The Competitive Behavior of Small Versus Large Firms: The American Steel Industry in the Late 19th Century

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Our present-day view of the late 19th-century iron and steel industry has been obstructed by the events of the turn of the century, when a wave of consolidation activity swept through the industry, culminating in the formation of the United States Steel Corporation in 1901.[1] Historians have offered many explanations for these mergers -- from the steel magnates' eagerness to escape ruinous competition to their desire to benefit from economies of scale. Whatever the explanation given, however, the underlying assumption has remained the same: consolidations marked an important turning point in the history of the industry, consummating the shift from competitive to noncompetitive patterns of market organization.

If we momentarily block the consolidation movement from our minds, we obtain a much more complex view of the industry than this simple schema would suggest. In the late 19th century, iron and steel firms interacted for the most part in two major ways, neither of which could be considered purely competitive in the economist's sense of the term. In some sectors of the industry firms employed brand identification as their main competitive weapon. Here enterprises tended to be small, relative to the total market for their commodities, but each attempted to obtain some control over prices by distinguishing its products from those of competitors. In other branches of the industry, firms produced a comparatively homogeneous output. These concerns were generally large -- large enough to affect the market prices of their goods. Yet each was vulnerable to the pricing strategies of its rivals. Where this type of firm predominated, price cutting, not product differentiation, was the main competitive weapon.

In this paper I describe these two coexisting systems in greater detail, drawing upon data from the pigiron, crude-steel, tinplate, and wire-nail branches of the industry. I suggest some reasons for the divergent evolution of these systems and trace some implications for our understanding of the industry's changing organizational structure.

SMALL FIRMS

At first glance, markets in the small-firm sectors of the iron and steel industry appear to have conformed to the model of pure competition. Firms were small -- seemingly to affect the prices of their goods. Moreover, one of the most striking characteristics of competition in these markets was the high rate of mortality among firms. Only 12 blast-furnace establishments out of a random sample of 26 taken from the 1880 *Directory of the American Iron and Steel Association* survived the next 10 years as independent enterprises, and only two lasted until the turn of the century [2].[2] Similarly, of the 38 tinplate "dipperies" that entered the industry between 1890 and 1896, 20 had disappeared by 1898 [2, pp. 1892-98].[3]

A closer look reveals, however, that a small number of firms were islands of stability in this sea of flux -- firms such as the Thomas Iron Company, whose production of pigiron increased steadily throughout the last half of the 19th century, or N. & G. Taylor, a tinplate dippery that retained its position of prominence despite the depression of the nineties and the organization of the American Tin Plate Company.[4] What differentiated the successful firms from those that disappeared? Above and beyond such usual factors as proximity to raw materials or markets, successful enterprises were distinguished by their ability to establish a good reputation for their brands -- by their ability to differentiate their products from those of competitors. As trade journal reports frequently attested, declines in demand affected most severely firms that had failed to develop good reputations for their brands:

> [T]he market for [pigiron], as might be expected is weak, but so far as we can learn, there is no disposition to make concessions on standard brands; undesirable and unknown brands might be bought at a reduction of $1 or more per ton....
>
> Some [of the tinplate dipperies] which make special plates, such as high-grade roofing ternes, the reputation of which is established and for which there is a steady demand, have been enabled to keep fairly busy. But the majority of these firms...have not operated to anything like their full capacity.... The close margin at which the ordinary qualities of tin and terne plate have been selling by the manufacturers who their own black plate has made the dipping business unprofitable...except, as we have said, [for] special plates which have made a name for themselves and which command high prices.[5]

Brand identification was attractive to firms because it allowed them to decrease the elasticity of demand for their output and thereby protect themselves both from competition and from fluctuations in market conditions. Of course, the firms' success in pursuing this strategy varied from one part of the iron and steel industry to the next, depending upon the type of commodity produced. Pigiron, for example, was an intermediate good, used in the manufacture of other iron and steel products. Though furnacemen attempted to differentiate their product, by adopting brand names such as Charlotte, Rebecca, Mount Vernon, or Riverside, their customer's attachment to brands was not as strong as it might be in a consumer good industry.[6] Hence pigiron producers had less leeway to set prices independently of the actions of their competitors. As the Philadelphia correspondent of *Iron Age* wrote in 1897: "Different holders have different ideas, besides which there are different qualities, but as sellers are all seeking a market, almost all brands sympathize..." [12, 18 March 1897, pp. 22-25]. Nevertheless, data on market transactions recorded in the American Iron and Steel Association *Bulletin* indicate that a considerable dispersion of prices characterized the market for pigiron, that the strategy of brand identification allowed some firms to maintain prices long after their competitors had made cuts [1]. For instance, although the price of No. 1 foundry pigiron dropped from slightly more than $15 per ton in June 1892, to a little less than $14 a year later, some pigiron sold for $15 as late as December 1892, and for $14.75 until March 1893 -- despite the fact that some firms had cut their prices to $14.50 as early as August, to $14.25 in October, and $14 beginning in February.[7] In the tinplate industry dipperies, especially those that specialized in the production of terne plates (steel sheets coated with a mixture of tin and lead) had much more scope for product differentiation, since terne plate was a final good, used primarily as a roofing material.[8] Firms that won good reputations for their brands were remarkably successful in maintaining prices, even during the severe depression of the 1890s. From January 1896 to July 1897, the average price of common-grade tin plate fell from $3.80 to $3.17 per box, a decline of 17 percent [3, p. 28]. Over the same period of time, the price of the branded tin plates quoted in the *Metal Worker* fell only 4 percent on the New York market, while branded roofing plates fell only 1 percent. Moreover, some of the most prestigious firms -- for example, John Hamilton & Company and N. &. G. Taylor -- did not reduce quotations at all during this period.[9] That their products were selling well too is evinced by repeated notices in the *Metal Worker* recording a strong demand for "Hamilton's Best Redipped," and by Nathan Taylor's subsequent testimony before the Industrial Commission:

> Our business is prosperous and it always has been. We have not been affected in the past when business has been depressed in tin plates.... We have always catered to the very best buying element, have always striven to make the very best tin plates, have always found buyers for them who have made no complaint of our prices.... [28, "Testimony," p. 935]

These established firms were able to maintain prices despite the depression because industry output rapidly adjusted to the decline in demand. The weakest concerns failed and withdrew from the market, while many of those that survived were forced to curtail production substantially. In tinplate the total number of dipperies declined steadily from 32 in 1894 to 27 in 1896 to 23 in 1898 [2, pp. 1894-98]. Moreover, many of the survivors ran at substantially less than their full capacity throughout the depression. Quarterly reports on tinplate conditions in the *Metal Worker* indicate, for example, that five dipperies were idle throughout the first quarter of 1896 while most of the rest ran at 40 percent to 75 percent of capacity. A year later three or four were idle while many others were running at 25 percent to 60 percent of capacity. In the pigiron industry output similarly adjusted to fluctuations in demand. Following the panic of 1893, the number of furnaces in blast dropped by as much as two-thirds, while price declines in 1895 provoked another massive exodus from the market.[10]

In sum, the essential features of the competition among small firms that produced differentiated products were (1) output adjusted rapidly to fluctuations in demand; and (2) declines in demand affected most severely firms without established brands, many of whom actually failed. In these sectors of the iron and steel industry firms were by no means all in the same situation. Enterprises that possessed reputable brands directly benefited from the failures and curtailments of their weaker rivals. As a result, they rarely demonstrated any interest in pools or similar devices to restrict competition. When the chairman of the Eastern Pig Iron Association proposed the formation of a pool during the depression of the 1890s, only one major firm expressed itself in favor of the combination.[11]

LARGE FIRMS

Small firms that differentiated their products had been the dominant type of enterprise in the mid-19th century. But as transport and communications improvements enlarged the market for manufactured goods, another type of firm and another sort of competitive system came to the forefront. This new firm specialized in producing large quantities of common-grade goods for

sale in mass markets -- Bessemer steel rails for steam locomotives, tinplate for the manufacture of tin cans, standard-size nails, and so on. Such common-grade producers differed from their smaller competitors in two important ways. In the first place, their fixed charges were a much higher proportion of total costs. There were two basic reasons for this. First, large firms tended to use more capital-intensive production techniques. The giant tinplate mills that produced common grades of material pioneered in automating their finishing processes, while dipperies typically specialized in "hand-dipped," "old-method" varieties of plates.[12] Where steelmen such as Andrew Carnegie earned renown for their policy of hard-driving blast furnaces, speeding up production through the use of powerful blowing engines [14, pp. 88-89], merchant pigiron producers rarely adopted the technique and sometimes deliberately limited furnace throughput. As the *American Manufacturer* remarked about one high-grade furnace in Tennessee, output seemed small in comparison with furnace size, but the firm's chief concern was quality rather than quantity [5, 24 April 1896, p. 586].

In addition to employing more capital-intensive production techniques, the large firms tended to be more vertically integrated than their smaller competitors. Merchant pigiron furnaces, of course, produced nothing but pigiron, while large steel-making enterprises produced pigiron, converted it into steel, rolled the steel into rails or billets, and sometimes even processed the billets. Tinplate dipperies merely coated the steel sheets they purchased from rolling mills, while most large producers rolled their own sheets as well as finished them. Similarly, the largest wire-nail works rolled rods from billets, drew them into wire, and turned the wire into nails. Smaller works only attempted the last one or two of these production stages.[13] Vertical integration increased overhead charges by internalizing costs that otherwise would have been completely variable. It therefore worked in the same direction as the increased capital-intensity of production; it raised the proportion of fixed in total costs the firm had to meet [21, p. 70].

The second way in which large firms differed from small was that they tended not to differentiate their products. This was in part a function of the type of goods they produced. Common-grade products were by definition homogeneous in quality and consequently not easily differentiated. Thus as late as 1909 the officers of the United States Steel Corporation, a consolidation which combined mainly common-grade producers, saw little point in expending resources for advertising.[14] More important, some large firms consciously rejected the policy of product differentiation, sensing that brands partitioned the market and erected barriers to the expansion of their output. The tinplate industry is a case in point. Concerned that consumers were

being confused and intimidated by the proliferation of brands, the industry's leading producer spearheaded a drive to standardize the different grades and qualities of tin plate -- so successfully that the *Metal Worker* stopped quoting prices by brands.[15]

These two basic characteristics -- the large firms' comparative homogeneity of product and their high proportion of fixed in total costs -- shaped the patterns of competitive behavior that developed in the large-firm sectors of the iron and steel industry. In the absence of product differentiation, competition among firms necessarily took the form of price cutting, and since each firm's product was a close substitute for the others', the lowest quotation set the price for them all. That the market for common-grade goods operated very nearly on a one-price basis can be seen from the reporting practices of the *Iron Age*. Although the editors usually quoted a range of prices -- 50 cents or so wide -- for each individual grade of pigiron, they generally found that one value would suffice to describe the entire market for semifinished steel. Similarly, data on market transactions recorded in the American Iron and Steel Association *Bulletin* reveal less price dispersion for Bessemer-steel billets in general than for just one grade of pigiron, and this was especially the case during downswings [1].[16]

In combination with a cost structure characterized by high fixed costs, the lack of product differentiation meant that large firms were particularly susceptible to ruinous price competition during periods of depression. Because fixed charges were so high, average total costs rose steeply whenever production was curtailed. Hence if a firm reduced its output in response to a decline in prices, it would soon find itself producing at a loss. As pressures mounted to meet interest and dividend payments and to replace obsolete or worn-out equipment, the temptation to struggle for a greater share of the market would become irresistible. Realizing that by expanding output the firm could reduce unit costs, it would cut prices in order to increase sales. The problem was, of course, that when a number of competing firms pursued the same strategy, prices were bid lower and lower as each attempted to increase its market share at the others' expense [21, pp. 192-95]. Nor could the market easily reestablish equilibrium. In industries such as tin plate and wire nails all the leading firms were fairly evenly matched, and it was extremely difficult to force capacity out of production. Because fixed costs were such a high proportion of total costs, there was a wide range of prices within which firms would produce at a loss. The large firms, moreover, demonstrated a great deal of staying power, while such failures as did occur rarely resulted in the idling of capacity.[17]

There was, as a result, considerable incentive for firms to avoid competition. Outbreaks of ruinous price cutting could be

prevented so long as prices were not allowed to fall below total costs. Manufacturers recognized this and eagerly banded together in pools and other similar organizations to prevent price competition from erupting. As three producers of iron beams explained in a letter to the American Iron and Steel Association *Bulletin* written to justify collusive activity:

> It is popularly considered an axiom that competition for orders will necessarily cease when the price obtained ceases to yield a profit, and that, therefore, unrestricted competition will insure the manufacturer as large a profit as he is fairly entitled to. Every manufacturer knows that this is entirely untrue. The cost of every manufactured product is made up of two classes of expenses, namely, those which depend upon the output, such as material, labor, fuel, and those which must be met whether or not any product be made, such as taxes, rent, interest or mortgages, salaries, general expenses, etc. There will, of course, be no competition for work at prices below those which will cover the expenses of the first class, but the price must be sufficient to cover both classes of expenses before any profit can be realized, and the keenest competition occurs when the ruling price is such as to somewhat more than cover the first class without fully meeting the second, because there is then a life-or-death struggle to reduce the inevitable loss which stares the manufacturer in the face. Under such circumstances there is no escape from bankruptcy except in some cases which will limit competition. [1, 7-14 November 1888, pp. 329-30]

Some iron and steel associations were remarkably successful in preventing competition, even during the long depression of the 1890s. The rail pool, for instance, had set the price of standard rails at $30 per ton in the early 1890s. After the Panic of 1893 it lowered the price in successive steps to $22 and then raised it to $28 in 1895 (a price it enforced for at least 16 months). These reductions were executed with the utmost precision. Successive pricing targets never took more than two months to achieve, while each was maintained for at least six months.[18] The success of the rail pool, however, contrasts sharply with the disastrous failures of other iron and steel organizations in the 1890s. The wirenail pool brought producers more than a year's respite from downward spiraling prices, but its collapse in late 1896 left the industry in a worse state than before [10]. Though they made repeated attempts at organization,

tinplate manufacturers never even managed a brief respite [9, pp. 76-78].

I can do little more here than sketch the broad outlines of an explanation for this pattern of success and failure.[19] Ruinous competition plagued those sectors of the iron and steel industry which, like the tin plate and wire nails, had experienced an abnormally rapid expansion in the early 1890s, an expansion which created problems of excess capacity, forcing at least some firms to run less than full.[20] At less than capacity levels of production, average total costs were necessarily high, but this position was tolerable so long as business conditions were prosperous. So long as prices exceeded total costs, firms were content to work their way gradually to more profitable levels of production. The depression soon jolted them from their complacency, however. Falling demand quickly transformed profits into losses. Finding it imperative to move toward their optimal levels of production, they cut prices with the aim of expanding sales. In the process they set off a bout of ruinous price competition which the existence of so much excess capacity made very difficult to end. Pools and trade associations proved ineffective against the combined onslaught of excess capacity and depression, and manufacturers ultimately turned to consolidation for relief.

This analysis of the events of the 1890s provides, I think, a useful context for understanding the changing organizational structure of the iron and steel industry. As I suggested at the beginning of this paper, the consolidation movement distorts our view of the 19th century economy because it was a response to ruinous competition produced by a particular combination of circumstances -- an overexpansion of capacity followed by a steep decline in demand. Such competition was the exception rather than the rule. In the late 19th century, small firms successfully employed product differentiation to protect themselves from the competition of their rivals. At the same time, the large firms that produced homogeneous products formed oligopolistic associations to contain price competition. In the late 19th century, therefore, patterns of interaction among firms -- large and small -- rarely conformed to the economist's idea of pure competition, and the consolidation movement could certainly not be said to demarcate a shift from a competitive to a noncompetitive industry structure. By recognizing the extent to which noncompetitive patterns of market behavior existed in the 19th century, we obtain a much better vantage point from which to assess the long-term impact of the consolidation movement on the organizational structure of the iron and steel industry.

NOTES

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1. Among the most important iron and steel consolidations formed in these years were seven that eventually merged to form the United States Steel Corporation: American Tin Plate (1898), American Steel and Wire (1899), American Steel Hoop (1899), National Tube (1899), American Bridge (1900), American Sheet Steel (1900), and Shelby Steel Tube (1900). For descriptions of these consolidations and discussions of the reasons for their formation, see [8; 9, pp. 76-99; 11, pp. 235-302; 14, pp. 182-89; 16, pp. 198-207; 17; 18; 20, pp. 134-40; 22, pp. 216-62; 23, pp. 189-93; 24, pp. 63-112; and 29, pp. 96-123].

2. Only furnaces that produced predominately non-Bessemer pigiron were included in the sample.

3. "Dipperies" were finishing works that coated steel sheets (known as black plates) with tin or a mixture of tin and lead. Tinplate production in the United States was insignificant before passage of the McKinley Tariff in 1890.

4. On the Thomas Iron Company, see [12, 25 May 1893, p. 1183]. Most of the tinplate dipperies that survived the depression of the 1890s were destroyed by policies of the American Tin Plate Company that denied them a source of raw materials. But N. & G. Taylor came through the depression with sufficient financial resources to integrate backward into black-plate production and then into open-hearth steel [12, 13 July 1899, p. 6; and 3 January 1901, p. 27; 19, 4 February 1899, p. 36; 3 February 1900, p. 34; 8 June 1901, p. 48; 7 December 1901, p. 36; 21 November 1903; p. 35]. See also [28, "Testimony," pp. 890-94, 933, and 935].

5. The first quote is from [12, 11 March 1880, pp. 18-19], and the second from [12, 13 January 1898, p. 10]. See also [12, 25 March 1880, pp. 18-19; 16 September 1880, p. 18; 6 March 1890, pp. 386-89; 20 March 1890, pp. 470-73; 27 March 1890, pp. 512-13; 4 January 1894, p. 19; and 7 January 1897, p. 18].

6. In the pigiron industry, however, attachment to brands was encouraged by the state of technology. Although years of custom and practice had evolved a set of criteria which distinguished the different grades of pigiron by their carbon and silicon content and by the uses for which they were best suited -- for example, Foundry No. 1 or No. 2, gray forge, and car wheel -- it was not yet common to use chemical analysis to identify the various grades. Instead manufacturers fractured a sample of the iron and determined the metal's structure by examining the

surface of the break, a technique that was so imperfect that buyers found it useful to restrict their purchases to familiar brands in order to assure as uniform a quality of iron as possible [15, pp. 82-87].

7. For a more extensive analysis of this data, see [13, pp. 58-64].

8. Trade journal reports indicate that architects often specified terne plate by brand name in their plans.

9. See quotations of tinplate brands in [19, pp. 1896-97]. Not all brands made the *Metal Worker*'s of quotations.

10. See quarterly reports in the tinplate industry in [19, pp. 1896-97] and monthly reports on blast-furnace operations in [1], pp. 1893-95].

11. [12, 16 July 1896, p. 123]. See also [27, pp. 1417-18]. Southern furnaces were an important exception. Their struggle to break into Northern markets led them to attempt several combinations. See, for example [5, 4 March 1898, p. 306; and 17 June 1898, pp. 846-47].

12. Nineteen of the brands attributed to differies in the 1896 AISA *Directory* explicitly specified "old method," "old process," "old style," or "hand dipped"; only four of the brands listed by other firms were so described [2, p. 1896]. There is no information on how the remainder of the brands were made, but trade journal reports indicate that it was the dipperies that specialized in labor-intensive, handfinished plates. See, for example, [12, 3 September 1896, p. 451]. See also [28, "Testimony," p. 940; and 9, pp. 30-49].

13. The average capacity of 26 tinplate dipperies in 1896 was 1,225 boxes a week (not including the one large firm, N. and G. Taylor), while the average capacity of the 33 tinplate rolling mills was 3,239 boxes a week. The eight wire-nail rolling mills in existence in 1896 had an average capacity of 1,033,000 kegs of nails a year, the 21 wire-drawing works had an average capacity of 194,000 kegs a year, and the 14 finishing plants an average capacity of 54,000 kegs [2, p. 1896].

14. According to US Steel Corporation minutes, such advertising as the company did engage in was intended primarily as a public relations ploy -- to ensure favorable treatment in the trade journals. See [25, Vol. VI, pp. 3778, 3786, 3931-36, 3962-63, and 3967].

15. See the continuing discussion of the problem of brands in [19] beginning with the 6 June 1896 issue.

The AISA *Directory* listed brands and trade marks for both dipperies and rolling mills. In 1896, there were listed an average of six brands per dippery and only three per rolling mill [2, p. 1896]. Moreover, proportionally fewer of the rolling mills' brands were actually quoted in market reports. It was possible to trace to manufacturers 115 of the brands quoted in

the *Metal Worker* in 1896 and 1897. Eighty-four belonged to dipperies and 31 to rolling mills (only two of the latter to major firms) [19, pp. 1896-97].

16. After correcting for variations in the timing of deliveries, the average weekly standard deviation in the price of steel billets was 14 cents per ton for the period 1891 to 1894. The spread was much wider in prosperity than in depression. When prices were rising, the corrected average was 17 cents per ton, but for weeks when prices were falling the mean was only 9 cents per ton. Variations in prices were more possible on the upswing, when production outran consumption and shortages of the metal developed for prompt delivery. On the downswing, however, values were much more uniform and bottom figures tended to rule.

By contrast, the spread in the price of No. 1 foundry pigiron remained about the same regardless of business conditions. The average weekly standard deviation was 18 cents per ton during upswings and 16 cents per ton during downswings. The difference between these figures and those for billets is magnified when one considers that billets were about 50 percent more valuable than pigiron, and that the figures represent virtually the entire billet industry but only the one grade of pigiron.

In calculating the weekly standard deviations, I weighted prices by the quantity of metal sold. Weeks in which only one transaction was recorded were excluded from the analysis.

17. Despite severe price competition, no major tinplate rolling mill failed or left the market during the 1890s. One major wire-nail firm failed after the Panic of 1893 and another withdrew from the market, but both mills were brought into production again under new ownership. There were no other important failures during the depression of the 1890s. Such stability presents a striking contrast to the high rates of mortality in the small-firm sectors of the industry [12, 4 January 1894, p. 30; and 2, 1892-98].

18. Of course, the rail pool collapsed in early 1897, but unlike in the cases to be discussed later industrial peace was easily reestablished in 1898. Scholars seem to have overemphasized the importance of this brief period of turmoil [5, 12 February 1897, p. 234]; 12, 11 February 1897, p. 19; 30 May 1897, p. 23; and 1 December 1898, p. 37]. On the rail pool, see [6; and 23, pp. 186-89].

Other relatively successful oligopolistic structures emerged in the plate and beam branches of the iron and steel industry.

19. For a fuller exposition, see [13, pp. 75-98].

20. Tinplate production was virtually nonexistent in the United States before the passage of the McKinley Tariff in 1890. By 1894 there were 47 firms in the industry with a total capacity of more than 98,000 boxes of tinplate per week. Wire-nail

production increased from 125,000 kegs in 1887 to 5,681,801 in 1894. Between 1892 and 1894 alone nail capacity increased 33 percent. By contrast, between 1887 and 1893 the number of steel-rail producers dwindled from 14 to 6, while output failed to expand; 2,101,904 gross tons of rails were produced in 1887. This level of output was not attained again until 1899. In 1892 only 1,535,588 gross tons were produced [2, 1888 to 1894; 4, p. 106; and 26, Vol. 2, p. 2127]. See also [7, pp. 174-80; 23, pp. 169-83; and 24, pp. 68-72].

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