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fairly comprehensive and orderly fashion with the economic and industrial issues upon which price research in this industry should throw light. Not all the projects outlined in Chapter VI are immediately feasible. Materials not now available will be needed for the actual prosecution of some of these studies. Yet perspective is gained and the effectiveness of immediate research enhanced by placing particular problems in the framework provided by this broader outline.

## II

### CHARACTERISTICS OF THE INDUSTRY THAT AFFECT PRICES

TO THOSE not familiar with the iron and steel industry the brief review that follows will give a background for better understanding of the research program outlined in subsequent chapters. The summary of the industry's characteristics deals with (1) conditions of production; (2) methods of distribution; (3) the structure of prices.

#### CONDITIONS OF PRODUCTION

Individual enterprises in the iron and steel industry vary significantly in their degree of integration. From this viewpoint, they may be classified into four kinds of companies; integrated, semi-integrated, non-integrated, and merchant blast furnace. In the first group are companies that begin operations with the production of pig iron and carry on through successive stages of steel making to the finished rolled products. As may be seen from Table 1, the 18 fully integrated companies had 90 per cent of pig iron capacity and 85 per cent of finished hot-rolled capacity in 1937.<sup>1</sup> The 56 semi-integrated companies that comprise the second group begin with the production of crude steel and had 9 per cent of finished hot-rolled capacity. The 58 non-integrated companies that constitute the third group are

<sup>1</sup> *Directory of the Iron and Steel Works of the United States and Canada, 1938*, American Iron and Steel Institute.

TABLE 1

Selected Data for Iron and Steel Companies, classified  
by Degree of Integration, 1938

	FULLY INTEGRATED	SEMI- INTEGRATED	NON- INTEGRATED	MERCHANT FURNACE	TOTAL
Number of companies	18	56	58	27	159
Number of plants *	111	70	61	33	275
<i>Pig iron capacity</i>					
Gross tons	45,953,380	...	...	5,268,000	51,221,380
Percentage of total	90	...	...	10	100
<i>Steel capacity</i>					
Gross tons	65,951,300	7,096,592	...	...	73,047,892
Percentage of total	90	10	...	...	100
<i>Finished hot- rolled capacity</i>					
Gross tons	49,025,900	5,508,250	3,284,750	...	57,818,900
Percentage of total	85	9	6	...	100

Compiled from *Directory of the Iron and Steel Works of the United States and Canada, 1938*, American Iron and Steel Institute

\* Includes plants equipped with blast furnaces, steel furnaces, and hot rolls.

concerned with the rolling of semi-finished steel, and had 6 per cent of finished hot-rolled capacity. The merchant blast furnace companies that make up the fourth group operate blast furnaces for the production of pig iron but do not manufacture steel in any form. They possessed 10 per cent of pig iron capacity.

#### *Industrial concentration*

From the above summary it is clear that despite variation in the degree of vertical integration, the industry as a whole is relatively highly integrated. This concentration of capacity in the hands of a small group of integrated producers who control an important portion of the source of

supply of raw materials of their less completely integrated rivals has a significant effect upon prices. Possibly even more significant has been the effect upon prices of the relative size of the United States Steel Corporation and its consequent price leadership.

This analysis of capacity according to degree of integration does not adequately reveal the dominant position of a few companies in the industry. In Table 2 is shown the steel ingot capacity of the five leading producers in 1938. The present concentration of capacity has an important bearing upon price problems in this industry.

TABLE 2

## Steel Ingot Capacity of the Five Leading Steel Producers, 1938

COMPANY	GROSS TONS	PERCENTAGE OF TOTAL
United States Steel Corporation	25,790,000	35.3
Bethlehem Steel Company	10,042,000	13.7
Republic Steel Corporation	6,500,000	8.9
Jones and Laughlin Steel Corporation	3,671,200	5.0
National Steel Corporation	3,400,000	4.7
Total, five companies	49,403,200	67.6
Total, industry	73,047,892	100.0

Compiled from *Directory of the Iron and Steel Works of the United States and Canada, 1938*

*Geographic concentration*

Not only is the steel industry highly integrated, it is also characterized by geographical concentration of production in relatively few states. Pennsylvania accounted in 1938 for 32.5 per cent of total pig iron capacity and 32.7 per cent of finished hot-rolled capacity.<sup>2</sup> Ohio came second, with 21.7 per cent of pig iron capacity and 20.2 per cent of finished capacity. Indiana had 10.5 per cent of pig iron capacity and 11.9 per cent of finished capacity. These three states thus accounted for 64.7 per cent of pig iron capacity and 64.8

<sup>2</sup> *Directory of the Iron and Steel Works of the United States and Canada, 1938*, American Iron and Steel Institute.

per cent of finished hot-rolled capacity. The high ratio of transportation costs to raw material costs and the large amount of power required for producing a ton of finished steel have been factors in this localization of production capacity. Thus the cost of assembling coal and ore has been one of the determinants of the location of blast furnaces and hence of steel plants.

Steel making and steel rolling are also concentrated territorially since steel works frequently locate contiguously to blast furnaces because of: (1) the relative economy of shipment of steel products as they approach the finished stage; (2) the necessity of providing reasonably full utilization of the capacity of blast furnaces and open-hearths; (3) economies in heat conservation; (4) historical accidents of individual company expansion. Although the geographic distribution of the industry has been in good part determined by accessibility to coal and ore, differences among districts in production capacity and in its degree of utilization cannot be explained entirely by differences in assembling costs. Since the cost of shipping finished tonnage steel is high relative to the value of the products, the relative cost of transporting the finished product to consuming areas is also an important factor in accounting for location of capacity and differences in utilization among the several producing regions.

The role played by the price structure as an additional influence upon regional concentration and relative plant utilization, together with the effects of the present territorial distribution upon prices, raise important questions that invite study, particularly in view of changes in the price structure initiated in summer 1938. Since steel plant location is significant primarily with respect to the location of consuming industries, this study should comprehend the influence on consumers' locations of steel transportation costs as well as the price structure of steel.

It is pertinent to inquire also into the extent to which the producing capacities of the individual corporations are geographically concentrated. Analysis of the territorial dis-

tribution of steel plants indicates that in 1938 only 17 companies in the entire industry had establishments in more than one of the wage districts established under the NRA code and that only 9 companies had plants in more than two districts. This concentration has an important price significance because of its effect upon the degree of competition within production areas and the competitive interrelations among them.

### *Technological factors*

Another factor of considerable importance to price behavior is the tremendous fixed investment required for steel production and the resultant burden of overhead costs and rigidity of production facilities. Blast furnaces, steel works, and rolling mills represent investments in units of equipment on such a large scale that it is not feasible to enlarge or alter the capacity by small increments or to shift production capacity quickly among regions. (The highly specialized nature of some steel production equipment contributes to the inflexibility of plant and gives rise to characteristic pricing problems.) Since overhead costs constitute a large proportion of total costs, the average or unit costs of production, as computed by orthodox accounting methods, are highly sensitive to changes in the rate at which capacity is utilized. Extreme shifts in demand, together with the cyclical inflexibility of prices and the apparent relative inelasticity of demand for many products, have contributed to the notoriously wide fluctuations in operating ratios in this industry. As a result of these fluctuations average unit costs have been subject to violent changes. The preponderance of overhead costs together with the amplitude of their per unit fluctuations<sup>3</sup> suggest the need for more accurate cost data. Collection of information about overhead cost, however, involves serious difficulties because it is questionable whether the method of evaluating fixed assets followed by some firms yields cost information appropriate

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<sup>3</sup> These fluctuations depend upon the method of allocating overhead cost, which differs considerably among companies.

for most price research problems. The actual relation between heavy fixed investments (with consequent inflexible and immobile capacity and violently gyrating per unit costs) and prices is little understood and needs further study.

To summarize, the production of iron and steel is characterized by certain conditions that have an important bearing upon price research: (1) a high average degree of integration, combined with complex variation in completeness; (2) concentration of production capacity in the hands of a few highly integrated producers; (3) concentration of production capacity in a few states; (4) restriction of the production capacity of individual companies to a few geographic regions; (5) large investments in highly specialized plants with consequent large and unstable overhead costs and inflexible and territorially immobile production capacity. These conditions are not peculiar to the steel industry. In varying degree they are found in most of the heavy industries that have developed with the rise of mass production and large scale enterprises. They have, however, placed a characteristic stamp upon the iron and steel industry which necessitates study of its price problems with reference to them.

#### METHODS OF DISTRIBUTION

Because of the large number of the industry's products and the wide variety of products and grades its distribution characteristics cannot be adequately summarized in a brief treatment. Nevertheless, the methods by which iron and steel products are marketed may be broadly delineated. Much steel-making pig iron is used by the integrated company that produces it, whereas merchant pig reaches the consumer primarily through the medium of agents and brokers, or is sold directly to industrial consumers. Certain rolled steel and semi-finished steel products are shipped directly from the producer to non-integrated mill customers. Also, much finished tonnage rolled steel is sold through the sales organization of the mills and shipped directly from them to the buyers' premises. The jobber's function in the

sale of tonnage rolled steel is limited to 'fill-in' orders for immediate delivery and supply of small fabricators. Further finished steel products are more often sold through independent middlemen.

#### SOME CHARACTERISTICS OF IRON AND STEEL PRICES

In view of the complexity of the industry's price structure, we describe separately the distinctive characteristics of the prices of pig iron, iron and steel scrap, semi-finished steel, finished steel, and special steels.

##### *Pig iron*

The price structure of pig iron is relatively simple and data are readily available although the degree of departure of actual from quoted prices is not known. As a result, the price behavior of quoted pig iron prices has often been carefully analyzed and interpreted. Unfortunately, however, a study of pig iron prices contributes little to an understanding of the price problems and structure of the industry as a whole, for only a relatively small percentage of the pig iron produced is ever sold on the market. Although the production of pig iron is the first stage in the manufacture of steel products, more than 80 per cent of steelmaking pig iron is delivered in molten condition directly to the steel furnaces, usually being merely transferred from one department to another within integrated establishments.

Pig iron prices prior to the NRA code were customarily quoted on an f.o.b. furnace basis. The low value of pig iron relative to its bulk and weight tends to delimit the geographical areas within which it can be shipped to advantage. Nevertheless, the price differentials among furnaces, and the character of changes in them, invite study to determine the nature and degree of imperfection of competition. Not only the degree of competition in the purchase and sale of pig iron, but also the relationships of its prices to the prices of its raw materials, e.g., ore, coke, and limestone, and to the prices of other steel and iron products require further investigation.



*Iron and steel scrap*

Data on the behavior of the prices of iron and steel scrap are fairly adequate. Scrap has become an important raw material for the production of steel products. Within certain limits it is, for this purpose, a significant substitute for pig iron. Scrap prices seem highly sensitive to shifts in demand. A distinctive feature of the marketing of iron and steel scrap derives from the few buyers, especially large buyers, in this market. Investigation of the nature and extent of the interrelationships between the prices of scrap pig iron and other basic raw materials and the prices of other steel products might reveal much about price behavior in this industry.

*Semi-finished steel products*

A classification of steel products is essential to an understanding of the structure of steel prices. Three classes of steel products may be identified: special steels and two types of tonnage steel—semi-finished and finished. Semi-finished steel is subject to further processing either in another department of an integrated concern or by independent non-integrated producers. The economic characteristics of the production of semi-finished steels and the price behavior of this group of products are similar in many respects to those of pig iron, with certain important differences. A large proportion of pig iron produced for sale is made by independent merchant furnaces, whereas a large proportion of the total output of semi-finished steel products is made by integrated steel mills which convert this steel into finished steel products as well as sell it to non-integrated mills. Such non-integrated mills thus become not only customers of the integrated concern but also its competitors in the sale of finished products. Both this relationship and the fact that the buyers for purposes of further processing are not numerous affect the price behavior of these semi-finished products. There is some evidence that prior to the code prices for these products were some-

what more flexible than those of many finished steel products, but less flexible than the prices of pig iron. This requires further investigation. Much depends upon how faithfully actual prices follow nominal price quotations and what techniques are used to measure flexibility.

### *Finished steel products*

Finished steel products, e.g., plates, bars, sheets, are produced by both integrated and non-integrated concerns. Although the consumption of certain of these products is concentrated in regions contiguous to the steel producing centers and restricted to relatively few purchasers, this group of products as a whole is sold to a large number of consumers, scattered geographically, whereas they are produced by a small group of mills concentrated in a few geographical areas. Most of these steel producing regions tend to have capacity in excess of demand in contiguous areas.

Most tonnage steels, more particularly those designated 'finished', are sold under a basing point price quotation system, that is, prices are quoted not f.o.b. mill but at destination, the destination price being usually computed on all-rail freight rates from so-called basing points. Thus, under a basing point system, the price received by the mill for finished steel varies, in the absence of change in the basing point prices, in accordance with the location of the customer and mill relative to the basing point and to each other.

The relation between the degree of price flexibility or of price control and the method of quotation invites further research. Analysis of price fluctuations under a basing point system of quotation must obviously encompass recognition not only of changes in prices at given basing points, but also changes in the number of basing points and in price differentials among various basing points. The number of quotation points has been increased from time to time since 1924. In the summer of 1938 several new basing points for certain types of products were established. But more im-

portant, most differentials among basing points were eliminated. In the few exceptions they were substantially reduced. At the same time prices quoted for most products at Pittsburgh were drastically lowered. Although not all mills have become basing points, such points have been established in most important steel producing centers. The influence of technological progress on basing points is suggested by the fact that every basing point for hot-roll sheet and strip (except Pacific Coast ports) is now the location of a continuous mill, and that almost every continuous mill is now within 50 miles of a basing point. Furthermore, the differential price reduction has tended toward equalization of the cost of delivered steel at the major producing centers. These modifications of the basing point system present unusual opportunity to study the economic consequences of this system of price quotation, and their effects upon cross hauling, the degree of utilization of production capacity in various areas, profit margins in various areas, location of new production capacity and of consuming industries.

### *Special steels*

Special steels include highly alloyed and cutting steels of all grades. They are produced, for the most part, in small electric furnaces by companies specializing in these products. Special steels constitute a relatively unimportant product group, when measured by the tonnage produced. Their value, however, in relation to weight is considerably greater than that of 'tonnage' steels. Consumers of special steels are likely to be primarily interested in physical and chemical characteristics, such as toughness, hardness, resistance to acids. The importance of price as a factor influencing the purchase of these steels, however, requires investigation. Moreover, producers have fostered product differentiation by means of patents, brand names, and consumer specifications. Hence, direct price comparisons are made difficult and have therefore not played an important role in this branch of the steel industry except in the case of a few kinds of standardized special purpose steels.

The preceding discussion should serve not only to reveal important price problems involved in the production and distribution of iron and steel products but also to indicate the need, in dealing with price behavior in this industry, of taking cognizance of the different characteristics of various groups of products.

### III

#### STATISTICAL DATA

##### PERTAINING TO THE PRICE STRUCTURE

IN OUR description and appraisal of important available material relating either directly or indirectly to price problems in the iron and steel industry we cover only primary sources of data.<sup>1</sup> Many of the sources of published data listed below refer merely indirectly to price information; that is, they include information on costs of materials, quantity and value of output, capacities, balance sheet figures, and other data that might be useful in analyzing price problems in the industry.

##### PRIMARY SOURCES OF DATA BEARING DIRECTLY OR INDIRECTLY UPON PRICE RESEARCH IN IRON AND STEEL

###### *American Iron and Steel Institute*

1) *Directory of the Iron and Steel Works in the United States and Canada.* Most issues contain information on rated capacities for making all raw, semi-finished, finished hot-rolled, and other further finished products by plants for each operating company in the United States and Canada. (The 1935 Directory did not contain data on semi-finished capacities.) Moreover, they describe furnaces and other equipment, often giving the year of construction or of last reconditioning. The more recent issues include also summary tables giving total capacity for products by states. The fifteenth edition of this Directory was published in 1901

<sup>1</sup> The ultimate primary sources of most data are, of course, the records of the individual companies. Such data, however, are not usually available to the research worker.