity, and the resulting demand for capital goods will probably not be offset by decumulation in those sectors facing insufficient demand. Decumulation in those sectors cannot exceed the rates of physical depreciation; also a certain part of their investment may be made for purposes of modernization, and in the case of oligopolies, for purposes of market strategy.

[2] Charles Schultze has presented regressions of prices on output that demonstrate downward rigidity. Schultze, op. cit., pp. 110-113.
Harold Levinson has carried out cross-section regressions of wages on employment and prices on output which also reveal downward rigidity. Harold Levinson, Forthcoming Study Paper, Joint Economic Committee, "Study of Employment, Growth, and Price Levels."

II. Empirical Analysis of the 1954–58 Inflation in Machinery Prices

The machinery sector was selected for analysis because several economists have suggested that excessive investment demand was a causal factor in the recent general inflation.[3] The machinery industries are ideal for the purpose of testing this hypothesis since a relatively large portion of their output is investment goods, and adequate data are available. If investment demand played a role in the 1954–57 inflation, we should expect it to show up in the machinery sector.

Let us therefore proceed to test the hypothesis that the growth of demand had a significant impact on machinery prices. We have gathered together different pieces of information and carried out different tests. First, several simple pieces of evidence are presented, followed by a more elaborate statistical test.

1. Machinery prices and wages and materials costs

If all of the rise in machinery prices were explainable by increases in wage costs and materials costs, the hypothesis of demand pressure would be weakened, though not necessarily rejected. However, the data reveal that this did not occur.

The wholesale price index for machinery and equipment rose 19 percent between 1954 and 1957. Meanwhile unit wage costs rose 10 percent in nonelectrical machinery and 5 percent in electrical machinery.[4] The sectoral wholesale price index "intermediate materials for durables manufacturing" rose 11½ percent over the same period.[5] It is clear that rising labor costs and materials costs cannot account for more than half of the increase in machinery prices.

Since wage costs and materials costs do not explain the greater than average increase in machinery prices, it follows that taxes, property income or depreciation per unit of output must have risen. Data on the breakdown of gross value added for manufacturing have already been published by Charles Schultze.[6] Similar computations have been carried out for two-digit industries within manufacturing.[7] Table 1 below presents a comparison of the movements of the different components of gross value added of the two machinery sectors with manufacturing as a whole.

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[3] See note 1.

[4] The changes in unit wage costs were computed as follows:

$$\frac{\text{Unit wage cost (1957)}}{\text{Unit wage cost (1954)}} = \left[\frac{\text{Average hourly earnings, 1957}}{\text{Average hourly earnings, 1954}}\right] \cdot \left[\frac{\text{Output/total man-hour, 1954}}{\text{Output/total man-hour, 1957}}\right]$$

The productivity indexes were computed by dividing a Federal Reserve output index (with 1954 value added weights) with a total man-hours index computed from published BLS data (a 40-hour workweek assumption was made for nonproduction workers).

In nonelectrical machinery productivity rose 1 percent while average hourly earnings rose 11 percent. In electrical machinery, productivity rose 9 percent; average hourly earnings rose 14 percent.

[5] The components of the wholesale price index for "intermediate materials for durables manufacturing" have the following weights:

Iron and steel	0.52
Nonferrous metals	.19
Other	.29

The proportions of nonmachinery current inputs into machinery in the 1947 input-output table were:

Iron and steel	0.34
Nonferrous metals	.20
Other	.46

As the "other" inputs contain some iron and steel, the weights of this sectoral price index are a fair approximation to the proportions of current inputs into machinery.

[6] Schultze, op. cit., p. 124.

[7] Charles Schultze and Joseph Tryon, Forthcoming Study Paper, Joint Economic Committee, "Study of Employment, Growth and Price Levels."

It is readily seen that a large chunk of the rise in the price of value added in machinery is accounted for by the rise in gross margins. For manufacturing as a whole, however, changes in gross margins had a negligible influence upon the price of value added. Although these data must be taken with a small dose of salt,[8] the results are striking and are, of course, what one would expect if machinery were undergoing demand pressure.

TABLE 1.—*Changes in value added components, 1955–57*

Industry	Series	Percent change, 1955–57	Percent of price change accounted for by change in component
Manufacturing as a whole	Price of gross value added	7.4	100.0
	Unit labor cost	11.4	93.7
	Gross margins		−1.0
	Capital consumption	19.4	19.8
	Property	−7.0	−20.8
	Indirect taxes	6.8	8.3
Electrical machinery	Price of gross value added	12.8	100.0
	Unit labor cost	8.8	52.6
	Gross margins		48.0
	Capital consumption	9.6	3.3
	Property	43.0	44.7
	Indirect taxes	−1.5	−.7
Nonelectrical machinery	Price of gross value added	14.2	100.0
	Unit labor cost	13.3	68.6
	Gross margins		27.5
	Capital consumption	15.6	6.9
	Property	16.5	20.6
	Indirect taxes	20.5	3.9

Source: Forthcoming Study Paper by Charles Schultze and Joseph Tryon.

2. The behavior of overtime hours worked

If a sector were faced with demand pressure, one would expect firms in that sector to increase overtime man-hours in an attempt to meet the demand. Data for two-digit industries and for manufacturing as a whole are available only since January of 1956. The statistic we have chosen as an indication of relative demand pressure is the deviation between nonelectrical and electrical machinery overtime hours and overtime hours for manufacturing as a whole.[9] Table 2 reveals that the difference between overtime hours in nonelectrical machinery and overtime hours in manufacturing as a whole was about 1.0 hours in the first half of 1956. It fell to about 0.7 for the remainder of 1956 and the first 5 months of 1957, then rapidly declined to negative levels for the remainder of 1957 and continued to decline to a low of −0.8 in August 1958.

The deviations between electrical machinery and manufacturing were always negative and showed less sharp cyclical fluctuations. The published data weakly favor the demand pressure hypothesis for nonelectrical machinery, and are inconclusive for electrical machinery.

[8] The value added deflator was

$$\frac{\text{Value added (year i)}}{\text{Value added (base year)} \times \left[\frac{\text{Output (year i)}}{\text{Output (base year)}}\right]}$$

This deflator rests on the assumption that real value added moved the same as output.
The deflator was split into its various components in proportion to current expenditures on those components.
Changes in gross margins for manufacturing are somewhat understated because the last half of 1957 was a period of contraction.

[9] By comparing machinery overtime hours less manufacturing overtime hours for different periods, the effect of structural differences that influence the average level of overtime hours is eliminated. Seasonal patterns, will remain, but the data does not reveal strong seasonal behavior.

TABLE 2.—*Overtime hours: Machinery compared with manufacturing*

Period	Total manufacturing	Electrical machinery	Nonelectrical machinery	Electrical minus manufacturing	Nonelectrical minus manufacturing
1956—January	3.0	2.9	4.0	−0.1	1.0
February	2.8	2.5	3.9	−.3	1.1
March	2.7	2.4	3.8	−.3	1.1
April	2.7	2.7	3.8	0	1.1
May	2.6	2.5	3.6	−.1	1.0
June	2.7	2.4	3.6	−.3	.9
July	2.6	2.0	3.4	−.6	.8
August	2.7	2.5	3.4	−.2	.7
September	3.1	2.9	3.8	−.2	.7
October	3.1	3.1	3.7	0	.6
November	3.0	2.9	3.5	−.1	.5
December	3.1	2.8	3.7	−.3	.6
1957—January	2.6	2.4	3.3	−.2	.7
February	2.5	2.3	3.2	−.2	.7
March	2.5	2.2	3.1	−.3	.6
April	2.3	2.0	3.0	−.3	.7
May	2.2	1.8	2.7	−.4	.5
June	2.4	2.0	2.7	−.4	.3
July	2.4	1.7	2.5	−.7	.1
August	2.4	2.1	2.4	−.3	0
September	2.5	2.0	2.4	−.5	−.1
October	2.3	1.7	2.1	−.6	−.2
November	2.3	1.5	1.9	−.8	−.4
December	2.0	1.3	1.9	−.7	−.1
1958—January	1.7	1.0	1.6	−.7	−.1
February	1.6	1.0	1.5	−.6	−.1
March	1.6	1.0	1.6	−.6	0
April	1.5	.9	1.5	−.6	0
May	1.7	1.0	1.5	−.7	−.2
June	1.9	1.2	1.6	−.7	−.3
July	1.9	1.3	1.5	−.6	−.4
August	2.3	1.6	1.5	−.7	−.8
September	2.4	2.2	1.8	−.2	−.6
October	2.4	2.0	1.8	−.4	−.6
November	2.6	2.2	2.1	−.4	−.5
December	2.6	2.3	2.2	−.3	−.4
1959—January	2.3	2.0	2.2	−.3	−.1
February	2.4	2.1	2.4	−.3	0
March	2.6	2.0	2.7	−.6	.1
April	2.6	1.8	2.9	−.8	.3
May	2.7	2.1	3.0	−.6	.3
June	2.9	2.3	3.2	−.6	.3

An analysis of supplementary data provided by BLS provided a clearer picture. Those machinery sectors with the greatest price increases in the 1954–57 period worked more overtime hours than other machinery sectors in the first months of 1957. A rank correlation between changes in prices 1954–57 and peak-minus-trough overtime hours for the period 1957–58 for six machinery groups yielded a perfect correlation coefficient of +1.[10]

The results of the analysis of overtime hours are compatible with the demand pressure hypothesis.

3. Plant and equipment expenditures and capital appropriations

If a sector is undergoing demand pressure, one would be surprised if it did not purchase relatively more plant and equipment than other sectors. The reference base for each sector is the previous peak level of plant and equipment expenditures in that sector. The statistic—peak expenditures/previous peak expenditures—was computed for nonelectrical machinery, electrical machinery, manufacturing as a whole, primary metals, and iron and steel. The latter two sectors were chosen for comparative purposes because the Eckstein-Fromm

[10] The groups were selected three-digit machinery components. The rank correlation coefficient of changes in prices, 1954–58, on peak minus trough overtime hours, 1957–58, for the same six subgroups was 0.829, which is significant at the 5 percent level on a one-tailed test. The odd period was used because the data were not available prior to 1957.

study suggests that demand pressure did not play the dominant role in the recent steel inflation.[11] Three peak-to-previous-peak ratios were computed for each of these sectors:

(i) Peak quarter, 1956–57/peak quarter, 1952–53.
(ii) Peak year, 1956–57/peak year, 1952–53.
(iii) 1956+1957/1952+1953.

The results are tabulated as follows:

TABLE 3.—*Plant and equipment expenditures: Peak to previous peak ratios*

Statistic	Manufacturing	Primary metals	Steel	Electrical machinery	Nonelectrical machinery	Total machinery
Peak quarter/prior peak quarter	1.37	1.32	1.18	1.27	1.53	1.43
Peak year/prior peak year	1.34	1.25	1.14	1.27	1.60	1.47
1956+1957/1952+1953	1.31	1.16	1.10	1.40	1.57	1.51

See also chart 7, p. 76.

Total machinery is higher than total manufacturing on the basis of each of the three comparisons, and much higher than iron and steel. Nonelectrical machinery provided most of the expansion for the machinery sector as a whole (which is partially explainable by the inclusion of appliances and radio and television in the electrical sector—products whose output did not expand very much in this period).

When one remembers the condition of demand for hard goods during the 1950–53 expansion, the 1956–57 levels of plant and equipment expenditures of the machinery sector are even more striking. After allowing for the 20 percent price rise in the implicit GNP investment deflators, the fact that machinery sectors purchased 25 percent more real plant and equipment is a strong piece of evidence supporting the demand theory.

Since plant and equipment expenditures appear some time after the *decision* to expand is taken, it may be instructive to look at the behavior of capital appropriations.

TABLE 4.—*New appropriations less cancellations*

(Millions of dollars)

Year	Manufacturing	Iron and steel	Electrical machinery	Nonelectrical machinery
1955	8,768	1,696	427	294
1956	10,000	1,500	762	504
1957	7,558	1,138	405	442
1958	4,897	903	267	275

Source: Computed from National Industrial Conference Board series.

NOTE.—The above figures are for reporting companies only, and are not strictly comparable with the plant and equipment expenditures series.

As the above table illustrates, appropriations for the two machinery sectors in 1956 and 1957 relative to 1955 were higher than a similar comparison for iron and steel and manufacturing as a whole. The appropriations data, therefore, confirm the results of the analysis of plant and equipment expenditures.

[11] Otto Eckstein and Gary Fromm, "Steel and the Postwar Inflation," Joint Economic Committee, "Study of Employment, Growth, and Price Levels," Study Paper No. 2.

4. Capacity and output relative to previous peak

It is unfortunate that sufficiently precise capacity statistics are not as yet available to permit a sensitive test of the relative degree of capacity utilization in different industries. In the absence of such measures, we have used the ratio of output to previous peak output in order to compare machinery subsectors with iron and steel, with total manufacturing, and with durable manufacturing. For each of these sectors, we computed the previous output peak from a 3-month moving average. Ratios of output to the previous peak were computed for each month during the period of suspected demand pressure. Two such periods were defined: (*a*) Starting when output rises above the previous peak, ending when output reaches a new peak, and (*b*) starting when output rises above the previous peak, ending when output falls below the previous peak after the new peak has been reached. These ratios were then averaged over each period for each sector to obtain the statistics used below in the intersectoral comparisons. The machinery output indexes selected were those for "industrial and commercial machinery," and "electrical apparatus and parts." These sectors have the virtue of excluding appliances, radio and television, and farm machinery.

TABLE 5.—*The behavior of output relative to its previous peak during periods of suspected demand pressure*

Sector	Period by definition (*a*) [1]		Period by definition (*b*) [1]	
	Length of period, months	Average ratio to previous peak	Length of period, months	Average ratio to previous peak
Manufacturing as a whole	20	1.022	33	1.031
Durable manufacturing	13	.996	19	1.009
Iron and steel	19	.972	25	.994
Iron and steel (excluding low month) [2]	18	1.017	24	1.029
Industrial and commercial machinery	15	1.050	20	1.052
Electrical apparatus and parts	15	1.068	28	1.080

[1] See text.
[2] Month of July 1956 excluded because a strike occurred.

The data show that the two machinery subsectors had a higher average ratio of output to previous peak output than iron and steel or durables manufacturing, and were somewhat higher than those for total manufacturing. The behavior of output relative to its previous peak is evidently not in conflict with the demand pressure explanation of the machinery inflation.

5. Orders data and prices for machinery

Up to this point, we have not introduced a demand variable explicitly into the analysis, but have looked at variables reflecting the reactions of suppliers (such as plant and equipment expenditures and overtime hours) or variables reflecting the interaction of demand and supply, such as output. We have seen that these data either support or do not conflict with the demand pressure explanation of inflation. All we need now is Hamlet himself.

For an industry characterized by a production timelag between order placement and shipments, new orders in the current period represent demand for output in future periods. Since there is no

supply feedback upon orders placed in the current period, new orders are a "pure" demand variable. An increase in new orders, therefore, means either a shift in the demand-price function or a movement along that function. Since machinery prices never declined much during the period we are studying, an increase in orders must be due to a shift in the demand-price function, with the rise in prices tending to understate the shift. Just as changes in new orders represent shifts in the demand function, the difference between new orders and sales represents the deviation between demand and current production. This provides the acid test of the demand pressure hypothesis: were changes in prices related to changes in orders relative to sales? A good starting point is provided by the behavior of the total machinery price index in relation to new orders, unfilled orders, sales, and inventories.

For the period 1954 to the present, these data strongly suggest that demand pressure was a causal factor in the upward swing in machinery prices. The year 1954 and the first quarter of 1955 were a period of relative price stability in the machinery sector. Prices began rising from April 1, 1955, and rose steeply until November 1956. Thereafter they rose at a slower rate until November of 1957, when price stability was once again achieved.[12] The wholesale price index excluding farm products and foods began its climb in June of 1955, rose more slowly than machinery prices until February 1957, then leveled off.

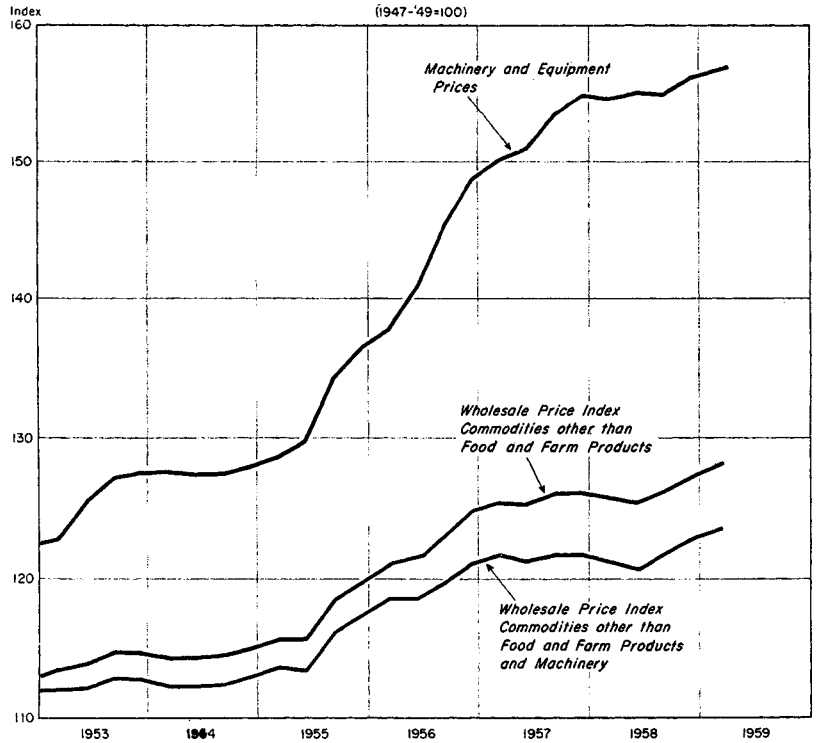

CHART 1.—Machinery prices compared with industrial prices.

[12] See chart 1.

Unfilled orders of machinery rose from a low of $13.7 billion in December 1954 to a high of $20.2 billion in February 1957. New orders exceeded sales (on a seasonally adjusted basis) for every month of the period February 1955 to December 1956. The inventory build-up beginning in the second quarter of 1955 lasted into the third quarter of 1957.[13]

At first glance, the data suggest that the 1955–57 inflation in machinery prices was associated with the rate of change in unfilled orders

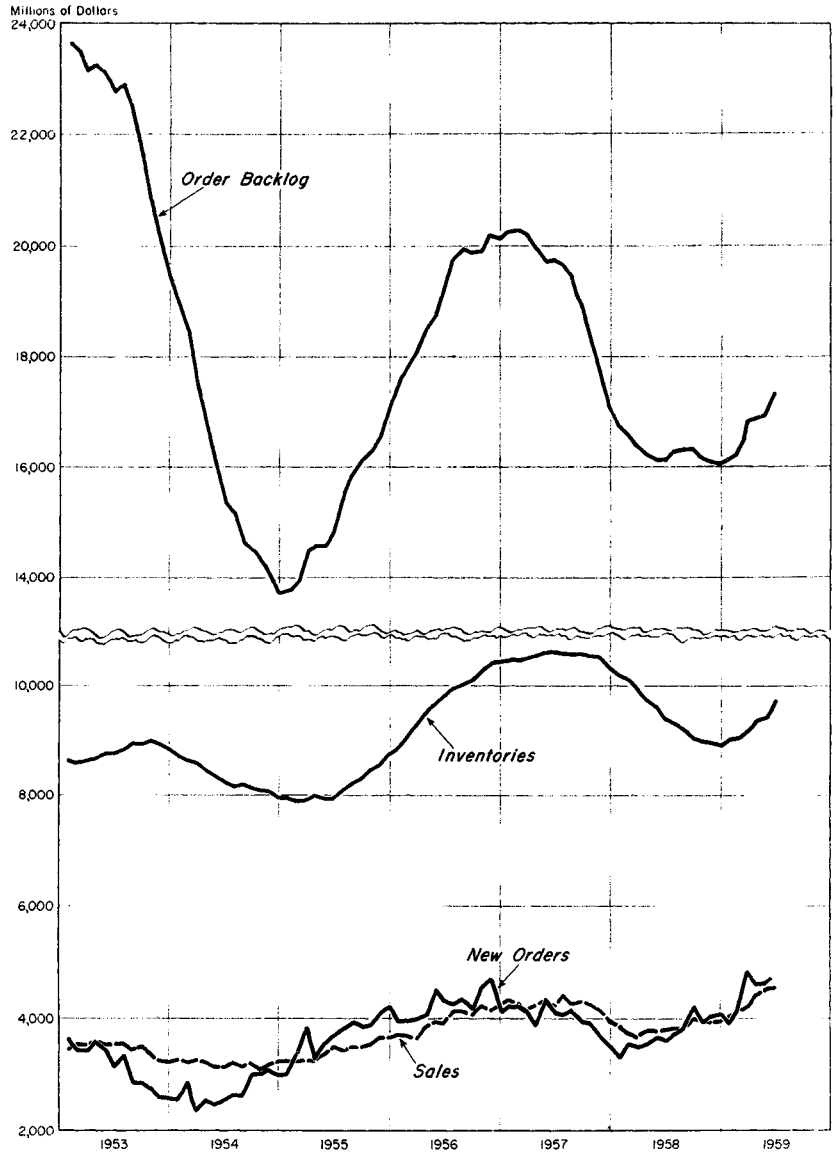

CHART 2.—Machinery: New orders, sales, unfilled orders, and inventories (monthly).

[13] See chart 2.

and with the level of unfilled orders. Throughout the period of most rapid price rise (April 1955–November 1956) new orders exceeded sales—the slowdown in the rate of increase in machinery prices matching the peak in unfilled orders. During the subsequent period of more slowly rising prices, unfilled orders were falling, but were still high in relation to sales.

To sum up for the period 1954–58 as a whole: rising unfilled orders are well associated with rising prices. There appears to be a lag in the response of prices to a fall in unfilled orders—in the 1954–58 cycle, prices continued to rise, although more slowly, about 8 months after unfilled orders turned down. Another observation is that rising machinery prices were accompanied by rising inventories, while stable prices are accompanied by falling inventories. This rise in inventories indicates that producers were building up stocks to meet higher expected future levels of demand, and that goods in process were rising as production responded to order placement.

These data, then, suggest that the rise in machinery prices between 1955 and 1957 was probably caused by demand pressure.

It might be argued that the above arguments in favor of a relationship between orders and demand are not rigorous enough; that the observed coincidence between movements in prices and movements in orders is spurious because of the strong autocorrelation in the series; that the general level of business activity may be strongly correlated with both prices and orders and hence that the observed relationship does not reveal a true structural relationship.

In order to make rigorous quantitative estimates of the impact of demand on machinery prices, and in order to provide a quantitative comparison of machinery with steel, a multiple regression analysis of the machinery and steel sectors has been carried out. The details of these analyses are presented in Technical Appendix I. At this point, it suffices to mention the results.

Four regression equations were fitted for both the steel sector and a composite machinery sector. Quarterly data for the period quarter III 1953, to quarter II 1959, were used. The machinery composite consisted of three subsectors—industrial machinery, other nonelectrical machinery, and generating machinery. These subsectors were combined for the purpose of time series regressions by the use of dummy variables.

The most important equation fitted was: changes in prices on—

$$(1)\ \frac{\text{New orders—Sales}}{\text{Sales}}\ \text{(previous quarter)}$$

$$(2)\ \frac{\text{GNP—GNP trend}}{\text{GNP trend}}$$

$$(3)\ \frac{\text{Unfilled orders}}{\text{Sales}}\ \text{(end of previous quarter)}$$

(4) Changes in wages

In the discussion below, "Beta" coefficients will be mentioned. These are "standardized" regression coefficients, i.e., they express the relationship between the price variable measured in terms of its standard deviation with the various explanatory variables measured

in terms of their standard deviations. These Beta coefficients are therefore suitable for comparing the impact of a particular variable upon prices in the two sectors.

The results obtained are as follows:

(1) (New orders —sales)/sales reveal a significant positive association with changes in prices in the machinery sector, but had no significant relationship with changes in prices for the steel sector. (The Beta coefficients in the final equations were 0.3352 for machinery and —0.1145 for steel, the latter coefficient being insignificant with a wrong sign.)

(2) The general level of business activity is significantly positively associated with prices for both sectors. (The Beta coefficients in the final equations were 0.2942 for machinery and 0.4458 for steel.)

(3) Changes in wages, as would be expected, are significantly positively related to changes in prices. This positive relationship is much more marked for steel, however. (The Beta coefficients in the final equation were 0.4334 for machinery and 0.7985 for steel.)

(4) The ratio of unfilled orders to sales (previous quarter) did not significantly affect prices in either sector.

(5) The regression constant, which provides an estimate of price changes when all the independent variables are zero, is much higher for steel than for any of the machinery subsectors. (The regression constants in the final equations were 1.116 for industrial machinery, 0.320 for other nonelectrical machinery, 0.623 for generating machinery, and 2.188 for steel.)

(6) These results are in perfect agreement with the demand pressure explanation of the machinery inflation and with Eckstein and Fromm's analysis of the steel industry. During the period 1953–59, movements in orders relative to sales, which represents demand, had a significant positive impact upon machinery prices, but not on steel prices. Moreover, the relatively large constant and strong price-wage relationship revealed in the steel equation supports the view that prices and wages in that sector behaved to a certain extent "autonomously."

6. Additional evidence suggesting demand pressure hypothesis—Movements in prices of machinery compared with movements in steel prices—Concentration indexes

A simple piece of evidence is revealed by a comparison of the graphs of steel prices and machinery prices. Steel prices behaved in a rather rigid time pattern—moving slowly throughout most of each year with pronounced upward leaps near midyear (presumably when the yearly wage adjustment is made). In contrast, machinery prices behaved irregularly through time. Both series, however, demonstrated downward rigidity (this phenomenon will be discussed below).[14]

The subsectors of machinery that led the price upswing had quite low concentration ratios, lower than other subsectors of the industry.[15] These data suggest that market power probably did not play a major role in the recent inflation of machinery prices. This is not to deny, however, that market power may be of significance for downward price rigidity during recessions.

[14] See charts 1, 3, and 8.
[15] See table 6.

TABLE 6.—*Concentration ratios and price changes for machinery subsectors*

Machinery subsectors	Weighted average concentration ratio: 4 firms	Weighted average concentration ratio: 8 firms	Percent rise in prices, 1954–57
Agriculture machinery and equipment	52.07	66.59	9.33
Construction machinery and equipment	20.00	29.00	21.58
Metalworking machinery and equipment	17.21	24.77	25.38
General industrial machinery and equipment	24.09	35.27	22.93
Electrical machinery and equipment	53.36	70.58	18.07

Weighted average concentration ratios are the weighted average of concentration ratios for 4-digit product groups within each of the machinery subsectors above. The weights used are value of shipments for the 4-digit product groups. Data was obtained from "Concentration in American Industry," report of the Subcommittee on Antitrust and Monopoly, U.S. Government Printing Office, 1957.

NOTE.—The above subsectors are not exhaustive.

SUMMARY OF THE EMPIRICAL ANALYSIS OF DEMAND PRESSURE AND MACHINERY PRICES

Before leaving the court of empiricism, let us pause a moment to tie down the decision. Each of the pieces of evidence which we have reviewed either strongly supports or else does not refute the hypothesis that demand played an important role in the machinery inflation. The two most important pieces of evidence that favor demand pressure were the behavior of plant and equipment expenditures and the multiple regressions of changes in prices on changes in orders, the general level of business activity, and changes in wages. All of the other evidence, however, gave at least slight support to the demand pressure theory. The verdict must be that demand pressure played an important, and probably the dominant, role in the 1954–57 inflation in machinery.

This is not to say that wages and materials costs, particularly steel, had no influence upon machinery prices. They did. But rises in these costs clearly cannot explain the extraordinary rise of machinery prices (i.e., the rise in wages and materials costs can account for little of the difference between the rate of increase of machinery prices and the rate of increase of industrial prices in general).

III. MACHINERY INFLATION OVER MORE THAN ONE CYCLE

Table 7 reveals the relative inflation of machinery prices during the postwar period. Machinery prices rose faster than the industrial wholesale price index over the period as a whole and for both of the subperiods. Chart 8 demonstrates the downward price rigidity of the components of the machinery sector during the past two recessions. See app. IV, pp. 77–81. It is evident that machinery inflation has not been confined to the expansion phase of the 1954–58 cycle.

TABLE 7.—*Percentage increases in wholesale prices: Machinery compared with industrial goods*

Sector	Period		
	1947–57	1947–53	1953–57
Machinery and equipment	63.0	34.3	21.4
All commodities other than farm products and foods	31.8	19.6	10.2

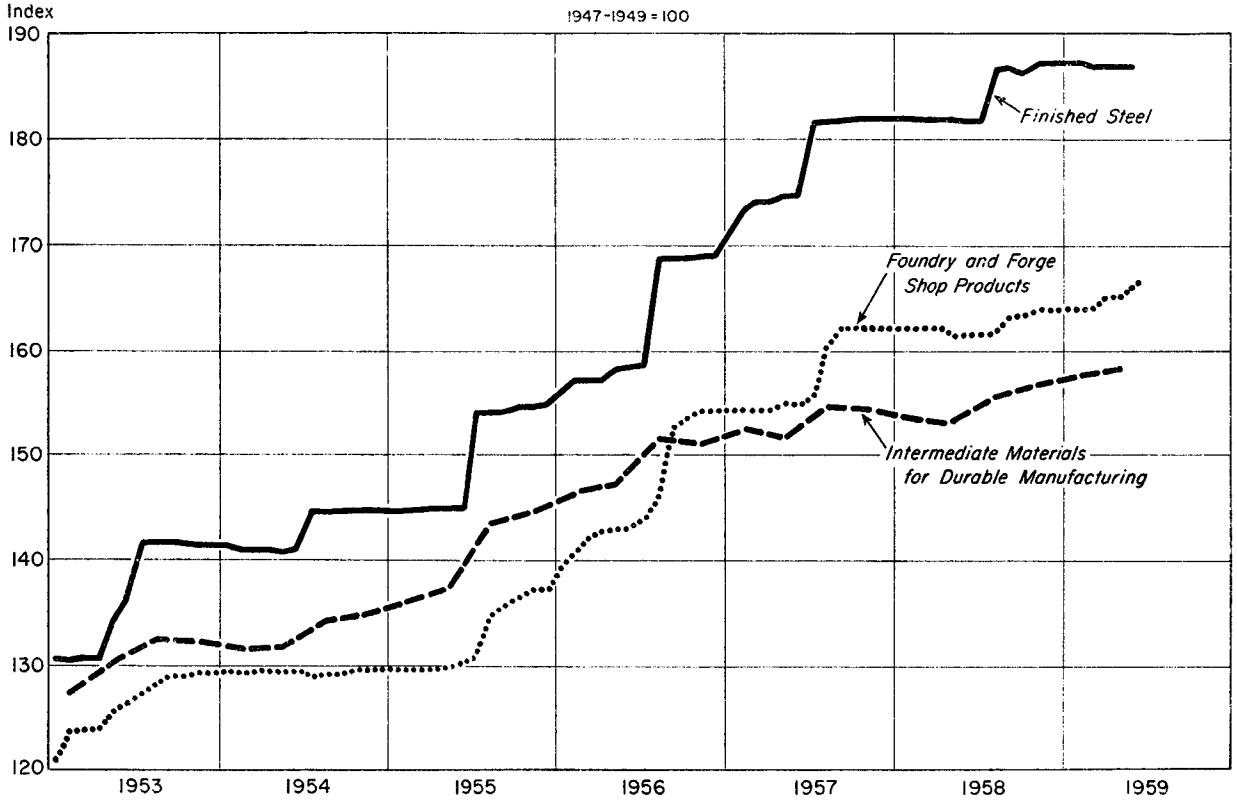

CHART 3.—Price indexes of important inputs into machinery.

We have already shown that demand pressure can cause a runup in machinery prices. Now we must attempt to explain how a machinery inflation can continue over more than one business cycle, and why machinery prices are downward rigid.

During the recession period of price stability, wage costs and steel costs tend to catch up with the new level of prices (see charts 1, 3, and 4). In addition, the rise in machinery prices during the preceding expansion will have directly raised current costs and capital costs of machinery producers. The 1947 input-output table reveals [16] that an important share of the inputs into each of the five machinery sectors was purchased from other machinery sectors. A general machinery inflation will therefore bring some direct pressure to bear upon current costs within the machinery sector. The rise in machinery prices will also increase the capital costs of machinery producers, and will reduce the attractiveness of entry into the sector. In addition, market power may reinforce price rigidity in some machinery subsectors, particularly where specialization leaves a small number of firms producing a product.

These factors not only tend to cause downward rigidity, but also set the stage for another runup in prices when the next expansion occurs. Machinery prices may therefore start off from each recession-price plateau into a new round of inflation, since the rise in wages, current input costs and capital costs absorb much of the profit gain, and may tend to increase entry barriers. So long as investment demand remains highly cyclical, and so long as wages and steel costs rise during recessions and hence contribute to downward price rigidity, the peril of inflation in machinery prices is likely to remain acute.

IV. The Significance of a Capital Goods Inflation for Price Level Stability and Economic Growth

It is fairly clear why the machinery inflation came about. We now turn to an analysis of its impact upon two key policy objectives. Others have shown how an inflation in a particular sector can have an impact on the general level of prices in the economy.[17] In the analysis of the more general impact of a machinery inflation, however, we must deal not only with those general price effects that arise from an inflation in any particular sector, but also with those effects peculiar to a capital goods inflation.

The more general implications of a machinery inflation can be classified under three headings: (1) The direct impact of the increase in machinery prices upon some measure of the general level of prices; (2) The more indirect effects of machinery prices upon other prices through their impact upon the input costs of other industries. These indirect effects will be discussed under the headings of (i) wage effects, (ii) current input cost effects, and (iii) capital cost effects; and (3) The implications for economic growth of a capital goods inflation.

1. The direct impact of machinery prices upon two measures of the general level of industrial prices

The direct impact upon the general price level can be defined as the change in the general price level that can be attributed to the

[16] The input-output tables used throughout this paper are those published in Duane Evans and Marvin Hoffenberg, "The Interindustry Relations Study of 1947," "Review of Economics and Statistics," May 1952, pp. 97-142.

[17] For a detailed exposition of this process, see Schultze, op. cit., pp. 54-77.

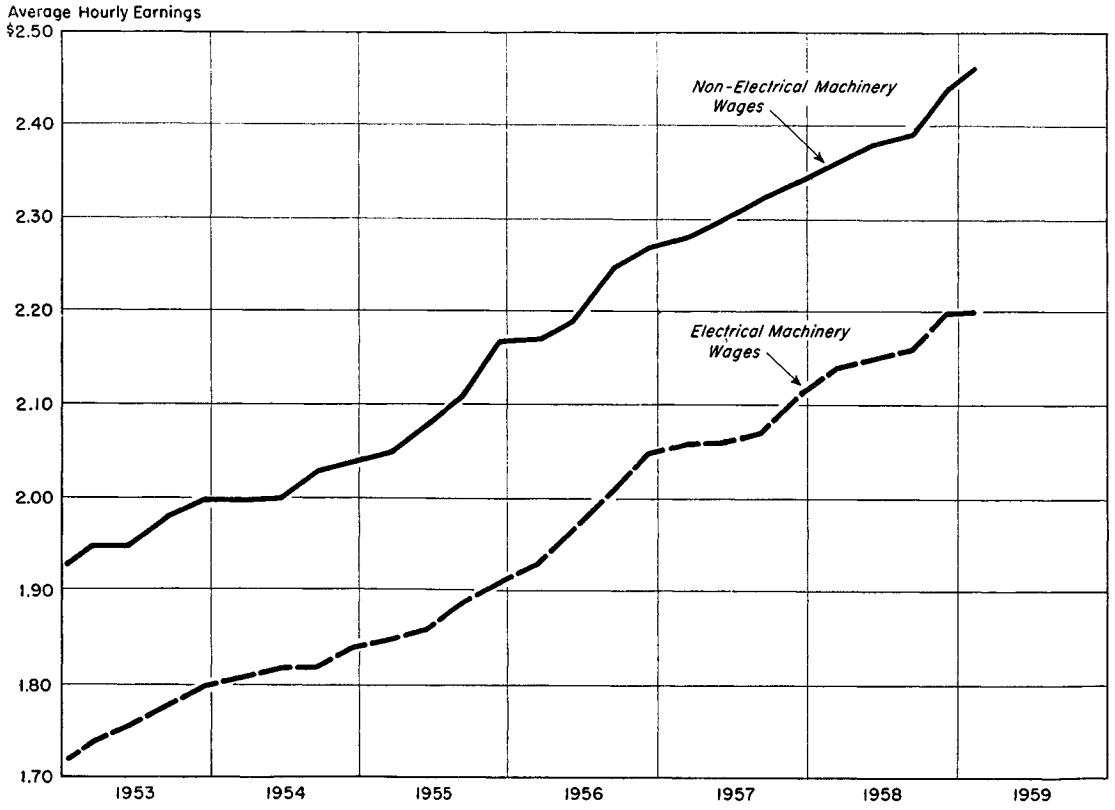

CHART 4.—Wages in the machinery sector.

greater than average gains in machinery prices. This direct impact is therefore a function of the weight of the machinery sector in the general price index and its price change relative to the average price change of the other components of the index. As our main concern is industrial prices, we selected two general price indexes: The wholesale price index excluding farm products and foods, and the finished goods sectoral index of the wholesale price index (again excluding farm products and foods).

For each of these general price indexes, the movement of the index can be compared with the movement of the index after excluding machinery.[18] The difference between the two rates of increase divided by the actual rate of increase in the general index gives us a measure of the percentage of inflation directly attributable to the greater than average rise in machinery prices. The results are tabulated in table 8 below.

TABLE 8.—*Direct impact of machinery prices upon 2 general industrial price indexes*

Index	Period	Percent of inflation in index attributable to greater than average rise in machinery prices
Wholesale price index, excluding farm products and foods	1954–57	18.0
	1954–58	20.3
Finished goods sector, excluding foods—wholesale price index	1954–57	22.8
	1954–58	24.6

This table reveals that nearly one-fifth of the recent inflation in the industrial wholesale price index, and over one-fifth of the inflation in the wholesale price index for finished industrial goods are due to the greater than average price rise in machinery.[19] It is obvious that the direct significance of the recent price rise in machinery upon the general level of industrial prices was far from negligible.

2. Indirect effect of machinery prices upon other prices

(i) *Wage effects.*—Schultze [20] has suggested that demand pressure in a particular sector will lead to higher wage increases by that sector. These wage increases will then have repercussions upon wages in other sectors.

This phenomenon evidently did not occur in the machinery sector. The ratios of average hourly earnings in both electrical and nonelectrical machinery to average hourly earnings in manufacturing as a whole remained almost constant throughout the whole period. Disaggregation of the machinery sector does not change these results—the rates of change in wages for the subgroups are not associated with rates of change in prices.[21] If wage effects were present during this period they were well concealed.

[18] The movement of an index with one of its components excluded indicates the rate of change in the total index that would have occurred if the particular component had behaved like the average of the rest of the components.

[19] These computations really give an estimate of the effect of demand pressure in the machinery sector on the level of industrial prices. Since we are comparing what actually happened with what would have happened if machinery had risen the same amount as the rest of the index, we have almost completely eliminated the effect of higher wages and materials costs.

[20] Schultze, op. cit., p. 70.

[21] See tables 9 and 10.

TABLE 9.—*Average hourly earnings: A comparison of machinery with manufacturing*

	Total manufacturing	Electrical machinery	Nonelectrical machinery	Ratio of electrical machinery to total manufacturing	Ratio of nonelectrical machinery to total manufacturing
1951—March	1.56	1.54	1.74	0.987	1.115
June	1.59	1.58	1.76	.994	1.107
September	1.61	1.60	1.79	.994	1.112
December	1.63	1.63	1.81	1.00	1.110
1952—March	1.65	1.66	1.84	1.006	1.115
June	1.65	1.67	1.85	1.012	1.121
September	1.69	1.69	1.87	1.00	1.107
December	1.73	1.71	1.93	.988	1.116
1953—March	1.75	1.74	1.95	.994	1.114
June	1.77	1.76	1.95	.994	1.102
September	1.79	1.78	1.98	.994	1.106
December	1.80	1.80	2.00	1.00	1.111
1954—March	1.79	1.81	2.00	1.011	1.117
June	1.81	1.82	2.00	1.006	1.105
September	1.81	1.82	2.03	1.006	1.122
December	1.83	1.84	2.04	1.005	1.115
1955—March	1.85	1.85	2.05	1.00	1.108
June	1.87	1.86	2.08	.995	1.112
September	1.90	1.89	2.11	.995	1.111
December	1.93	1.91	2.17	.990	1.124
1956—March	1.95	1.93	2.17	.990	1.113
June	1.97	1.97	2.19	1.00	1.112
September	2.01	2.01	2.25	1.00	1.119
December	2.05	2.05	2.27	1.00	1.107
1957—March	2.05	2.06	2.28	1.005	1.112
June	2.07	2.06	2.30	.995	1.111
September	2.08	2.07	2.32	.995	1.115
December	2.10	2.11	2.34	1.005	1.114
1958—March	2.11	2.14	2.36	1.014	1.118
June	2.12	2.15	2.38	1.014	1.123
September	2.14	2.16	2.39	1.009	1.117
December	2.19	2.20	2.44	1.005	1.114
1959—March	2.22	2.21	2.48	.995	1.117

TABLE 10.—*Percentage changes in wholesale price indexes and in average hourly earnings, 1954–57 for 6 machinery subgroups*

Machinery subgroup	Percentage change in prices	Percentage change in wages
Agricultural machinery and equipment	9.33	16.16
Construction machinery and equipment	21.58	16.41
General industrial machinery and equipment	22.93	14.14
Metalworking machinery and equipment	25.38	14.22
Electrical machinery and equipment	18.07	13.74
Miscellaneous machinery and equipment	15.70	14.87

(ii) *Current input cost effects.*—A rigorous analysis of the effect of higher machinery prices upon the costs of other industries requires that machinery inputs into those industries be broken into current inputs (i.e., flows of machinery that are required for the output of a given product), and capital inputs (i.e., stocks of machinery that are required for the output of a given product).

One set of estimates of current machinery inputs into other industries is provided by the 1947 input-output table. According to these estimates, machinery products were important as current inputs into only a limited number of other sectors, and into other machinery sectors.[22] In table 11 below, we illustrate the sum of the direct requirements of machinery per dollar of gross output for those non-

[22] The significance of the input of machinery into the machinery sectors themselves has been discussed above in sec. III.

machinery sectors where it is not negligible. The 1957 relative importance of machinery in the wholesale price index would be increased by approximately 4½ percent if the machinery requirements of four of these sectors are taken into account.[23] Thus, the current input cost effects of machinery are relatively small.

TABLE 11.—*Current machinery input requirements of 5 sectors*

Industry (1947 input-output classification):	*Sum of direct requirements of machinery per dollar of gross output (in 1947)*
Plumbing and heating supplies	$0.116
Motor vehicles	.076
Other transportation equipment	.071
Fabricated structural metal products	.039
Other fabricated metals	.033

(iii) *Capital cost effects.*—The current input price effects of a machinery inflation as estimated above are small because most machinery products were treated as capital inputs into other industries, and were consequently allocated to final investment demand in the 1947 input-output table.[24] This table may overstate or understate the proportions of machinery that are in fact current rather than capital inputs. It does seem reasonable, however, that a large share of machinery output becomes capital inputs into other industries.

Whereas a rise of current input costs affects an industry almost immediately, a rise in capital costs will exert its influences over a period of time. The length of this period will, however, depend upon the rate of growth of demand for the industry's products, the competitive structure of that industry, and the average life of the capital used in the industry.

The faster the rate of growth of demand, the faster will an industry adjust to higher capital costs. Since a growing industry will require either entry of new firms or expansion of capacity by existing firms, prices must rise enough to maintain marginal investment yields on new capital. Industries with a rapidly expanding demand will consequently respond more quickly to an increase in capital costs than industries with a stationary demand.

The rate at which an industry's prices adjust to a rise in capital costs will also depend upon the competitive structure of the industry. Since a rise in capital costs will increase entry barriers, those industries whose prices are mainly constrained by the possibility of entry (i.e., close-knit oligopolies), will be enabled to set higher prices as a result of the rise in capital costs. Those firms which use full-cost pricing methods will raise their prices if capital costs rise, since the rise in capital costs will increase depreciation charges.[25]

The rate of adjustment of prices to capital costs will also depend upon the average life of capital in the industry. The shorter the average life of capital, the faster will be the rate of adjustment of prices to capital costs.

[23] The machinery requirements of other transportation equipment were excluded because no wholesale price index is yet available for this group of products.

[24] Fifty-four percent of the gross output of the machinery sectors were allocated to final demand, 19 percent were current inputs into other industries, 12 percent were current inputs into machinery industries and 15 percent were undistributed.

[25] This effect is not necessarily confined to firms that use full-cost pricing. Many firms may raise prices in an attempt to finance the higher investment costs internally. This phenomenon in the steel industry has received attention by Dunlop and by Eckstein and Fromm. (John T. Dunlop, "Policy Problems, Choices and Proposals," in the American Assembly, Wages, Prices, Profits, and Productivity, May 1959. Eckstein and Fromm, op. cit.).

Whereas the rate at which prices adjust to higher capital costs is a function of the rate of increase of demand, the competitive structure of the industry, and the average life of capital within the industry, the size of that adjustment is a function of (1) the ratio of capital to output, and (2) the degree of substitutability between capital and other inputs. Those industries which are capital intensive and which cannot substitute other inputs for capital to any great extent will tend to have the greatest longrun price response to a rise in capital costs.[26]

Quantitative estimates of the extent of each of these capital cost effects are difficult to obtain. Estimates have been made, however, of the share of depreciation expenses in the inflation of gross value added for manufacturing during the recent expansion. These are presented below in table 12.

TABLE 12.—*Changes in unit costs in manufacturing, 1955–57*

Cost category	Percent change, 1955–57	Percent of total change accounted for by each category
Price of value added	7.4	100.0
Unit wage cost	6.7	39.5
Unit salary cost	21.9	54.2
Unit capital consumption	19.4	19.8
Unit profits	−7.0	−20.8
Unit indirect taxes	6.8	8.3

NOTE.—The large negative change in unit profits is explainable by the fact that the last half of 1957 was a period of contraction.

Source: Schultze, op. cit., p. 124.

Approximately one-fifth of the increase in the price of gross value added between 1955 and 1957 in manufacturing is due to the rise in depreciation. Part of this increase is explainable by larger real investment, during the period, and by the 1954 changes in the tax laws, but some of the rise is due to increased capital goods prices. (About 45 percent of the 1955–57 increase in private purchases of structures and equipment in manufacturing is due to price increases.)[27] While it is impossible to derive a precise estimate, the data do suggest that increased capital costs were of some importance in the recent inflation.

(3) A capital goods inflation and economic growth

A continuing inflation of capital goods prices has some negative implications for the growth potential of the economy. The increase in entry barriers resulting from the rise in capital goods prices impedes the dynamic process of competitive adjustment. The real capital formation potential of the economy will be lowered because the capital purchasing power of personal savings will be eroded. Finally, a rise in capital goods prices may adversely affect the industry's expenditures

[26] Higher capital costs may also cause a rise in the corporate demand for loanable funds—the size of this impact being a function of the elasticity of real investment with respect to the price of capital goods, and the success with which firms are able to finance the higher costs internally (by raising prices as discussed above, or by reducing dividends). If this price elasticity is less than one, and if firms are not able to finance completely the higher capital costs internally, the corporate demand for external funds will rise. This increased demand for loanable funds will tend to drive up interest rates (an important group of prices in the economy).

[27] The rate of change in real purchases of structures and equipment was compared with the rate of change in money purchases structures and equipment. Department of Commerce data was used.

on research and development—since prices of scientific equipment may participate in the rise in capital goods prices.[28]

Estimates of the erosion of the capital purchasing power of personal savings have been made for the periods 1929–58, and two subperiods 1929–47 and 1947–58. Two estimates of erosion have been computed. One is a measure of the erosion of personal savings accounted for by the difference between the change in investment goods deflators and the change in the total GNP deflator. The other is a measure of the erosion caused by the difference between the change in the investment goods deflators and the changes in the consumption expenditures deflator. These calculations are tabulated below.

As table 13 illustrates, the erosion of both the equipment and the plant purchasing power of personal savings has been of considerable significance over the period as a whole. The erosion of equipment purchasing power has taken place mostly since World War II, whereas the erosion of plant purchasing power occurred more evenly.[29]

This erosion of the capital purchasing power of personal savings will be offset, to some extent, by the rise in business saving resulting from the higher depreciation allowances that accompany a capital goods inflation.

TABLE 13.—*Erosion of capital purchasing power of personal savings*

(1) PERCENTAGE INCREASE IN CAPITAL PURCHASING POWER OF SAVINGS HAD INVESTMENT GOODS PRICES RISEN THE SAME AS TOTAL GNP PRICES

[In percent]

	Equipment	Nonresidential construction
1929–58	17	48
1929–47	1	24
1947–58	16	18
1954–58	7	7

(2) PERCENTAGE INCREASE IN CAPITAL PURCHASING POWER OF SAVINGS HAD INVESTMENT GOODS PRICES RISEN THE SAME AS CONSUMPTION PRICES

[In percent]

	Equipment	Nonresidential construction
1929–58	29	63
1929–47	7	31
1947–58	21	25
1954–58	10	10

[28] As yet there are no comprehensive price indexes available for the instruments sector. Three of the machinery subsector price indexes, however, include products that are useful in research and development. The following table compares the rates of change of these price indexes with the rates of change of the industrial wholesale price index and the machinery and equipment price index for the postwar period.

Sector:	*Percent change, 1947–49 to 1957*
Electrical integrating and measuring instruments	49.1
Switchgear, switchboard, and control apparatus	67.6
Precision measuring tools	40.7
Machinery and equipment	51.9
All commodities except farm products and foods	25.6

[29] This is not to imply that all of personal savings went into purchases of plant and equipment. A large share of personal savings is invested in housing. However, the capital purchasing power of the entire pool of investable funds has to be considered.

V. Conclusions

1. The role of demand pressure

We have analyzed the recent inflation of machinery prices and have reached the conclusion that demand pressure played the major role in that inflation. The two strongest tests applied were an intersectoral comparison of plant and equipment expenditures and a multiple regression of prices on orders, the general level of business activity, and wages. The results of both these tests strongly support the demand pressure hypothesis.

2. Machinery inflation over more than one cycle

Rising wages and materials costs, particularly steel, combined with the effects of higher machinery prices on current input and capital costs within the machinery sector itself probably account for downward rigidity of machinery prices during recessions, and set the stage for a future runup of prices when demand expands.

3. More general price implications of the machinery inflation

(i) The direct impact of the machinery inflation upon two measures of the general price level of industrial goods is fairly large.

(ii) Pattern setting wage behavior by this sector appears to be negligible.

(iii) The impact of machinery upon the current costs of other sectors as indicated by the 1947 input-output table appears to be small, though it is of some importance for current costs in the motor vehicle, other transportation equipment, and plumbing and heating supplies sectors. The impact of a machinery inflation on capital costs throughout the economy are probably important, but no direct estimate of these effects has been made. A review of the behavior of capital consumption expenditures during the 1955–57 period, however, suggests that the inflation of capital costs was of some significance.

4. The effect of high machinery prices upon growth

The erosion of the capital purchasing power of personal savings and the lessening of competition resulting from a capital goods inflation may have inhibiting effects upon the growth potential of the economy.

5. Policy implications

(i) Since the major cause of the inflation in machinery is demand pressure in boom periods coupled with downward rigidity during contractions, any policy that aims at reducing this inflation must attempt to grapple with one or both of these problems.

(ii) Policies which succeed in stabilizing the cyclical behavior of investment demand will probably tend to reduce the inflation of machinery prices (1) by reducing the demand pressure during expansions, and (2) by lessening the risks incurred in the industry, thereby lowering entry barriers and reducing downward price rigidity. Any anti-inflationary policy designed to control demand, whether monetary or fiscal, will be effective against a capital goods inflation only to the extent that it reduces the demand for capital goods by other industries. If general monetary and fiscal policies have little direct influence upon the investment demands of those industries, then

only the most severe monetary and fiscal policies will have a significant effect upon the inflation of capital goods.

(iii) A policy which successfully checks the steel inflation may help to alleviate downward rigidity in the machinery sector. Steel is an important input into the machinery sector, and one whose price has tended to rise during business contractions.

APPENDIXES

TECHNICAL APPENDIX I

The Multiple Regression Analysis

We obtained the strongest single piece of evidence favoring the influence of demand on machinery prices from multiple regressions of changes in prices on—

(1) Various orders variables.
(2) Ratio of deviations of GNP from its postwar trend to that trend.
(3) Changes in wages.

Data for the period quarter III 1953 to quarter II 1959 was used.

These multiple regressions were carried out for a "composite" machinery sector composed of three subsectors: (1) industrial machinery—metalworking, general industrial, and special industry machinery; (2) other nonelectrical machinery—the remainder of the nonelectrical sector; (3) generating machinery. These subsectors were chosen because (a) data was available and (b) appliances, radio, and television are excluded.

The technique used in combining these sectors was that of dummy variables: i. e., the regression model used for the machinery composite was:

$$Y_{it} = \alpha_i + \sum_{j=1}^{k} B_j X_{j\,it} + E_{it}$$

where Y_{it} is the value of the dependent variable for subsector i at time t, and $X_{j\,it}$ (j=1 . . . k)the values of the independent variables for subsector i at time t. α_i is the constant for industry; B_j are the "true" regression coefficients relating Y to X_i; E_{it} is the random shock variable for industry i at time t.

The estimates of α_i and B_j—a_i and b_j—were estimated by least squares. The a_i's were obtained by introducing two dummy variables into the analysis—one for industrial machinery and one for other nonelectrical machinery—a dummy variable for industry 1 takes the value one for $i=1$ and the value zero for $i \ddagger 1$.

a_3=the ordinary constant in the regression equation.
a_1=the regression constant plus the regression coefficient for dummy variable 1.
a_2=the regression constant plus the regression coefficient for dummy variable 2.

For purposes of comparison, we fitted similar regression hyperplanes for the iron and steel sector (as this is not a composite sector, we did not, of course, use dummy variables).

The variables used and a brief description of them are as follows:

(1) *Prices.*—Price indexes for the three machinery subsectors were computed from the published wholesale price indexes for three-digit components of machinery. The base of the index is 1947–49=100. Iron and steel prices are the published price indexes for "total steel mill products." First differences of each price variable were taken in order to eliminate the trend and to reduce autocorrelation.

(2) *Wages.*—For each machinery subsector a "representative" wage was selected: For industrial machinery, average hourly earnings for general industrial machinery, for other nonelectrical machinery, average hourly earnings for construction and mining machinery, for generating machinery, average hourly earnings for electrical machinery. Each of these was then converted to index number form so that the wage index for first quarter 1953 equaled the price index for first quarter 1953 for each subsector. For steel, a wage index for blast furnaces, steel works, and rolling mills, base: 1947–49=100 was used. First differences of each wage series were taken.

(3) *The general level of business activity.*—A logarithmic trend was fitted to the quarterly GNP data, for the period quarter III 1946 to quarter IV 1958, and extrapolated for the first two quarters of 1959. The deviation of actual GNP from this trend as a ratio to the trend was used as a measure of the general level of business activity.

(4) *Orders variables.*—Unpublished monthly data supplied by the Department of Commerce on new orders, sales, and unfilled orders for the three machinery subgroups and for iron and steel were used. The data were combined into quarters and the following variables were used:

$\frac{\text{New orders-Sales}}{\text{Price index}}$ (current, and with lags of one and two quarters)

$\frac{\text{New orders-Sales}}{\text{Sales}}$ (current, and with lags of one and two quarters)

$\frac{\text{Unfilled orders (end of quarter)}}{\text{Sales (during quarter)}}$ (with lags of one and two quarters)

Four regression equations were fitted to the data on machinery and steel:

(1) $\Delta P(t)$ on $\frac{NO-S}{P}(t-1)$, $\frac{GNP-GNP^*}{GNP^*}(t)$, $\frac{UFO}{S}(t-1)$, $\Delta W(t)$.

(2) $\Delta P(t)$ on $\frac{NO-S}{S}(t-1)$, $\frac{GNP-GNP^*}{GNP^*}(t)$, $\frac{UFO}{S}(t-1)$, $\Delta W(t)$.

(3) $\Delta P(t)$ on $\frac{NO-S}{P}(t-1)$, $\frac{NO-S}{P}(t)$, $\frac{GNP-GNP^*}{GNP^*}(t)$, $\Delta W(t)$, $\frac{NO-S}{P}(t-2)$, $\frac{UFO}{S}(t-2)$

(4) $\Delta P(t)$ on $\frac{NO-S}{S}(t-1)$, $\frac{NO-S}{S}(t)$, $\frac{GNP-GNP^*}{GNP^*}(t)$, $\Delta W(t)$, $\frac{NO-S}{S}(t-2)$, $\frac{UFO}{S}(t-2)$

Where: P=Price index.
ΔP=First difference of the price index.
ΔW=First difference of the wage index.
NO=New orders.
S=Sales.
UFO=Unfilled orders
GNP=Gross national product.
GNP^*=Trend value of gross national product.

In addition, we obtained a complete matrix of simple correlation coefficients involving all possible combinations of these variables. Regressions (3) and (4) were rejected because there is fairly large multicollinearity for the machinery sector, since the orders variables have a fairly high autocorrelation (first order autocorrelation coefficient is about 0.75). For steel, the autocorrelation of orders is smaller (first order autocorrelation coefficient is about 0.5) but the large number of independent variables used uses up scarce degrees of freedom (we only have 24 observations for steel as opposed to 72 for the machinery composite).

Regressions 1 and 2 produce almost identical results, due to the extremely high correlation between $\frac{NO-S}{P}(t-1)$ and $\frac{NO-S}{S}(t-1)$.

The results of regression 2 and the matrices of correlation coefficients are presented in Technical Appendix IV, tables 1–3.

STATISTICAL PROBLEMS

(1) Coefficients of multiple determination are not very high for machinery (R^2 for regression 2 is 0.5603). Much of this is explicable by errors of observation.

Errors of observation are probably quite serious for the price and wage variables after first differencing.

e.g.: Suppose an index is accurate to within 0.1
i.e., 125.7 ± 0.1.
A typical first difference becomes
1.5 ± 0.2.

With even such a conservative estimate, errors of observation account for nearly 20 percent of the variance of first differences in machinery prices.

(2) Errors of observation: these will increase the unexplained variance ($1-R^2$) and the standard errors of the regression coefficients. Errors in the independent variables will cause a bias toward zero of the regression coefficients. This effect therefore tends to understate the results.

(3) Multicollinearity. This is why equations 3 and 4 were not used analytically. Equation 1 and 2 are quite free of this phenomenon, as can be seen from the correlation matrices.

(4) Simultaneous relationships: When we use a single equation model we are assuming that it is a reasonable approximation to the real world; i.e., that a more complete model would not improve the explanatory as well as the predictive power of the model very much. Let us now look for possible "feedback" relationships in our regression model for equation 2:

$$\Delta P_t = \alpha + B_1 \frac{NO-S}{S}(t-1) + B_2 \frac{GNP-GNP^*}{GNP^*} + B_3 \frac{UFO}{S}(t-1) + B_4 \Delta W(t) + Et$$

Both the orders variables are lagged and hence no feedback on them is possible.

The GNP being a large aggregation relative to either of the sectors, any shortrun feedback is probably very small.

For the wage variable, however, it is quite likely that a feedback equation exists, i.e.:

$$\Delta W_t = \gamma \Delta P_t$$

This is likely because of the wage variables we have used and because a second structural equation relating wages to prices or price-related variables such as profits seems reasonable.

The use of quarterly data, however, will reduce the power of any feedback relationship of prices upon wages. The system becomes more recursive as the time unit becomes smaller. For example, if wages are related to prices during the previous quarter, the system becomes completely recursive (aside from the very minor feedback of prices on GNP).

It is difficult to believe that wages in the current quarter are influenced much by prices in the current quarter. Firms may mark up wage costs immediately after a new wage bargain, but unions probably do not respond quickly to higher prices, if only because of the length of contracts. "Wage drift" may occur, but this is a relatively slow moving process.

The wage variable used is average hourly earnings which includes overtime as well as straight-time earnings. Since overtime hours will rise when an industry is under demand pressure and since prices are structurally related to demand, a rise in prices due to demand pressure "causes" a rise in *measured* wages. It has been argued that a structural feedback of prices on wages is probably small for quarterly data. The influence of overtime earnings on average hourly earnings will result in some positive feedback of prices on wages, however. This relationship will lead to some upward bias of the regression coefficient for wages.

TECHNICAL APPENDIX II

Quality Change and the Wholesale Price Index for Machinery

Insofar as the wholesale price index for machinery and equipment does not adequately allow for quality change, our conclusions are weakened. It will therefore be worthwhile to inquire briefly into the way quality change is handled by BLS.

BLS uses the following methods to adjust for quality change: [30]

(1) Minor quality changes: No adjustment is made. The decision whether or not a given change is "minor" is based upon the judgment of the commodity specialist.

[30] "Problems in the Collection of Comparable Wholesale Price Series," U.S. Bureau of Labor Statistics Mar. 13, 1959.

(2) Linking: "If the quality change is major, usually the new item is linked into the index, reflecting no change in price between the old item in the preceding period and the new item in the current period, on the assumption that the full differential is the best valuation of the quality change." [31]

(3) In recent years BLS has asked the manufactures "to supply an estimate of the proportion of the total price differential between the old and the new item that is properly attributable to price change and the proportion resulting from changes in quality." [32]

The following table reveals what was done in 88 cases of quality changes in the machinery and motive products groups during 6 months of 1958:

	Number	Percent of total
(1) Minor changes	31	35
(2) Linked to index	37	42
(3) Adjusted for quality difference as estimated by producer	20	23

Source: "Problems in the Collection of Comparable Wholesale Price Series", BLS.

The treatment of minor changes will obviously give an upward bias to the price index—a bias that will become cumulative through time.

The linking method could lead to bias, in either direction: Linking will overstate price changes if the price differential between the new and the old model is an underestimate of the quality differential, and vice versa.

Treatment (3) is quite likely to lead to a downward bias in the price index. It is reasonable to suppose that manufacturers are not objective with respect to quality changes in their products (what manufacturer for example, would admit to quality deterioration of his product?).

From the limited evidence available, it is not clear whether the wholesale price index for machinery and equipment is biased or in what direction. Only a thorough study of particular items and their treatment by BLS could yield a firm estimate of the direction of the bias and its magnitude.

TECHNICAL APPENDIX III

Data Sources

(1) All price series used are either published Bureau of Labor Statistics (BLS) wholesale price indexes or else combinations of published indexes. Whenever a group of BLS indexes were combined, or a published combination disaggregated, the rules given in BLS Bulletin No. 1214 were followed.

(2) Wage data used are those published by BLS as average gross hourly earnings.

(3) Productivity indexes were obtained by dividing a Federal Reserve output index with 1954 weights by a production-worker man-hours index and a total man-hours index. These latter indexes were computed from BLS data on average weekly hours' employment of production workers and total employment (a 40-hour week assumption was made for nonproduction workers).

(4) Average overtime hours are from BLS. In addition to the published data, data on overtime hours for three-digit machinery components for the period January 1957 to date were made available by BLS.

(5) Output series used are Federal Reserve production indexes. In addition to the published indexes, the Federal Reserve provided series of production indexes for all two-digit industries in mining and manufacturing based on 1954 value added weights.

(6) Plant and equipment expenditure series are published Department of Commerce series for two-digit groups.

(7) Series on capital appropriations are published by the National Industrial Conference Board. These are only available from the first quarter of 1955.

(8) Data on unfilled orders, sales, new orders, and inventories for two-digit groups are those published by the Department of Commerce. Commerce also made available data for three machinery subgroups and for iron and steel.

[31] Ibid., p. 4.
[32] Loc. cit.

TECHNICAL APPENDIX IV—TABLES AND CHARTS

APPENDIX TABLE 1.—*Regression equations*

Regression 2 for machinery:

$$\tilde{\Delta}Pi(t)=a_i+b_1\frac{NO-S}{S}i(t-1)+b_2\frac{GNP-GNP^*}{GNP^*}(t)+b_3\frac{UFO}{S}i(t-1)+b_4\Delta Wi(t)$$

Where i is the subsector subscript:
$i=1$ industrial machinery.
$i=2$ other nonelectrical machinery.
$i=3$ generating machinery.

Independent variable	Regression coefficient	Partial correlation coefficient	Beta coefficient	Standard error of beta coefficient
$\frac{NO-S}{S}i(t-1)$	*4.171	*0.4110	*0.3352	0.0922
$\frac{GNP-GNP^*}{GNP^*}(t)$	*15.860	*.3561	*.2942	.0957
$\frac{UFO}{S}i(t-1)$	.017	.0039	.0044	.4381
$\Delta Wi(t)$	*.690	*.5274	*.4334	.0866

Regression constants	$a_1=$ 1.116
	$a_2=$ .320
	$a_3=$ .623
Standard error of estimate	$Sest=$ 1.072
Multiple correlation coefficient	$R=$ .7485*
Coefficient of multiple determination	$R^2=$ .5603*
Degrees of freedom	$n-7=65$

Regression 2 for steel:

$$\tilde{\Delta}P(t)=a+b_1\frac{NO-S}{S}(t-1)+b_2\frac{GNP-GNP^*}{GNP^*}(t)+b_3\frac{UFO}{S}(t)+b_4\Delta W(t)$$

Independent variable	Regression coefficient	Partial correlation coefficient	Beta coefficient	Standard error of beta coefficient
$\frac{NO-S}{S}(t-1)$	−2.095	−0.1845	−0.1145	0.1399
$\frac{GNP-GNP^*}{GNP}(t)$	*48.155	*.5053	*.4458	.1746
$\frac{UFO}{S}(t-1)$	−.980	−.0924	−.0726	.1795
$\Delta W(t)$	*.582	*.8122	*.7985	.1315

Regression constant	$a=$ 2.188
Standard error of estimate	$Sest=$ 1.796
Multiple correlation coefficient	$R=$ .8324*
Coefficient of multiple determination	$R^2=$ .6929*
Degrees of freedom	$n-5=19$

*Means the particular value is significant at the 5-percent level.

Throughout the discussion of the regression of prices on other variables, only mentioned Beta coefficients and regression constants were mentioned. The writer felt that this approach was clearer than a presentation of the equations, since regression equations by themselves yield little additional insight into the relationships between the variables, and may even be misleading unless accompanied by a discussion of the scaling and variability of the variables.

The tables above present the complete results of regression 2 for steel and machinery. Regression 1 has been omitted because it is so similar to regression 2. Regressions 3 and 4 are not presented for reasons mentioned in appendix II.

APPENDIX TABLE 2.—*Matrix of simple correlation coefficients: Machinery group*

	$\Delta P(t)$	$\Delta W(t)$	$\frac{GNP-GNP^*}{GNP^*}$	$\frac{NO-S}{P}(t)$	$\frac{NO-S}{P}(t-1)$	$\frac{NO-S}{P}(t-2)$	$\frac{NO-S}{S}(t)$	$\frac{NO-S}{S}(t-1)$	$\frac{NO-S}{S}(t-2)$	$\frac{UFO}{S}(t-1)$	$\frac{UFO}{S}(t-2)$
$\Delta P(t)$	1.000	0.533	0.416	0.454	0.503	0.489	0.477	0.526	0.529	0.034	−0.074
$\Delta W(t)$		1.000	.054	.445	.277	.221	.408	.287	.249	−.151	−.180
$\frac{GNP-GNP^*}{GNP^*}(t)$			1.000	.129	.300	.333	.117	.288	.300	.258	.207
$\frac{NO-S}{P}(t)$				1.000	.737	.546	.936	.697	.515	−.267	−.381
$\frac{NO-S}{P}(t-1)$					1.000	.730	.707	.937	.686	−.051	−.238
$\frac{NO-S}{P}(t-2)$						1.000	.530	.700	.936	.070	−.074
$\frac{NO-S}{S}(t)$							1.000	.755	.555	−.354	−.477
$\frac{NO-S}{S}(t-1)$								1.000	.743	−.120	−.321
$\frac{NO-S}{S}(t-2)$									1.000	−.005	.154
$\frac{UFO}{S}(t-1)$										1.000	.966
$\frac{UFO}{S}(t-2)$											1.000

APPENDIX TABLE 3.—*Matrix of simple correlation coefficients: Steel*

	$\Delta P(t)$	$\Delta W(t)$	$\frac{GNP-GNP^*}{GNP^*}(t)$	$\frac{NO-S}{P}(t)$	$\frac{NO-S}{P}(t-1)$	$\frac{NO-S}{P}(t-2)$	$\frac{NO-S}{S}(t)$	$\frac{NO-S}{S}(t-1)$	$\frac{NO-S}{S}(t-2)$	$\frac{UFO}{S}(t-1)$	$\frac{UFO}{S}(t-2)$
$\Delta P(t)$	1.000	0.738	0.299	0.147	0.171	0.227	0.222	0.144	0.228	0.177	0.342
$\Delta W(t)$		1.000	−.085	.300	.261	−.035	.322	.213	−.053	−.017	−.126
$\frac{GNP-GNP^*}{GNP^*}(t)$			1.000	−.285	−.202	.297	−.237	−.160	.325	.216	.556
$\frac{NO-S}{P}(t)$				1.000	.455	.213	.989	.432	.170	−.331	−.546
$\frac{NO-S}{P}(t-1)$					1.000	.576	.486	.990	.528	.282	−.328
$\frac{NO-S}{P}(t-2)$						1.000	.221	.581	.991	.250	.275
$\frac{NO-S}{S}(t)$							1.000	.463	.178	−.284	.486
$\frac{NO-S}{S}(t-1)$								1.000	.536	.354	−.277
$\frac{NO-S}{S}(t-2)$									1.000	.276	.341
$\frac{UFO}{S}(t-1)$										1.000	.556
$\frac{UFO}{S}(t-2)$											1.000

APPENDIX TABLE 4.—*Wholesale price indexes: Machinery, industrial goods, and industrial goods excluding machinery*

Period	All commodities except food and farm products	All commodities except farm and food and machinery	Total machinery and equipment
1953—March	113.4	112.0	122.8
June	113.9	112.2	125.3
September	114.7	112.8	127.1
December	114.6	111.5	127.5
1954—March	114.2	112.2	127.6
June	114.2	112.3	127.3
September	114.4	112.4	127.4
December	114.9	113.0	127.9
1955—March	115.6	113.6	128.6
June	115.6	113.5	129.8
September	118.5	116.1	134.3
December	119.8	117.3	136.4
1956—March	121.0	118.5	137.8
June	121.5	118.5	140.9
September	123.1	119.7	145.2
December	124.7	121.0	148.6
1957—March	125.4	121.6	150.2
June	125.2	121.2	150.9
September	126.0	121.7	153.5
December	126.1	121.7	154.9
1958—March	125.7	121.2	154.8
June	125.3	120.7	155.2
September	126.2	121.8	155.1
December	127.2	122.8	156.3
1959—March	128.1	123.6	157.2
June	128.2	123.5	158.1

APPENDIX TABLE 5.—*Total machinery: New orders, sales, unfilled orders, and inventories*

[Value in millions of dollars]

	1953	1954	1955	1956	1957	1958	1959
New orders, seasonally adjusted:							
January	3,626	2,567	3,105	3,941	4,246	3,336	3,937
February	3,408	2,869	3,489	3,961	4,268	3,545	4,198
March	3,408	2,363	3,885	3,994	4,205	3,511	4,839
April	3,628	2,567	3,263	4,093	3,850	3,596	4,632
May	3,455	2,485	3,537	4,507	4,321	3,690	4,626
June	3,124	2,588	3,719	4,305	4,103	3,592	4,812
July	3,356	2,638	3,834	4,289	4,065	3,770	.....
August	2,807	2,664	3,974	4,360	4,124	3,851	.....
September	2,807	3,044	3,832	4,104	3,952	4,242	.....
October	2,771	3,053	3,877	4,585	3,943	3,975	.....
November	2,630	3,091	4,118	4,720	3,652	4,019	.....
December	2,600	2,972	4,205	4,127	3,422	4,047	.....
Sales, seasonally adjusted:							
January	3,478	3,279	3,248	3,720	4,342	3,847	4,017
February	3,541	3,257	3,259	3,722	4,290	3,726	4,131
March	3,552	3,296	3,287	3,667	4,158	3,685	4,226
April	3,611	3,266	3,265	3,894	4,242	3,748	4,423
May	3,511	3,164	3,395	3,967	4,354	3,736	4,507
June	3,531	3,171	3,501	3,939	4,259	3,780	4,552
July	3,549	3,214	3,444	4,146	4,447	3,808	.....
August	3,416	3,150	3,529	4,143	4,281	3,817	.....
September	3,509	3,207	3,539	4,058	4,314	3,999	.....
October	3,357	3,061	3,554	4,230	4,265	3,993	.....
November	3,285	3,185	3,683	4,189	4,175	3,951	.....
December	3,266	3,236	3,694	4,241	3,954	3,975	.....
Inventories, seasonally adjusted:							
January	8,645	8,718	7,949	8,850	10,444	10,222	9,008
February	8,576	8,642	7,873	9,046	10,454	10,101	9,086
March	8,614	8,583	7,880	9,299	10,478	9,920	9,215
April	8,663	8,437	7,897	9,514	10,509	9,744	9,346
May	8,748	8,357	7,928	9,697	10,624	9,636	9,482
June	8,787	8,261	7,944	9,838	10,601	9,446	9,739
July	8,868	8,190	8,088	9,978	10,622	9,323	.....
August	8,993	8,210	8,216	10,008	10,609	9,221	.....
September	8,982	8,111	8,314	10,089	10,658	9,074	.....
October	8,989	8,074	8,477	10,294	10,583	9,026	.....
November	8,944	8,065	8,567	10,404	10,517	8,954	.....
December	8,853	7,975	8,735	10,409	10,374	8,904	.....
Unfilled orders, unadjusted:							
January	23,734	18,901	13,750	17,540	20,213	16,703	16,083
February	23,543	18,461	13,961	17,806	20,230	16,548	16,187
March	23,175	17,296	14,442	18,048	20,195	16,327	16,785
April	23,278	16,653	14,568	18,438	19,931	16,184	16,854
May	23,108	15,907	14,521	18,715	19,642	16,093	16,929
June	22,746	15,298	14,881	19,257	19,695	16,084	17,391
July	22,944	15,082	15,504	19,737	19,629	16,230	.....
August	22,380	14,617	15,912	19,914	19,400	16,281	.....
September	21,616	14,454	16,091	19,852	18,919	16,308	.....
October	20,806	14,264	16,228	19,888	18,311	16,125	.....
November	20,029	13,958	16,532	20,169	17,731	16,045	.....
December	19,365	13,708	17,092	20,083	17,120	16,012	.....

Source: Department of Commerce.

APPENDIX TABLE 6.—*Electrical machinery: New orders, sales, and unfilled orders*

[Value in millions of dollars]

	1953	1954	1955	1956	1957	1958	1959
New orders, seasonally adjusted:							
January	1,512	1,045	1,290	1,514	1,811	1,407	1,564
February	1,487	1,319	1,530	1,549	1,999	1,720	1,682
March	1,559	766	1,878	1,583	1,789	1,653	2,094
April	1,589	1,035	1,326	1,655	1,753	1,470	1,822
May	1,479	971	1,443	1,950	1,979	1,674	1,744
June	1,383	896	1,454	1,766	1,921	1,511	1,888
July	1,538	1,039	1,650	1,784	1,689	1,650	--------
August	1,114	1,000	1,593	1,778	1,797	1,578	--------
September	948	1,444	1,529	1,476	1,498	1,849	--------
October	1,051	1,230	1,462	1,830	1,754	1,703	--------
November	898	1,417	1,388	1,974	1,620	1,872	--------
December	892	1,120	1,589	1,615	1,491	1,890	--------
Sales, seasonally adjusted:							
January	1,378	1,342	1,383	1,506	1,785	1,622	1,708
February	1,451	1,337	1,380	1,495	1,827	1,586	1,724
March	1,459	1,386	1,397	1,428	1,711	1,542	1,704
April	1,462	1,379	1,375	1,579	1,765	1,567	1,804
May	1,444	1,302	1,414	1,672	1,833	1,572	1,796
June	1,486	1,323	1,464	1,642	1,763	1,572	1,789
July	1,480	1,325	1,424	1,744	1,890	1,577	--------
August	1,424	1,294	1,476	1,694	1,823	1,624	--------
September	1,476	1,372	1,469	1,583	1,760	1,712	--------
October	1,387	1,281	1,477	1,675	1,795	1,726	--------
November	1,338	1,385	1,491	1,734	1,743	1,728	--------
December	1,351	1,425	1,466	1,758	1,626	1,710	--------
Unfilled orders, unadjusted:							
January	12,408	10,285	7,585	8,607	9,559	8,947	9,319
February	12,281	10,140	7,609	8,555	9,600	9,075	9,279
March	12,255	9,416	8,018	8,653	9,610	9,144	9,621
April	12,488	9,158	8,074	8,864	9,742	9,143	9,667
May	12,488	8,812	8,013	9,015	9,767	9,287	9,652
June	12,518	8,445	8,118	9,275	10,076	9,425	10,006
July	12,832	8,375	8,572	9,585	10,106	9,629	--------
August	12,526	8,080	8,644	9,599	10,021	9,530	--------
September	12,020	8,223	8,772	9,553	9,771	9,534	--------
October	11,561	8,051	8,611	9,526	9,552	9,391	--------
November	11,013	7,926	8,370	9,554	9,299	9,339	--------
December	10,537	7,618	8,531	9,449	9,123	9,381	--------

Source: Department of Commerce.

APPENDIX TABLE 7.—*Nonelectrical machinery: New orders, sales, and unfilled orders*

[Value in millions of dollars]

	1953	1954	1955	1956	1957	1958	1959
New orders, seasonally adjusted:							
January	2,114	1,522	1,815	2,427	2,435	1,929	2,373
February	1,921	1,550	1,959	2,412	2,269	1,825	2,516
March	1,849	1,597	2,007	2,411	2,416	1,858	2,745
April	2,039	1,532	1,937	2,438	2,097	2,126	2,810
May	1,976	1,514	2,094	2,557	2,342	2,016	2,882
June	1,741	1,692	2,265	2,539	2,182	2,081	2,924
July	1,818	1,599	2,184	2,505	2,376	2,120	-------
August	1,693	1,664	2,381	2,582	2,327	2,273	-------
September	1,859	1,600	2,303	2,628	2,454	2,393	-------
October	1,720	1,823	2,415	2,755	2,189	2,272	-------
November	1,732	1,674	2,730	2,746	2,032	2,147	-------
December	1,708	1,852	2,616	2,512	1,931	2,157	-------
Sales, seasonally adjusted:							
January	2,100	1,937	1,865	2,214	2,557	2,225	2,309
February	2,090	1,920	1,879	2,227	2,463	2,140	2,407
March	2,093	1,910	1,890	2,239	2,447	2,143	2,522
April	2,149	1,887	1,890	2,315	2,477	2,181	2,619
May	2,067	1,862	1,981	2,295	2,521	2,164	2,711
June	2,045	1,848	2,037	2,297	2,496	2,208	2,763
July	2,069	1,889	2,020	2,402	2,557	2,231	-------
August	1,992	1,856	2,053	2,449	2,458	2,193	-------
September	2,033	1,835	2,070	2,475	2,554	2,287	-------
October	1,970	1,780	2,077	2,555	2,470	2,267	-------
November	1,947	1,800	2,192	2,455	2,432	2,223	-------
December	1,915	1,811	2,228	2,483	2,328	2,265	-------
Unfilled orders, unadjusted:							
January	11,326	8,616	6,165	8,933	10,654	7,756	6,764
February	11,262	8,321	6,352	9,251	10,630	7,473	6,908
March	10,920	7,880	6,424	9,395	10,585	7,183	7,164
April	10,790	7,495	6,494	9,574	10,189	7,041	7,187
May	10,620	7,095	6,508	9,700	9,875	6,806	7,277
June	10,228	6,853	6,763	9,982	9,619	6,659	7,385
July	10,112	6,707	6,932	10,152	9,523	6,601	-------
August	9,854	6,537	7,268	10,315	9,379	6,751	-------
September	9,596	6,231	7,319	10,299	9,148	6,774	-------
October	9,245	6,213	7,617	10,362	8,759	6,734	-------
November	9,016	6,032	8,162	10,615	8,432	6,706	-------
December	8,828	6,090	8,561	10,634	7,997	6,631	-------

Source: Department of Commerce.

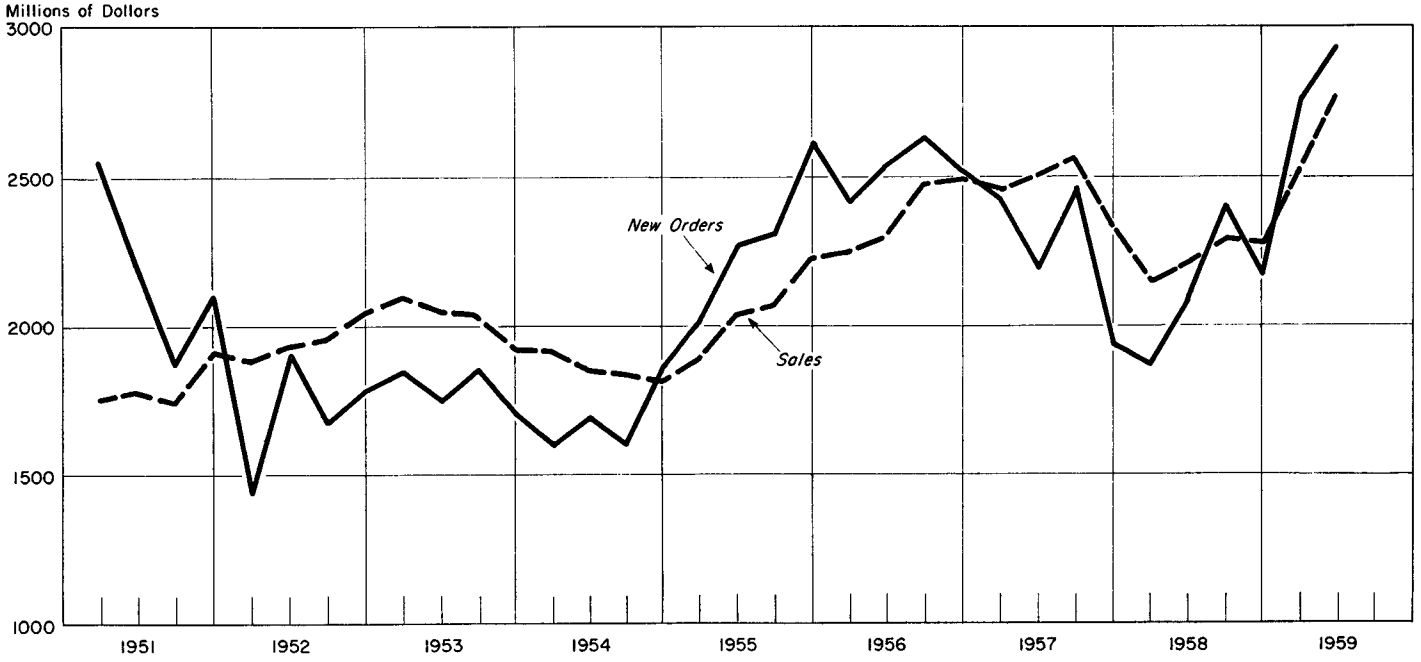

CHART 5.—Nonelectrical machinery: New orders and sales

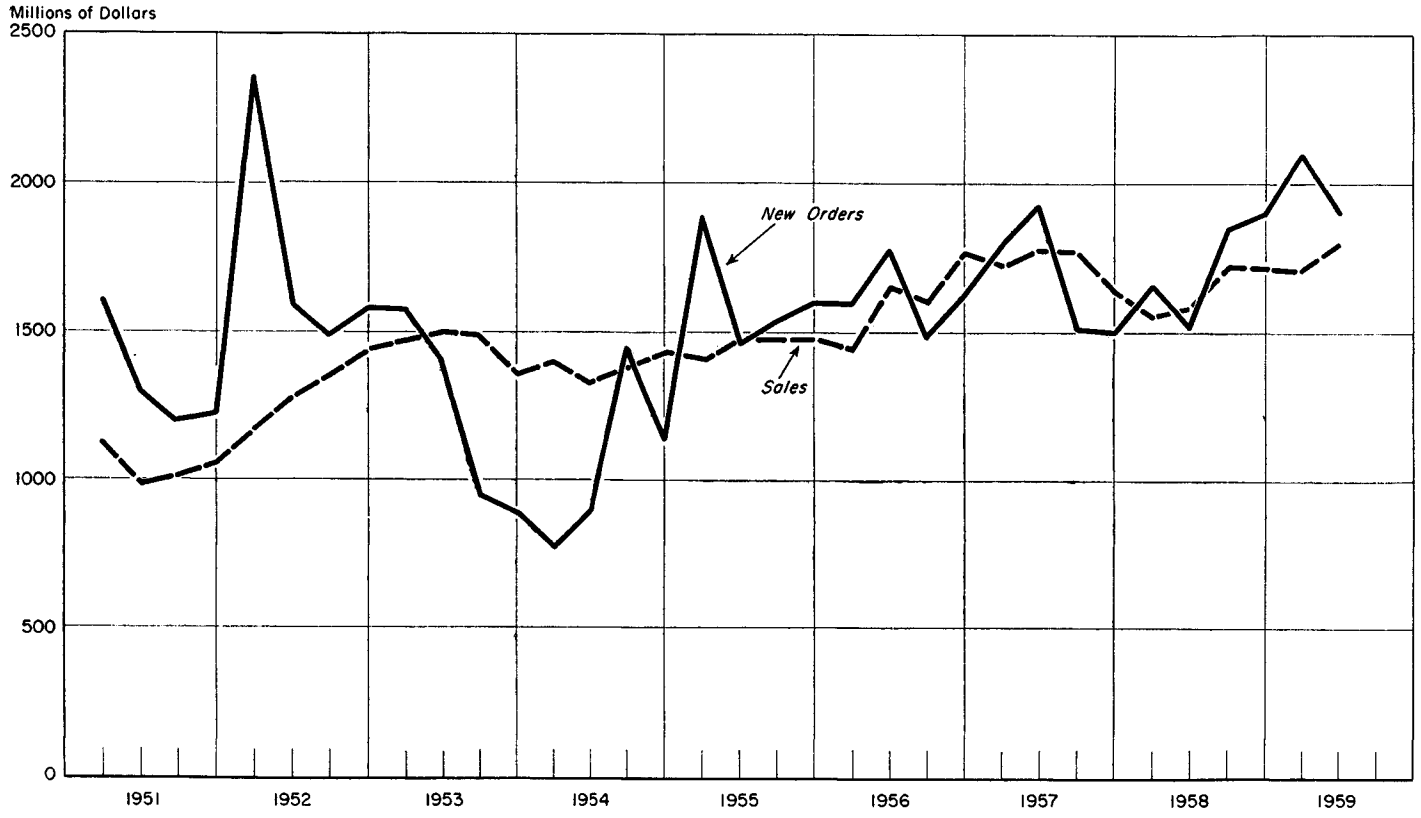

CHART 6.—Electrical machinery: New orders and sales

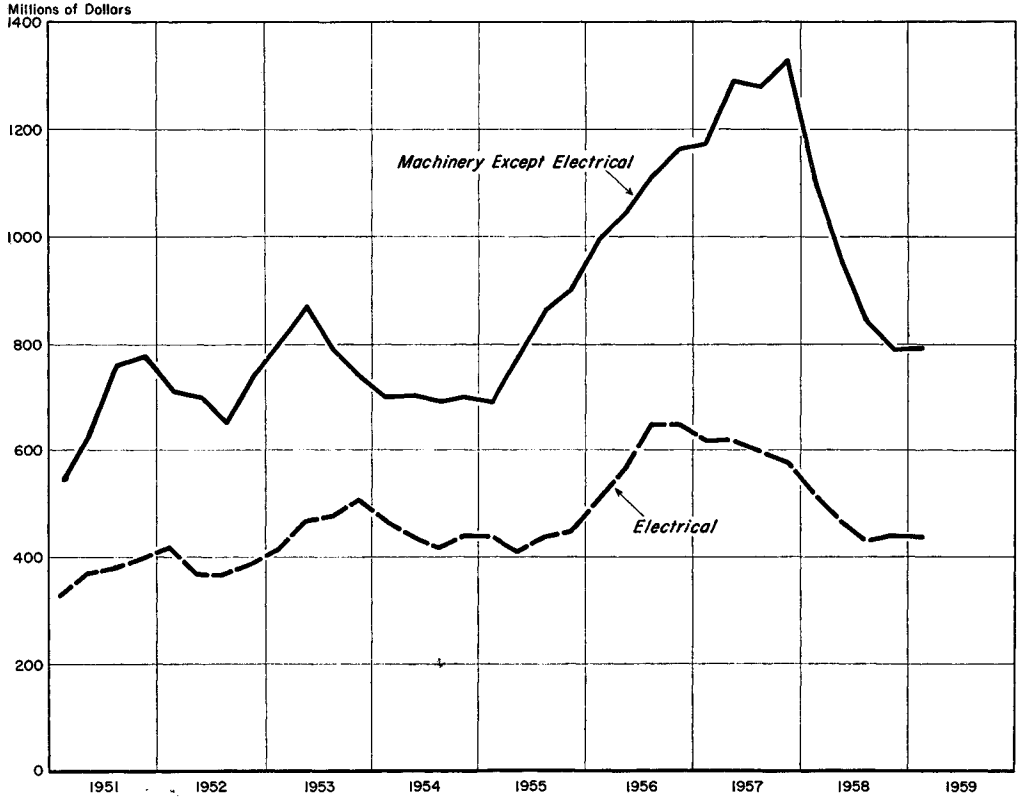

CHART 7.—Plant and equipment expenditures: Nonelectrical machinery and electrical machinery

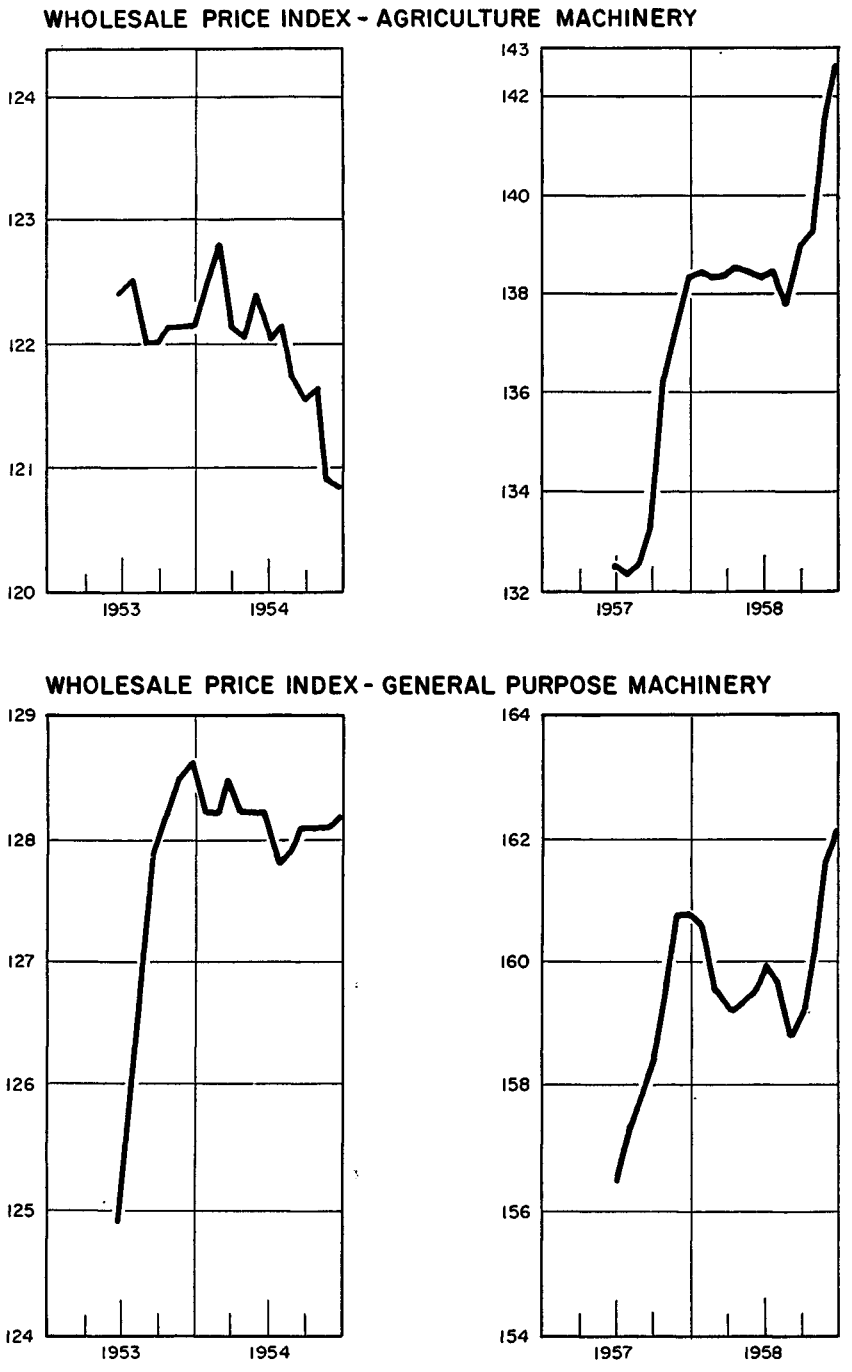

CHART 8.—Downward rigidity of machinery prices during the past two recessions

(Index 1947–49=100)

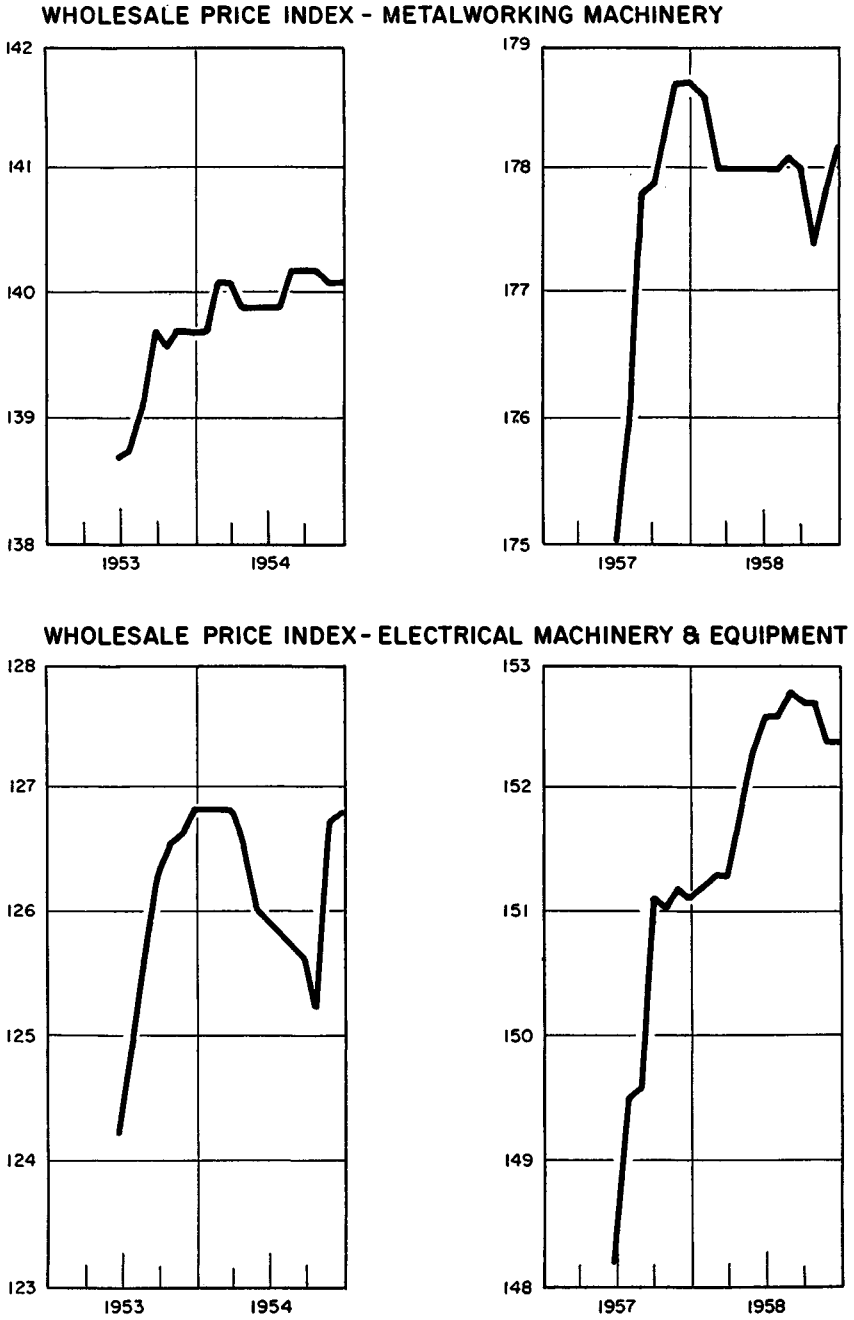

CHART 8.—Continued

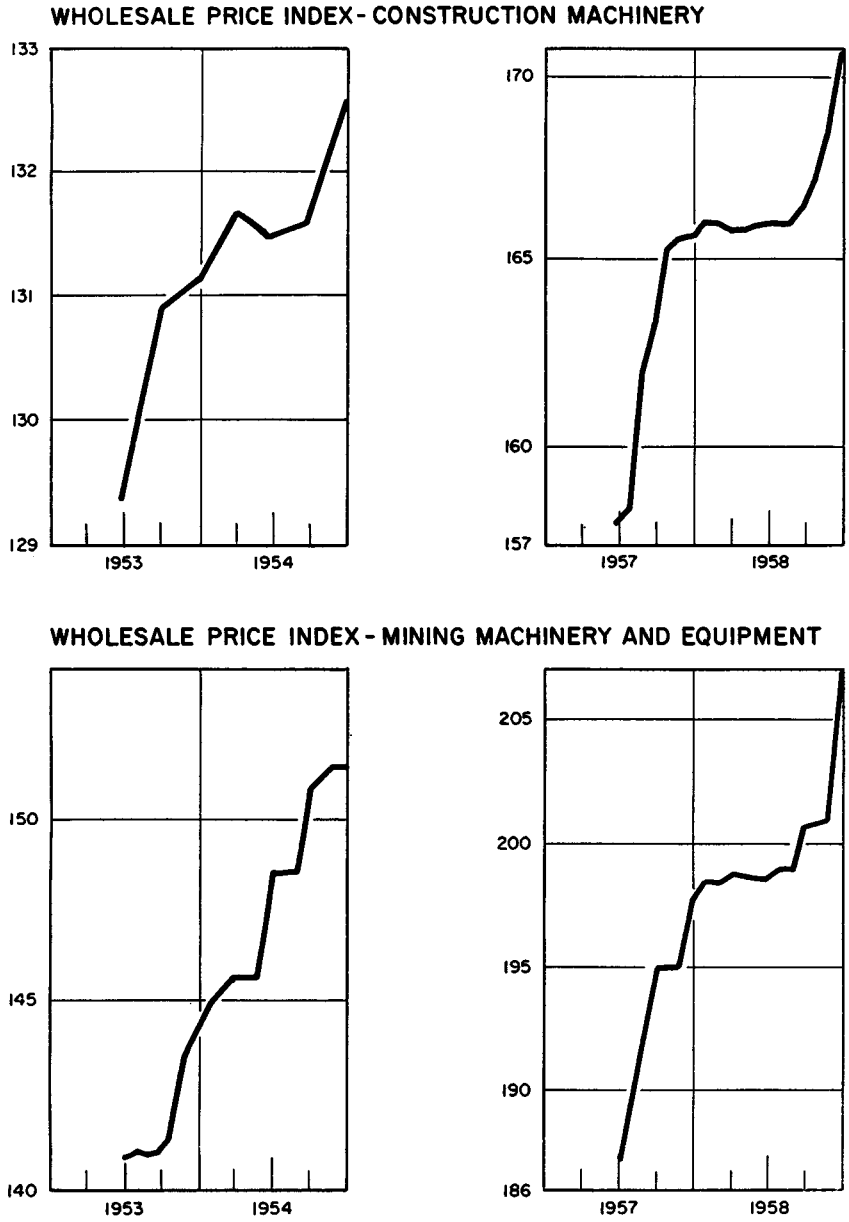

CHART 8.—Continued

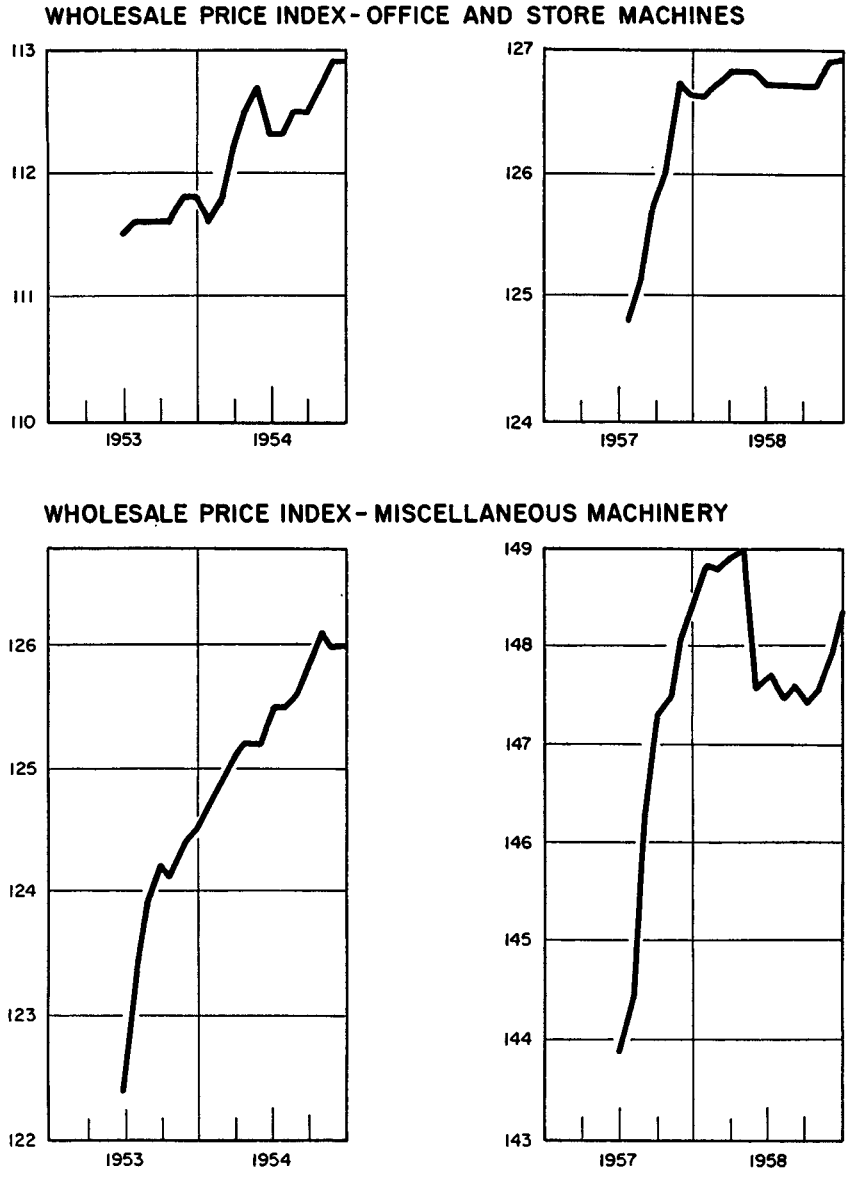

CHART 8.—Continued

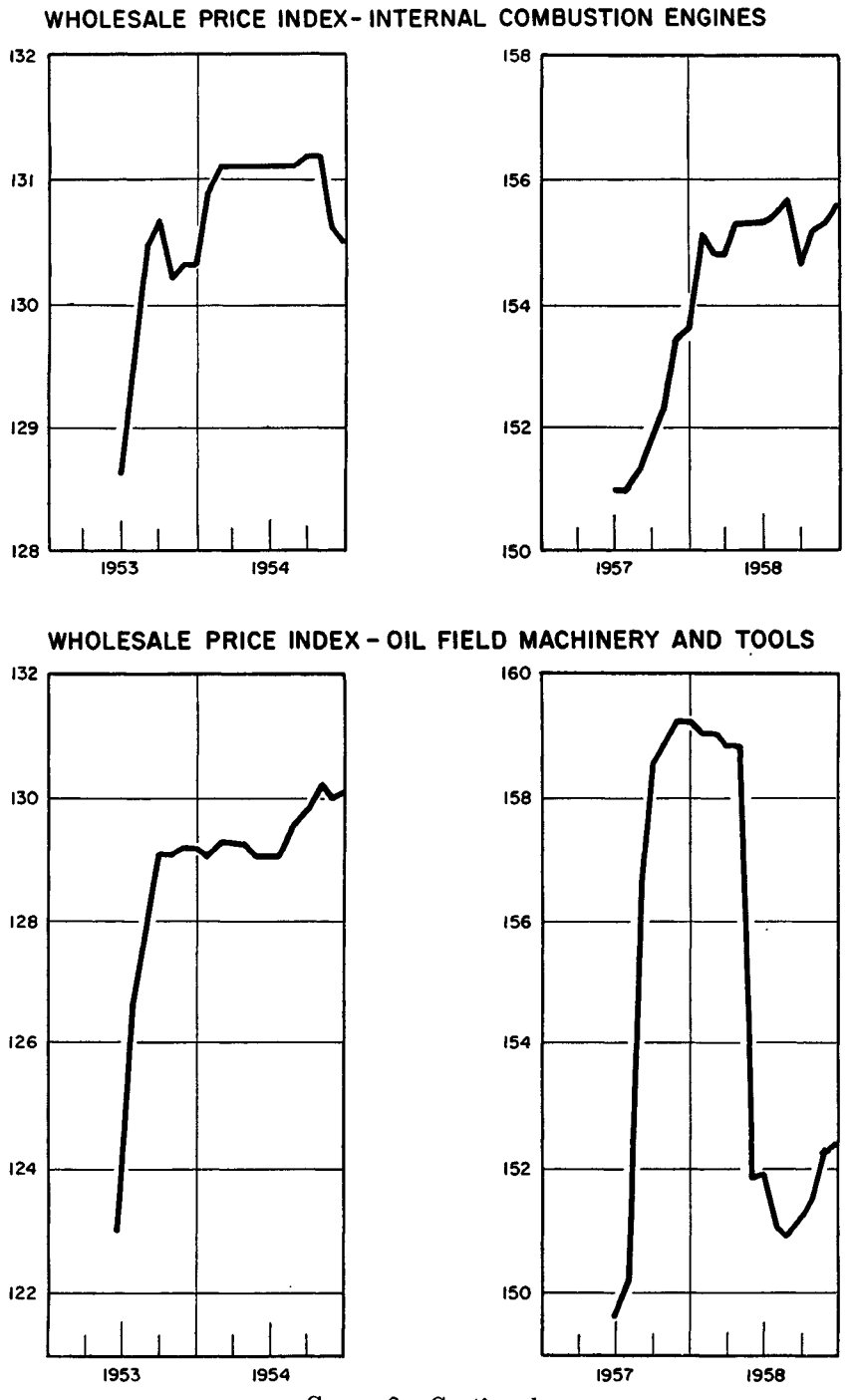

CHART 8.—Continued