The Emergence of Oligopoly

Eichner, Alfred S.

Published by Johns Hopkins University Press

Eichner, Alfred S.
The Emergence of Oligopoly: Sugar Refining as a Case Study.

For additional information about this book
https://muse.jhu.edu/book/68017

For content related to this chapter
https://muse.jhu.edu/related_content?type=book&id=2400642
FOR the American sugar refining industry the Period of Imperfect Competition lasted from 1730 to the early 1850’s, the Golden Age of Competition from the early 1850’s until the late 1870’s. What separated the two stages of industrial organization was a series of technological improvements—charcoal filters, the vacuum pan, steam power, and, finally and most important, the centrifugal machine—which made it possible to produce for the first time sugar of uniform quality on a mass scale. These cost-reducing innovations, together with the growth of population and income, as well as a transportation revolution which both created a vast new domestic market and shifted the flow of interregional trade, led to the sudden emergence of a competitive industry which displayed all the characteristics of the theoretical model: numerous firms pursuing independent pricing policies, relative ease of entry and exit, and product homogeneity.

On August 10, 1730, the *New York Gazette* carried an advertisement announcing the completion of the first sugar refinery on Manhattan Island:

Public Notice is hereby given that Nicholas Bayard of the City of New York has erected a Refinery House for Refining all sorts of Sugar and Sugar-Candy, and has procured from Europe an experienced artist in that Mystery. At which Refining House all Persons in City and Country may be supplied by Whole-sale and Re-tale with both double and single Refined Loaf-Sugar, as also Powder and Shop-Sugars, and Sugar Candy, at Reason-able Rates.¹

Two years later the London Board of Trade, investigating the extent to which colonial manufactures were competing against home prod-

ucts, reported that “several . . . sugar bakeries had been established in New England,” most probably referring to Boston and Providence. Soon thereafter refineries had also been erected at Philadelphia, the fourth of the four major cities which dominated the commerce and trade of colonial America.

Although sugar had been refined in England as early as the sixteenth century, the methods employed in America at this early date, and for nearly a century afterward, were extremely crude. The only major source of sugar, aside from the irregular and undependable flow of maple syrup, was sugar cane, grown throughout the tropical world but principally in the West Indies. In its natural state the sugar cane contained numerous undesirable elements, including dirt, living organisms, wood fibers and uncrystallizable glucose. The purpose of refining was to separate these various impurities from the sugar crystals.

This was accomplished in several stages. The first was to place the raw sugar that had been imported from the West Indies in large, open kettles, then melt it in a white lime solution to neutralize certain acids and prevent fermentation. Next came filtration, a process intended to remove as much of the foreign matter from the raw sugar as possible. In the primitive technology of the eighteenth century any floating particles which failed to settle to the bottom of the kettle were sifted out by pouring the liquid solution through blankets or linen bags. The sugar was then further clarified “by the use of bullock’s blood, albumen and clay” as filtering agents. As the final step in the refining process, the liquid solution was placed over an open fire and boiled until the sugar began to recrystallize. Then, at the proper moment, it was removed from the flame and allowed to cool. The result was what was known as loaf sugar, a large cylindrical roll from which lumps of various shapes could be cut to meet individual customers’ orders.


3 “… By 1739, the sugar houses of Philadelphia were well enough established in the refining of loaf sugar to cause quotations for the local product to appear regularly in the list of commodities in newspapers.” By 1762 the Philadelphia product had completely displaced the loaf sugar imported previously from London. See Anne Bezanson et al., Prices in Colonial Pennsylvania, pp. 181–82.


This last stage of recrystallization was a crucial moment in the refining process, for if the sugar was allowed to boil too long, it came out very brown and the taste was unsatisfactory. On the other hand, if the liquid solution was not allowed to boil long enough, too few of the impurities were removed. It required great skill to strike the proper balance, knowing just when to remove the sugar from the fire. For this reason, most of the early sugar refinery owners, following the example of Nicholas Bayard, brought "an experienced artist in that Mystery" over to this country from England, where the refining art was further advanced. Two of the skilled sugar men who came to America in this way were William and Frederick Havemeyer, progenitors of the family that was to play so important a role in the history of the American sugar refining industry.

Yet, despite the skill of these European masters, sugar refining remained a most imperfect art. Before 1830, the owner of a refinery considered himself fortunate if from one hundred pounds of raw cane he produced fifty pounds of refined sugar; within half a century the loss of more than 7 per cent in the refining process would be considered intolerable. As a result of these crude manufacturing methods, refined sugar was an expensive commodity. Its price during the later colonial period ranged from the equivalent of 7.1 cents a pound to the equivalent of 17.5 cents a pound. At Philadelphia, for which the most comprehensive data are available, the average price of loaf sugar from 1762 to 1775 was just a little over one Pennsylvania shilling (or the equivalent of 13.5 cents) a pound. Since, in Phil-

6 J. Carlyle Sitterson, Sugar County, pp. 145-46. While this refers specifically to the manufacture of sugar on the plantations of Louisiana, the technological problems were the same as those which confronted the early refiners on the Atlantic coast. In many respects the Louisiana planters on the eve of the Civil War were in the same primitive stage of manufacture that the Atlantic coast refiners had faced in 1830.


9 Unfortunately, comprehensive price quotations for refined sugar during the colonial period are available only for Philadelphia, occasional price quotations only for Boston. The highest price noted after 1761 at the former city was 1 shilling and 4 pence, the lowest price, 11 pence, while the highest price noted at Boston after 1752 was 6 shillings and 6.7 pence, the lowest price, 3 shillings and 2.6 pence. However, the Philadelphia and Boston shillings were not equal, the first being equivalent to six times the latter. In later U.S. monetary units the Philadelphia shilling was equal to 13.3 cents, the Boston shilling, 2.22 cents. See Bezanson, Prices in Colonial Pennsylvania, pp. 184-85, 423; Carroll D. Wright, History of Wages and Prices in Massachusetts, 1752-1860, pp. 45-49.

10 Bezanson, Prices in Colonial Pennsylvania, p. 423.
Philadelphia, skilled laborers such as carpenters and bricklayers earned at most the equivalent of only 80.0 cents a day during this period, while unskilled laborers earned at most the equivalent of only half that amount.\textsuperscript{11} Refined sugar was beyond the means of all but the wealthier classes. This was true not only in Philadelphia but in other major cities as well, for instance, Boston, Providence, and New York.\textsuperscript{12}

Although output was greatly limited by crude refining methods and attendant high prices, the sugar business could be highly remunerative. Cost figures have not survived the years,\textsuperscript{13} but there is evidence of several sugar refiners who, after a relatively short time, were able to retire with what in those days was considered a substantial fortune and either spend the rest of their lives in rural retreat or go on to more venturesome economic and political pursuits.\textsuperscript{14} This was especially true in New York, where many of the leading families—beginning with the Bayards and later including the Livingstons, the Cuylers, the Van Cortlands, and the Roosevelts—were at one time or another during the colonial period interested in refineries.\textsuperscript{15} To erect a “sugar house” and bring a skilled master over from Europe required a considerable capital outlay, and this fact not only made these prominent merchant families the most likely ones to undertake such enterprises but also served to limit the potential competition. In sum, then, sugar refining on the eve of the American Revolution was a business in which a man residing near a major seaport with considerable financial resources could, in a small way, hope to earn a


\textsuperscript{12} While detailed price data, comparable to that available for Philadelphia, have not been gathered for any of these cities, what little data there is fails to reveal any basis for considering sugar to be any less of a luxury item in those localities.

\textsuperscript{13} Based on the price data available in Bezanson, Prices in Colonial Pennsylvania, it is possible to estimate with some degree of reliability the margin between raw and refined sugar at Philadelphia for the years 1762–75. During this period the price of raw sugar was slightly less than half the wholesale price of refined, leaving a margin equivalent to approximately 6.9 cents a pound. Since each pound of raw sugar produced only half a pound of refined, it seems that the expense of refining, plus any profit that was to be made, had to come from the sale of the one-quarter pound of molasses which was a by-product of the refining process. From 1762 to 1775 the average price of molasses was 24.2 cents a gallon. However, without any knowledge of refining costs per pound, the analysis of profits cannot be carried any further, even for this one city.

\textsuperscript{14} See Pennsylvania Magazine of History and Biography, 21 (1897): 505, and pp. 30–31 below.

substantial return on his capital. It was a well-established type of enterprise, though not one which bulked large in the trade and commerce of that day. Finally, while sugar refining was among the first of this country’s manufacturing industries, it had not as yet advanced much beyond the handicap stage. It was thus a manufacture in the original sense of that word.

Despite the disruptions of the Revolutionary and Napoleonic wars, the nature of the industry remained essentially the same. The census of 1810, unreliable as it was in regard to manufactures, provides the first evidence of the sugar industry’s relative importance. It noted that of the $127.7 million in manufactured goods produced that year, refined sugar accounted for only $1.4 million, or just a little over 1 per cent.  

Meanwhile, sugar continued to be a luxury item, the price of refined sugar in the years just prior to 1820 being approximately twenty cents a pound, twice the price of raw. This represented nearly 14 per cent of the daily wages a skilled laborer could expect to earn. A three-cents-a-pound duty on raw sugar helped to keep the price of refined sugar high.

The typical transaction in sugar was still small. Although a substantial wholesale trade had existed from the very beginning, many of the wealthier families in the large cities where refineries were located continued to send their servants to the sugar house in person to purchase the weekly supply. The quality of the sugar varied greatly, depending on the skill of the refiner himself. But under the crude manufacturing methods of that day, sugar produced even by the same refiner varied considerably over time.

The one thing that changed significantly before 1820 was the type of person operating the refineries. In New York the old, prominent merchant families had all gone on to more prestigious pursuits. Isaac Roosevelt, for example, had become president of the Bank of New York, the city’s first such financial institution. The Livingstons, meanwhile, were preoccupied with their steamboat monopoly and

---

16 Trench Coxe, Arts and Manufactures of the United States of America for the Year 1810, p. 37.
17 H. Havemeyer, The Havemeyer Family, p. 98.
20 H. Havemeyer, The Havemeyer Family, p. 98.
EMERGENCE OF A COMPETITIVE INDUSTRY

extensive land holdings. They and the others were succeeded in the refining business by the Rhinelanders and the Seamens, the latter being the ones responsible for bringing William C. Havemeyer over to this country from England in 1802 to take charge of their refinery. In 1807, when his contract expired, the thirty-seven-year-old Havemeyer went into business for himself, forming a partnership with his younger brother, Frederick C. But though these newer and younger persons had come into the industry, the same crude refining methods continued to be employed.

Then, beginning about 1830, a series of important technological innovations, all of them originating in Europe, began to be introduced into this country. Perhaps the first of these was the use of "bone black," or animal charcoal, as a filtering agent instead of albumen, bullock’s blood, or clay. Bone black is the product obtained by burning animal bone in an airtight oven in much the same way charcoal is produced. Its unique purificatory powers were first discovered in 1811 by a Frenchman who found that while other materials were equally capable of destroying the organic coloring matter found in raw sugar, only animal charcoal was able to remove the brown stain caused by continued exposure to high temperature. The use of bone black made it possible not only to obtain a final product that was pure white and free of most impurities but also to derive a larger percentage of refined sugar from the same amount of raw cane. In 1832, animal charcoal was just beginning to be used in the United States.

While French refiners were experimenting with the use of animal charcoal as a filter, an Englishman, Edward C. Howard, was developing a greatly improved device for boiling sugar. Known as the vacuum pan, it was based on the well-known principle that liquids will boil at a lower temperature if the atmospheric pressure is reduced. Howard's apparatus, which he patented in 1812, consisted "of a globular copper vessel, enclosed within an iron or copper jacket." Hot steam was forced into the latter, while an air pump attached to

25 M. Figuer of Montpelier, according to ibid., pp. 96-97. According to a Dr. Evans, in an article in DeBow's Review, the use of bone black was first introduced by a M. Deroane and then perfected by a M. Dumont; see Evans, "Sugar Refining," p. 388.
26 U.S., Treasury Department, Documents Relative to the Manufactures in the United States, 1: 468.
the inner vessel, or concentrator as it was called, created a partial vacuum. This enabled the syrup to boil at a much lower temperature than would otherwise have been possible. But more than that, as the water in the syrup turned to steam, the effect was to force air from the concentrator. Then, as the steam was drawn off through a pipe and condensed by a jet of cold water, an additional vacuum was created. Thus the boiling process, once initiated, tended to maintain its own vacuum.

A number of improvements were later made in Howard's apparatus, the most significant being the introduction of a long steam pipe into the heart of the concentrator, but the advantages of even the first model were clearly evident. For one thing, the use of steam meant that the temperature could be more closely controlled than it had been when the syrup was simply boiled over an open fire. It also meant a considerable saving on fuel. But even more important, a thermometer and pressure gauge within the concentrator enabled the refiner to know exactly when the liquid was about to boil. If, after comparing the temperature shown on the thermometer with the temperature at which sugar would boil under the pressure indicated by the barometer, the refiner was still uncertain, he could, through a special device, examine the syrup itself without destroying the vacuum. This, along with the fact that the syrup could be boiled at a much lower temperature, meant that the discoloration of the final product which had often occurred in the past could now largely be avoided. As one enthusiastic report later noted, "There is no mode of concentrating syrups at present known which offers advantages equal to those of the vacuum pan..." Nor were there to be any in the future. Although sugar refining now required even greater skill and knowledge than before, it had ceased to be a mystery dependent on the intuition and artistry of a single master.

Several attempts were made before 1832 to adapt steam to sugar refining in the United States, but none of these proved successful. American mechanics seemed unable to learn how to control steam effectively. Then, in 1832, two brothers, Robert L. and Alexander Stuart, succeeded where others had failed. Their father, a small though moderately prosperous confectioner on New York's lower West Side, had died in 1826, leaving the business to his wife and two sons. When Robert, the older, turned twenty-one a year later, he took charge of the business and the following year invited his brother.

28 Ibid., p. 398.
29 Biographical Sketch of Robert L. and Alexander Stuart, p. 5.
Alexander to join him as a partner. No longer content to buy their sugar from others as their father had done, the two brothers decided to enter the refining end of the business for themselves. Instead of using the old methods, however, they began experimenting with the use of steam. (Their building on Greenwich Street was later the first in New York to be supplied with gas.) Practically everyone in the refining business, including William F. Havemeyer, son of the founder of the Havemeyer refinery, predicted failure. One day, when Havemeyer passed by, he saw a large steam boiler being carried into the Stuarts' refinery. Accosting Alexander, who was in charge of the manufacturing end of the business, he is supposed to have said, "Don't do it, it will ruin you!"

Yet within a year the Stuart brothers had secured a patent for their system of steam refining. In 1834 their sugar, exhibited at the American Institute Fair, became the envy of all the other refiners, and a year later the capacity of their refinery was increased fourfold, from three thousand pounds to twelve thousand pounds daily. The Stuarts were able to apply the steam not only to the refining process itself but also to many of the ancillary operations, such as lifting the raw product to the top of their six-story building before it began its descent through the various refining stages. The Stuarts adopted several other recent technological advances, but their competitors found it difficult to follow their example. "It seems curious," one writer later observed, "that these new processes, which . . . completely revolutionized the business, should have been resisted, and adopted with great reluctance. Heating by steam met with very determined resistance on the part of many old refiners, and in some cases partnerships were dissolved because the members of firms could not agree respecting the practicality and advisability of its adoption."

Among the partnerships dissolved was that of William F. and Frederick C. Havemeyer in 1842, the former to go into politics and the latter to devote full time to other business affairs. The refinery built by their fathers, a plant which had never produced more than one million pounds in any one year, was sold to their respective brothers, Albert and Diedrich.

Meanwhile, the firm of Robert L. and Alexander Stuart prospered. "The business increased so rapidly . . . that the two brothers were
compelled to build extensive quarters, first at the corner of Greenwich and Chamber Streets, and then in 1849, at Greenwich and Reade Streets.\(^{35}\) The latter building, a nine-story structure, contained eight large steam boilers, which together consumed eight thousand tons of anthracite coal a year. It was flanked by several other buildings used for storage. By 1853 the Stuart firm had become the predominant sugar refinery in America, producing about forty million pounds of sugar annually and employing a labor force of approximately three hundred men. That year, finding that the refinery required all their energies, the two brothers gave up their confectionery business.\(^{36}\)

Only the East Boston sugar refinery in Massachusetts rivaled the Stuart works. Erected in 1834, it was the venture of John Brown, who had gone to England to learn the advanced techniques, including the use of steam, which the refinery employed. Though the firm was forced to suspend operations during the Panic of 1837, it subsequently reopened and thereafter waxed continually stronger. In 1852 the refinery was modernized, and its capacity increased to 25 million pounds annually.\(^{37}\) Together with the Stuart works, it presaged the next stage in the sugar refining industry’s evolution, the Golden Age of Competition.

For many years the Stuart and East Boston refineries were the only substantial sugar works in the United States. Then, beginning in the early 1850’s, the number of refineries suddenly began to increase. “No longer ago than the year 1848,” reported *Hunt’s Merchant Magazine* in 1856, “there were but two refineries in New York city, . . . and now, notwithstanding the depression experienced last season, when two or three houses ceased operations, there are ten refineries, some of which cost from $500,000 to $800,00 or more, and two others will soon be added.”\(^{38}\) In Philadelphia, between 1853 and 1857, four new refineries were added to the one already in existence.\(^{39}\) Various factors lay behind this rapid expansion of the sugar refining


\(^{36}\) *Biographical Sketch of Robert L. and Alexander Stuart*, p. 6.


\(^{38}\) *Hunt’s Merchant Magazine*, 35 (1856): 500. The article lists only the Stuart and Woolsey firms, failing to mention the old Havemeyer refinery, which was still in operation.

industry, including, once again, several important technological and entrepreneurial innovations.

The final step in the refining process, once the syrup had boiled, was to separate the sugar crystals from the molasses, or that part of the syrup which would not crystallize. This process, known as "claying," consisted of "running the sugar into conical molds, and placing on top a layer of moist clay or earth. . . . The moisture from the clay percolating through the mass of sugar, would wash away the adhering molasses and leave the crystals comparatively free and clear." It was a lengthy and expensive process, requiring large curing sheds, much labor, and at least three weeks to complete. After the adoption of steam, it became the principal factor limiting the amount of sugar which a refinery could produce.

Then, in 1851, a new machine was patented which could perform the same function in a fraction of the time the claying process required. Boiled syrup was "placed in a revolving sieve, the wires of which are so fine that nothing but the liquid part of the sugar is allowed to pass. This sieve . . . is made to revolve with the tremendous velocity of two thousand revolutions per minute. By this means a centrifugal force is attained, sufficient to cause the liquid and impure portions of the sugar instantly to fly off, leaving the sugar itself behind, entirely purified and white. . . ." The invention of the centrifugal machine, no larger in size than an ordinary wash tub, helped to revolutionize the industry. It "opened the way for an almost unlimited amount of business in a given time, easily doing in a few hours work which before required many days." By 1857 the centrifugal machine was reported to be in use by most refineries.

Meanwhile, William Moller had developed a new type of cloth filter, as well as a way to restore used bone black. The latter invention was extremely important, since the rapid growth of the industry was leading to such a large increase in the price of animal charcoal that it was becoming a major item of expense. Now that the same bone black, after being cleaned with certain chemicals, could be used over and over again, that expense greatly diminished. Moller had worked for refineries in Boston and New York before joining the old Havemeyer firm in 1849. The new firm, Havemeyer & Moller, soon became famous for its "Cut Loaf Sugar," produced by a machine.

which Moller had also invented. “This sugar,” an early history of American manufacturing noted, “is well known throughout the continent, and is preferred by families because of its good quality, and the uniform size and shape of its lumps, at even a higher rate than the market price of ‘broken’ or ‘crushed’ sugar, or that cut into squares or cubes by hand labor.” Soon after the Civil War began, the firm became simply William Moller & Sons.

These new technological processes made possible a substantial reduction in the price of refined sugar. In the early 1830’s, soon after the Stuarts had begun producing sugar with their new steam process, the wholesale price of refined sugar had ranged on the average between 15 and 17 cents a pound. By 1851 it had fallen to between 8½ and 9½ cents a pound, which represented primarily a fall in the real price. This sharp drop, coupled with a rise in personal incomes, was to lead to a significant increase in the demand for refined sugar. From a figure of 18 pounds per person in 1850, sugar consumption in the United States was to jump to 24 pounds in 1853 and 31½ pounds in 1858. Meanwhile, fed by a steady stream of Irish and German immigrants, the population was rapidly expanding, especially in the northeastern states. Between 1840 and 1850 the population of the United States rose from 17.1 million to 23.2 million, an increase of 35.9 per cent. During the next decade it was to continue growing at about the same rate.

Helping to broaden the market for sugar was the revolution in transportation which was taking place contemporaneously. By 1851

46 The average range of wholesale prices for refined sugar in New York City between 1831 and 1860 was as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1831</td>
<td>15-16¾¢</td>
</tr>
<tr>
<td>1832</td>
<td>14-17</td>
</tr>
<tr>
<td>1833</td>
<td>14½-17¼</td>
</tr>
<tr>
<td>1834</td>
<td>15-16½</td>
</tr>
<tr>
<td>1835</td>
<td>14-16</td>
</tr>
<tr>
<td>1836</td>
<td>15½-17</td>
</tr>
<tr>
<td>1837</td>
<td>15-16</td>
</tr>
<tr>
<td>1838</td>
<td>15-16</td>
</tr>
<tr>
<td>1839</td>
<td>15-16</td>
</tr>
<tr>
<td>1840</td>
<td>11½-13¾</td>
</tr>
<tr>
<td>1841</td>
<td>11-13¢</td>
</tr>
<tr>
<td>1842</td>
<td>10</td>
</tr>
<tr>
<td>1843</td>
<td>10½-11</td>
</tr>
<tr>
<td>1844</td>
<td>11</td>
</tr>
<tr>
<td>1845</td>
<td>11½-11½</td>
</tr>
<tr>
<td>1846</td>
<td>11</td>
</tr>
<tr>
<td>1847</td>
<td>10</td>
</tr>
<tr>
<td>1848</td>
<td>8</td>
</tr>
<tr>
<td>1849</td>
<td>8½</td>
</tr>
<tr>
<td>1850</td>
<td>9½</td>
</tr>
</tbody>
</table>

Source: U.S., Treasury Department, Report of the Secretary, 1863, pp. 368-96.

47 The Pearson-Warren wholesale-price index fell from 94.3 in the years 1831-33 to 83.0 in 1851 (U.S., Department of Commerce, Bureau of the Census, Historical Statistics of the United States, 1789-1945, p. 115).
two separate rail lines, the Erie and what was later to become the New York Central, connected New York City with the Great Lakes. At the same time, the Pennsylvania Railroad gave the city of Philadelphia direct access to the Ohio River at Pittsburgh, while the Baltimore & Ohio Railroad did the same for Baltimore at Wheeling, West Virginia. Boston, though it lacked a major railroad to the West, nonetheless was the center of a rail network that tapped all of New England and joined the New York Central at Albany.\textsuperscript{50} By these various routes the large eastern seaboard cities could for the first time reach the rapidly expanding Midwest markets cheaply and expeditiously. Meanwhile, the Midwest was experiencing a railroad boom of its own, one that would soon give it a rail system as extensive as that in the East. By 1860 Ohio, Illinois, and Indiana together would have 7,908 miles of railroad, an eightfold increase within a decade.\textsuperscript{51} While it would take several decades more to integrate the eastern and midwestern systems completely,\textsuperscript{52} the fact was that the railroad was significantly altering the flow of interregional trade.\textsuperscript{53} This was especially true in the case of sugar.

Almost from the time the trans-Appalachian regions of the United States were first settled, they had been supplied with sugar from the plantations surrounding New Orleans. Inasmuch as a separate refining industry had failed to evolve,\textsuperscript{54} the raw cane was processed on each plantation by means of the same crude methods that had been common in the East before the Stuarts built their steam-powered refinery. The Louisiana product, though far less satisfactory than the sugar refined in New York or Boston, had nonetheless pre-empted the Midwest markets, primarily because it was so much cheaper. Here transportation costs were a major factor. Bulk commodities, such as sugar, could be shipped up the Mississippi River at a fraction of what it cost to carry them overland from the eastern seaboard. Even after the Erie Canal was built, Louisiana sugar continued to enjoy a substantial freight advantage.\textsuperscript{55}

\textsuperscript{50} George R. Taylor, \textit{The Transportation Revolution, 1815–1860}, p. 84.
\textsuperscript{51} \textit{Ibid.}, p. 79.
\textsuperscript{52} George R. Taylor and Irene D. Neu, \textit{The American Railroad Network, 1861–1890}.
\textsuperscript{53} Albert Fishlow, “Antebellum Interregional Trade Reconsidered.” \textit{The Economic Growth of the United States, 1790–1860}.
\textsuperscript{54} For an interesting analysis of why this happened, see Douglass C. North, \textsuperscript{55} According to Taylor (\textit{The Transportation Revolution}, pp. 136–37), as late as 1850 the freight rate from New Orleans to Cincinnati was twenty cents a hundredweight compared to eighty cents a hundredweight from New York City to Buffalo by way of the Erie Canal.
With the coming of the railroad this situation began to change. It was not just that the steam locomotive brought about a reduction in overland transportation rates, though certainly this was a significant factor. Whereas, before, it had cost between twelve and seventeen cents per ton-mile to transport goods by wagon, by 1851 it cost only four cents per ton-mile to haul them by rail. Nor was it just that the railroad was a more expeditious form of transportation, that, whereas it required eighteen days for goods to reach Cincinnati from New York by canal, it required only six to eight days by rail. Probably more important than either of these two advantages was the fact that the railroad was now able to reach many communities previously inaccessible by boat when river and canal waters were low or frozen, and thus assured steady and dependable delivery.

Gradually the surplus products of the Midwest—grain, meat, dairy items, wool, and lumber—were diverted from their natural course down the Mississippi River through the port of New Orleans and were sent instead across the Appalachians to the Atlantic seaboard cities. Once established, the same channels of trade were then used for eastern manufactured goods, including refined sugar, on the return trip west. This change in the flow of internal commerce, first initiated by construction of the Erie Canal, was made permanent by the advent of the railroad.

Still, eastern refined sugar probably would not have been able to gain a foothold in the Midwest had it not been for the fact that the Louisiana cane sugar industry had just about reached the limits of its expansion. This fact was not immediately obvious, for Louisiana cane production—protected by a substantial tariff—had grown steadily through the years up to 1853. After that, however, climatic conditions and lack of transportation facilities limited the normal Louisiana crop to 250 million pounds a year. This meant that whatever additional sugar cane was needed to meet the growing demand...
in this country had to be imported from Cuba. Because of the even higher tariff on refined products—six cents a pound until 1846 and 30 per cent ad valorem thereafter—this Cuban sugar was imported in a nearly raw state, then further processed at one of the Atlantic seaboard cities. The fact that the Louisiana cane industry had just about reached the limits of its expansion augured well for the East Coast refineries.

All these factors together, then—the demonstrated superiority of the steam refining process, the more recent technological improvements, the rising per capita consumption of sugar, the growth in the nation’s population, the transportation revolution and the resulting shift in the flow of interregional trade, the opening of the Midwest markets, and the end of the Louisiana sugar industry’s expansion—served to create a favorable climate for investment in sugar refining.

The early 1840’s had been largely a period of depressed business activity following the Panic of 1837.62 Prosperity returned in 1843, and the reviving economy received an added stimulus when, in 1849, gold was discovered in California, touching off one of the great expansionary decades in American economic history.63 It was over these years that sugar refining first developed into one of this country’s most important industries. According to an 1856 account, “the sugar refining interest of New York has increased, within a few years, to a business of great magnitude, till the city is nearly encircled by enormous refining establishments, easily recognized by their lofty walls and chimneys. . . .”64 By that year there were twelve refineries in New York City and vicinity, five in Philadelphia, five in New England, two in Baltimore, and one each in St. Louis, Cincinnati, and New Orleans. Together they produced 385 million pounds of refined sugar annually,65 a fourfold increase since 1850.66

In 1857 several additional refineries were completed, including one by Frederick C. Havemeyer. After selling out to his brother Diedrich in 1842, Frederick had devoted himself mainly to managing his

---

63 North, Economic Growth, p. 205.
65 Ibid., p. 501.
66 The 1850 census of manufacturing recorded the value of refined sugar produced in that year at $9.9 million. Estimating the average price to have been ten cents a pound, this would indicate an annual output equivalent to approximately 99 million pounds (U.S., Department of Interior, Abstract of Statistics of Manufacturing According to the Returns of the Seventh Census, p. 109).
father’s estate. But he had also found time to make several trips to Europe, where he was able to inspect the latest improvements in sugar refining. In 1856 Frederick decided to re-enter the refining business, in part, no doubt, because of the attractive prospects which the industry at that time seemed to offer and in part because he wished to assure his four young sons a place in the mercantile world. The oldest, Frederick C. Havemeyer, Jr., proved unsuited for business and the next oldest, George W., was killed soon thereafter in an accident at the refinery, but the two youngest sons, Theodore A. and Henry O., were both to become active partners in the firm, along with their brother-in-law, James L. Elder, and their cousin, Charles H. Senff. This firm eventually came to be known as Havemeyer & Elder.67

Frederick C. Havemeyer, together with a series of partners (including for a brief period William Moller), began erecting a refinery across the East River in Brooklyn, the first such establishment in what was then a separate city. Soon after construction of the plant was begun, Frederick sent his son Theodore to Germany and England to see what further advances had been made in the refining process since his own last trip to Europe. On his return, Theodore assumed an active role in laying out and building the new plant. The seven-story structure, when finally completed in 1860, was among the most modern sugar refineries in the world, incorporating within its walls all the recent technological improvements which Theodore had encountered in Europe, as well as those which had previously been developed in this country.68

The new Havemeyer refinery differed from the plants of other firms in one important respect. It was located on the water’s edge, which meant that the raw sugar could be unloaded from the boats directly into the refinery’s warehouses. Other refineries had to incur the extra expense of carting the raw sugar from the customs house to their respective places of business. Thus the Havemeyers were able to take advantage of an 1854 law sanctioning a system of private bonded warehouses.69 Under the new law it was possible to store imported goods not only in warehouses owned or leased by the federal government, as had previously been required, but in private warehouses as well, without paying duties on the goods until they were removed from the warehouses for domestic consumption.70 By

68 Ibid., pp. 51–52.
70 Ibid., pp. 51–52.
having their own refinery sheds designated as acceptable private warehouses for strong dutiable sugar, the Havemeyers were able to avoid the expense of dealing through regular customs warehouses.

In Boston, Seth Adams was imitating the Havemeyers' example. Before 1849 he had owned a machine shop where he produced, among other things, the Adams printing press that his brother had invented. Then a refinery which owed him money for machinery became insolvent, and to recoup his loss he entered the sugar refining business. When, in 1858, the old refinery burned down, Adams decided to build a new one along the harbor's edge in South Boston. More than twelve thousand piles were driven into the soft, reclaimed land, and a nine-story refinery capable of turning out five hundred pounds of refined sugar daily was erected on the site.71

Small though this output was, the sugar could be produced at a very low cost because of the refinery's waterfront location. How significant this advantage was for both the Havemeyer and Adams refineries was not at first appreciated, however, for the coming of the Civil War made the sugar refining industry so profitable that cost considerations became relatively unimportant.

At first it appeared that the outbreak of hostilities would have the opposite effect. Access to the Louisiana crop was immediately cut off, and this had the effect of raising the price of raw sugar. Increased quantities of cane were imported from Cuba, but that island could not hope to make up so great a deficiency on such short notice. Nor were the other centers of world production equal to the task. East Coast refiners soon found that they could not obtain additional quantities of raw sugar at any price.72 On top of that, in order to help finance the war, Congress began levying additional duties on imported sugar. By late 1862 the tariff on raw sugar was three cents a pound, more than double the immediate prewar rate.73 Yet, despite these and other vicissitudes, the sugar refining industry managed to thrive. Although the Stuarts were able to operate their refinery at only half its normal capacity, the profits on even that reduced output were greater than those earned before the war, when they operated at full capacity.74 The war-induced boom, reinforced by large govern-
ement purchases, assured a strong demand for refined sugar even at the much higher prices.

Lee’s surrender at Appomattox did not change this situation significantly. The demand for sugar, stimulated by the immediate post-war prosperity, continued strong. Meanwhile, the forces of supply had readjusted themselves. Sugar cane from Cuba and the other Caribbean islands more than made up for the raw sugar no longer received from Louisiana. For though the Civil War had ended, the Louisiana sugar industry was still in a state of disruption. For one thing, the labor supply was thoroughly disorganized. The planters, long accustomed to slave labor, were now faced with the necessity of dealing with free Negroes. It would take many years for both sides to adjust to the new relationship. In the meantime the productivity of labor, when labor could be obtained, fell sharply. But perhaps equally important, the planters found themselves faced with a shortage of capital. Seed, sheds, and mills had all been destroyed in the war, and short-term funds were needed to replace them as well as to pay wages. Unable to secure credit except at exorbitant rates, the planters had no choice but to restrict the amount of acreage planted in cane.

By 1872 the Louisiana sugar industry still had not fully recovered from the effects of the war, the statistics on imported raw sugar attesting to the diminished importance of Louisiana cane. Whereas, in the five years preceding the Civil War, foreign imports accounted for 63 per cent of the raw sugar consumed in the United States, by 1872 they accounted for over 90 per cent of domestic consumption. Thus the Civil War reinforced a trend already apparent before 1861, the growing dominance of eastern refined sugar.

Among the various refining centers in the East, New York reigned supreme. In 1872 its sugar houses processed 59 per cent of the raw sugar imported from abroad; two years earlier they had processed only 55 per cent. Soon the percentage would rise even higher, reaching 68 per cent in 1887. Many factors accounted for New York’s

---

75 Sitterson, Sugar County, pp. 213ff.; for a somewhat broader view of the problems posed by Reconstruction in the South, see Eli Ginzberg and Alfred S. Eichener, “The Reconstructed South,” in their The Troublesome Presence, pp. 199ff.

76 Sitterson, Sugar County, pp. 291–94.

77 New York, N.Y., Chamber of Commerce, Annual Report, 1872–73, pt. 2, p. 11. Foreign imports account for over 90 per cent of domestic raw sugar consumption whether one surveys the five years preceding 1872, the two years preceding 1872, or 1871 alone.

dominant role in sugar refining; its long pre-eminence as the nation's leading port, its numerous credit institutions for financing large importations of raw sugar, the availability of inexpensive anthracite coal for powering its refineries, and the large pool of relatively cheap unskilled labor to man them. But perhaps the most important factor was the city's extensive transportation facilities. Not only did two independent railroads provide year-round service to Chicago and other midwestern points, but a canal offered even cheaper carriage during the summer months, helping to force down railroad rates. None of the other seaboard cities were so adequately supplied with transportation facilities for tapping the trans-Appalachian regions, the fastest-growing market area for refined sugar. In addition, other railroads reached out from New York to the south and southwest, providing inexpensive transportation to those areas as well. By 1870, sugar refining had become New York's most important manufacturing industry.89

It was during these immediate post—Civil War years that the sugar refining industry most closely approximated the conditions underlying what economists were later to define as the purely competitive model.81 There was, first of all, the large number of refineries, not just in New York, but in Philadelphia and Boston as well. In 1869 there were forty-nine independent refining establishments in those three cities, including twenty-eight in New York and its vicinity.82 There were, in addition, two refineries in Baltimore and one in St. Louis.83 By 1878 there were still thirty-eight independent establishments in the three major refining centers, New York, Philadelphia, and Boston.84

79 Although sugar refiners were heavily dependent on credit institutions to finance their large importations of raw sugar, investment bankers apparently played only a minor role in the growth of the industry. The capital to build the refineries seems to have come entirely from the refiners themselves.
80 J. L. Bishop, History of American Manufactures, 3: 150.
81 Frank H. Knight, Risk, Uncertainty and Profit, pp. 78ff. For a discussion of the historical elicitation of the assumptions underlying the competitive model, see George J. Stigler, "Perfect Competition, Historically Contemplated," pp. 1–17.
82 See Appendixes A, B, and C of this volume.
83 Their names were affixed to a petition addressed to Congress, a copy of which can be found in the New York Historical Society Library, New York, N.Y.
84 See Appendixes A, B, and C of this volume.
No one of these refineries, moreover, controlled a disproportionately large share of its market. As Hugh N. Camp, one of the men active in the refining business during the period right after the Civil War, later testified before a congressional committee: "They were all pretty small then to what they are today. Some averaged only seven tons a day and some 400. My impression is that the average was about 200 tons a day." The largest refinery at this time, Havemeyer & Elder, was capable of producing only five hundred tons of refined sugar daily.

Entry into the industry was relatively easy, as evinced by its frequent occurrence. In New York, between 1869 and 1875, an average of from three to four new firms started business each year. Of course, about an equal number of firms disappeared annually, but this, too, reflected the industry's fluid character.

Entry was easy because the barriers were few. An up-to-date refinery, capable of producing sugar as efficiently as any competitor, required a capital investment of between $500,000 and $700,000, a sum not too great by itself to discourage entry. Once a refinery had been built or purchased, the new entrant was on an equal footing with his competitors. Raw sugar could be bought in the open market from any one of the numerous importers or brokers that had emerged in the wake of the refining industry's growth. Depending, of course, on his bargaining skill, the new refiner could be certain that, as a result of the intense competition among these importers and brokers, he would have to pay no more than the going market price for raw

---

86 See Appendix A of this volume.
87 For a theoretical treatment of this concept, see Joe S. Bain, Industrial Organization, pp. 173–76.
88 Havemeyer & Company, a refinery controlled by the same branch of the family that owned Havemeyer & Elder, represented a capital investment of $500,000 in 1872. Havemeyer Brothers & Company and Havemeyer, Eastwick & Company, two refineries controlled by the other branch of the family, the direct descendants of William F. Havemeyer, the former mayor of New York City, represented capital investments of $400,000 and $350,000 respectively in 1880 (H. Havemeyer, The Havemeyer Family, pp. 117–18, 123–24). Meanwhile, in 1877 Elisha Atkins of Boston was able to buy the old Waters refinery for $450,000, spending an additional $117,411 to recondition and modernize it. This renovated plant became the Bay State Sugar Refinery. See United States v. American Sugar Refining Co. et al.: Testimony Before William B. Brice, Special Examiner, pp. 4597–600; hereafter cited as United States v. American Sugar Refining Co. et al., pretrial testimony, 1912.
Similarly, the new entrant could dispose of his manufactured product through an extensive network of refined-sugar brokers and wholesale grocers without having to worry about setting up his own sales organization. In fact, the entire mercantile end of the business could be conducted within a few blocks' area of New York and the other major refining centers. Labor, coal, and bone black, the other inputs required, could also be obtained by new entrants on the same terms as any other refiner. While some technological processes were covered by patents, they were not important enough to put a refiner without access to them at a significant disadvantage. Actually, the most important technological processes not available to all comers were the trade secrets embodied in the skill of individual refining superintendents. The fact that men of such skill were limited in number was perhaps the most formidable barrier facing a new entrant. Still, it was often possible to hire the refining superintendent of a firm that had just gone out of business or to entice away the assistant from some active rival, frequently by making him a partner in the new venture.

The fact that the various sugar refining companies were primarily partnerships was also important, for this implied a value orientation which was essential if the industry was to behave competitively. As partnerships, the various sugar refining companies were interested primarily in maximizing their immediate profits. It could hardly be otherwise, for the life of the typical firm was too brief to permit many long-term considerations. Not only death and retirement but even disagreement among the partners could, and sometimes did, bring a sudden end to a prominent refining firm. While it survived, the firm was viewed by its members mainly as a vehicle for earning as large a

---

90 As Willett & Gray's Weekly Statistical Sugar Trade Journal noted after the sugar trust was formed, "... the existence of a well-organized sugar business ... heretofore included consignees, consignors, merchants, importers, bankers, brokers and agents who, in their combined capacities, helped the producer to carry his sugar and dispose of it, and naturally created a surplus of available stocks always existing in the consuming markets i.e., the refineries" (March 28, 1889). See also the later testimony of Wallace P. Willett, in United States v. American Sugar Refining Co. et al., pretrial testimony, 1912, pp. 176ff.

91 See the testimony of various former refining superintendents, such as Joseph Stillman, Julius A. Stursberg, and Max Wintjen, in United States v. American Sugar Refining Co. et al., pretrial testimony, 1912, pp. 4561ff., 4711ff., and 7017ff. respectively.

92 Economists have not sufficiently appreciated how closely associated the competitive model was with the non-corporate form of business organization.

93 In Edith Penrose's terminology, their "expectational" horizon was quite limited; see her The Theory of the Growth of the Firm, pp. 41–42.

94 See Appendix A of this volume.
return as possible on the capital which they had invested in it. As active members of the firm, they were at one and the same time both owners and managers. Some of the partners might have hoped that one day their sons would join them in the business, thus perhaps enabling the firm to survive beyond the life span of a single man, but this was a secondary consideration.

Of course, even by 1879, some sugar refineries had taken on the corporate form. The North River Sugar Refining Company, for example, had been organized under New York’s general incorporation laws as early as 1857, DeCastro & Donner as early as 1871. But although these firms assumed a corporate form, they remained essentially partnerships of a few active members. As an official of the sugar trust later testified: “Each one of these refineries was in the ownership of a limited number of persons. The Havemeyers, for instance, consisted of three partners, and others were in somewhat the same proportion.”

Competition during this period was fostered by the fact that refined sugar was essentially a homogeneous product. The new refining techniques had eliminated much of the variance in quality which had once been so characteristic of sugar. Centrifugal sugar was centrifugal sugar, and granulated was granulated. Each had its own easily recognizable characteristics. There were, of course, certain well-known brands, such as Havemeyer & Elder’s or Matthiessen & Weicher’s patent cut loaf sugar. These brands sold at a premium because of their reputation as consistently high-quality sugars. But aside from this reputation they were the same as other granulated sugars, and the premium paid for them was not that high. Whatever confusion as to quality still remained after the new refining techniques were developed was eliminated by the growing use of the polariscope. With this instrument it was possible to measure the exact saccharin content of sugar. While its greatest use was in the purchase and sale of the raw product, it also proved helpful in establishing a uniform quality for all lower grades of refined sugar.

It was not simply that the sugar refining industry was structured like a competitive industry. More importantly, it behaved like a competitive industry. There was, at any given moment in time, a

—

95 People v. North River Sugar Refining Co.: Record, p. 54; see also H. Havemeyer, The Havemeyer Family, p. 119.
98 The polariscope, although invented by the French optician M. Soleil as early as 1846, had only gradually been brought into commercial use; see DeBow’s Review, 5 (1848): 357.
single industry price determined by the interaction of impersonal supply and demand factors. This industry price was based on the latest quotation for standard “A” sugar, as reported by the brokers themselves. The prices of lower-grade sugars were obtained simply by subtracting the usual differentials.

This industry price then became the basis for each refiner’s price and output decision. If he thought the market was growing stronger, he would try to obtain a better price for his sugar. Otherwise he would sell all he could at the current industry price. Sometimes, when the market weakened, he would have to accept a price below the last market quotation. In that case, his price soon became the new industry price.

If the price of refined sugar rose, the refiner would increase his meltings until the additional cost he incurred threatened to wipe out any additional revenue he might earn. If, on the other hand, the price of refined sugar fell, he would reduce his output. As long as the industry price was greater than the cost of raw sugar, labor, fuel, bone black, and other direct costs, the refiner would keep his plant going, even though he was not fully covering his overhead costs, including a return on the capital invested in the business. But if the industry price fell so low that he could not even cover his direct costs, he would then shut down the refinery until the price once more rose to profitable levels. During the winter months, when the Louisiana crop was being harvested, many of the less efficient, marginal refineries found themselves forced to suspend operations temporarily.

What was most significant about the sugar refining industry’s pricing behavior was the frequency with which the margin between raw and refined sugar changed. Since the price of raw sugar itself

99 See the early volumes of Willett & Gray’s Weekly Statistical Sugar Trade Journal, available only at the New York offices of Willett & Gray, Inc. Although the earliest issues still extant date only as far back as 1883, they nonetheless are indicative of the industry’s pricing situation several years previous to that. See also the testimony of Stursberg, Claus Doscher, William Havemeyer, and others, in United States v. American Sugar Refining Co. et al., pretrial testimony, 1912, and the testimony of Henry O. Havemeyer, in U.S. House Committee on Manufactures, Report on Trusts.

100 The importance of frequent price changes as an indication of competitive price behavior was first pointed out by Gardiner C. Means in a memorandum to the Secretary of Agriculture in 1934. The memorandum was subsequently published as Senate Document No. 13 under the title Industrial Prices and Their Relative Inflexibility (74th Cong., 1st sess., 1935), and has now been republished in a collection of Means’s essays, The Corporate Revolution in America. Unfortunately, this point has been somewhat obscured by the attacks on Means for asserting in the same memorandum that not only the frequency of price changes, but also the magnitude of price changes, is indicative of competitive price behavior. The latter point has been effectively refuted, on both theoretical and empirical grounds.
fluctuated continually as a result of various competitive pressures in that market, the margin between raw and refined sugar was the true guide to the refineries' pricing practices. That margin changed almost daily as each refiner sought, independently, either to increase his own sales by undercutting the market price or to raise his total sales revenue by forcing up the industry price. Any member of the industry might be the initiator of these price changes.

Finally, the performance of the sugar refining industry was what one would expect of a competitive industry. The high profits in the years immediately after the Civil War not only attracted new firms into the industry but also encouraged the existing refineries to expand their output. As a result of the increased supply of sugar, as well as of continued improvements in technology, the margin between raw and refined sugar gradually narrowed. Before the Civil War it had been approximately 5 cents a pound; by 1869 it had fallen, on the average, to 3.59 cents a pound. The decline then continued as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Margin (per pound)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1870</td>
<td>3.47¢</td>
</tr>
<tr>
<td>1871</td>
<td>3.21</td>
</tr>
<tr>
<td>1872</td>
<td>2.88</td>
</tr>
<tr>
<td>1873</td>
<td>2.55</td>
</tr>
<tr>
<td>1874</td>
<td>2.28</td>
</tr>
<tr>
<td>1875</td>
<td>2.22</td>
</tr>
<tr>
<td>1876</td>
<td>2.07</td>
</tr>
<tr>
<td>1877</td>
<td>1.62</td>
</tr>
</tbody>
</table>

Moreover, the industry continued to adopt more improved methods of production, thereby penalizing those refineries which failed to keep

101 See the early volumes of Willett & Gray's Weekly Statistical Sugar Trade Journal.
104 Wells, The Sugar Industry and the Tariff, p. 70. During the earlier period, from 1860 to 1869, when sugar margins were declining, wholesale prices in general, according to the Warren-Pearson index, rose from 93 to 151, using 1910-14 as the base period. During the latter period, from 1870 to 1877, when sugar margins continued to decline, wholesale prices fell from 135 to 106 on the Warren-Pearson scale. The secular decline in sugar margins would thus appear to have been independent of general wholesale price movements.
up with the evolving technology. Of the three or four firms that were forced to leave the industry each year, the majority were handicapped by out-of-date equipment. No major technological breakthroughs occurred such as those which had, in effect, created an entirely new industry shortly before the Civil War, but the improvement in production techniques was nonetheless steady. For example, the Havemeyer & Elder firm was able to increase its output substantially simply by curtailing the authority of its foremen and reducing the boiling time from 4 to 2½ hours. As a result of this and other improved methods, such as double filtration, the direct cost of refining fell from approximately 3 cents a pound during the Civil War to 1½ cents a pound in the decade and a half immediately following, even for an average refinery. Meanwhile, the most efficient firms were able to refine sugar for only ¾–¾ of a cent a pound.

Thus the sugar refining industry seemed to be performing in the manner that economists have predicted a competitive industry would perform—it passed along to consumers the benefits of improved production techniques and thus assured, in the economic sphere, the greatest good for the largest number. But even as the sugar refining industry was most clearly manifesting its competitive character, it was going through a series of convulsions which seemed to suggest that a competitive industry was inherently unstable, for the convulsions were themselves the product of that same competitive character.

108 Testimony of Lawson N. Fuller before the Lexow committee (New York, Legislature, Joint Committee to Investigate Trusts, Report and Proceedings, p. 449; hereafter cited as Lexow committee investigation, 1897).