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## Genesis of the Sherman Act

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Genesis of the Sherman Act

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# 024

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## Genesis of the Sherman Act

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### 1. Introduction

The half century following the end of the Civil War in the United States includes a remarkable number of major economic changes. In 1870, 53 percent of the work force was on farms; by 1920 this figure dropped to 27 percent. The corporation became the leading actor on the economic scene. In 1899, 65 percent of all value added in manufacturing originated in establishments owned by corporations; by 1919 this figure had risen to 88 percent. We have no data on this before 1899 but there are signs that the growth from 1870 to 1899 of corporations is even more dramatic. From 1865 to 1890, the price level seems to have fallen by about 30 percent. Nominal interest rates were slow to adjust and many debtors bore an increasingly heavy load of real debt. Farmers were sorely pressed. In the 1880's new forms of business enterprise began, the trusts, to link the actions of separate companies. In some cases these trusts were very profitable. It seemed obvious to many that these profits must be nothing other than the fruits of monopoly and its restrictions. Therefore, there arose a great clamor for new laws to handle these perceived problems. Despite the 50 percent decline in the real freight rate per ton mile from 1870 to 1887, in 1887 Congress passed the Interstate Commerce Act which established the Interstate Commerce Commission in order to regulate railroads and oil pipe lines but not water traffic. Three years later it enacted the Sherman Antitrust Act.

Economists had little to do with the debate on these Acts. This is most probably owing to the youthfulness of the economists who were later to achieve great prominence. In 1890, when the Sherman Act was passed, J. B. Clark was 43, Richard Ely was 36, Taussig was 31, E. R. A. Seligman

was 29, and Irving Fisher was 23. Of the economists still remembered to this day only David A. Wells, who was 62 in 1890, and a Professor at Harvard would seem to have had the prestige if so inclined to influence the legislation. It was not to their voices that Congress paid heed (if heed they ever pay to economists).

Despite the falling price level, high real interest rates and occasional severe depressions and panics, there was substantial economic growth. The population grew rapidly both by immigration and by natural increase. New industries such as electricity developed. The steel industry grew to international importance. The most conspicuous trust of all, Standard Oil, won control of nearly the whole oil industry and it got large profits. The relative price of oil fell and oil output rose. This should not cause complaints from the consumers of oil though competitors of Standard would not rejoice. Examination of price data shows that the prices of industrial products fell relative to the general price level from 1870 to 1890. It is difficult to explain the passage of the Sherman Act as a response to this phenomenon in order to protect the consumer interest.

Industrialization meant the introduction of machinery. Fixed costs became a far more important proportion of total cost than before. Prices had to be high enough to recover both the overhead costs and the out-of-pocket expenses. Short sighted pricing policies that took into account only the latter would destroy the incentive to adopt the least cost methods of production. Producers, investors, and the customers had to find arrangements that would enable a sharing of the costs in order to secure the benefits of the new technology. The effects of the new environment were painful for some. The Sherman Act was partly a device to reduce the pain by imposing constraints

on cooperation among competitors. Nor is this all. Depending on the nature of the cost conditions, some forms of cooperation are necessary in order to have an equilibrium at all. As the new technology enveloped the economy, the Sherman Act had the effect of bringing before the courts some of the most perplexing problems of conflicting effects on efficiency that result from the proper balance between competition and cooperation.

## 2. A Historical Review

Nothing is more difficult than to imagine what things were like in the past. Speaking for myself, events that occurred before I was 10 years old seem very remote and far less real than those in my adult life. There is a strong tendency to believe that what is has always been and will remain. It is hard to comprehend that many things now so familiar are actually very new and did not exist at all even a short time ago. This is not only true of material things, computers, television, radio, automobiles, airplanes, nuclear energy and antibiotics but also of economic institutions. The latter do not enter our daily lives in the same obtrusive way as television and yet these institutions are very important. Our present circumstances owe much to such commercial innovations. It is sobering to realize that corporations are a fairly recent phenomenon. Trade in shares of stock on the New York Stock Exchange did not exceed the volume of trade in bonds until close to the turn of the century. The first organized futures market in the United States was the Chicago Board of Trade which began around 1850. Railroads did not exist before 1830 and they were responsible for the development of many of the new economic organizations. Economics itself is a new science and its development coincides with the changing commercial environment. In order to understand the reasons for the passage of the Sherman Antitrust Act of 1890 and its closely related and equally important predecessor, the Interstate Commerce Act of 1887 we must try to imagine what the economy was like in the Nineteenth century.

Although modern forms of business organization probably originate in Renaissance Italy and the Netherlands, for our purposes Elizabethan England is the most important starting point. It was then that joint stock companies under royal charter began in order to trade with distant regions. The Russia

Company, the Turkey Company, Hudson's Bay Company, the East India Company and the Africa Company are the leading examples. Their owners invested their capital by purchasing shares of stock in these companies. Under prescribed conditions they could sell their shares. The owners had limited liability and got the profits or losses. It does not seem possible to explain the origin of these companies solely as the result of technological innovation in ships and ship building though this was undoubtedly important. Trade over long distances to remote areas was risky. Partly to limit their risk, individuals were unwilling to put more than a fraction of their wealth in these trading ventures. The joint stock companies should be seen primarily as devices for accommodating the preferences of their investors with respect to risk while raising the capital necessary to promise a reasonable chance of gain. It was not new that merchants would band together in order to finance voyages for profit. But these ventures would dissolve at the conclusion of the voyage. What is new about the joint stock companies is this. They had the intention of remaining in business forever. Indeed, one of them, Hudson's Bay Company exists to this day.

Two centuries later Adam Smith wrote with deep suspicion of joint stock companies. He regarded them as inefficient, avenues of monopoly profit, easily turned into schemes for defrauding investors, and subject to abuse for political purposes. He pointed out the conflict of interest between the owners and the managers and he did not believe that the former could have adequate protection except in those businesses which were routine and did not require managers to act with energy and initiative. Yet when he wrote the joint stock company was at the start of its most significant development which continues to the present day.

## 2.3

By the end of the Seventeenth century there were important joint stock companies in banking and insurance. The Bank of England, a private joint stock company was founded in the 1690's during the reign of William and Mary. It was then that the debts of the government of England were consolidated and trade began in the London money markets in Consols. There was also the reform of the coinage of England organized by William Locke and Isaac Newton who as Master of the Mint was knighted for his services (not for his contributions to physics). This is the time of birth of insurance companies. These companies that insured ships met at Lloyd's Coffee House in London, others wrote life insurance and still others, fire insurance. It is interesting to note that the latter also furnished fire fighting services to their clients and these private fire protection services did not become nationalized until the time of Adam Smith.

At this time each joint stock company needed its own charter from Parliament. It was no routine matter to get such a charter. Parliament had to approve each specific instance. It was not until about 1830 that Parliament enacted general requirements so that a joint stock company could come into existence by satisfying these.

Since the American colonies were English possessions until 1776, they were under English law. Divergence could develop after 1789, the birthdate of the United States. Early U.S. corporations built and operated canals and toll roads. Like the English companies there were US corporations in insurance and banking. In all of these cases, however, the authority to form the companies came from special acts of the state legislatures. There was no general enabling legislation in any state to permit the formation of a corporation until shortly after the passage of such a law by Parliament. With few exceptions,



notably the First and the Second Bank of the United States, the US Congress did not grant charters to joint stock companies.

The invention of the steam engine in the latter part of the Eighteenth century originated in an attempt to pump water out of mines at a lower cost. This invention was to have far reaching consequences. The most important in our story is the invention of the railroad. By the 1830's, railroads were operating in both England and the US. It is this industry that most clearly shows the beginning of the divergence between the way economy actually works and certain influential theories that purport to describe how it works.

The latter third of the Nineteenth century saw the start of a line of economic theory that eventually became a highly refined and mathematically sophisticated model of general equilibrium. For several reasons this theory has considerable influence on the practicing economist today, even those who are far removed from it in their daily work. First, this theory is the main source of the belief that prices alone convey enough information to firms and consumers so that the actions they choose which are optimal for their own purposes turn out to be mutually consistent and efficient for the economy as a whole. Second, this theory defines competition very simply. A state of competition is said to exist when no one, no firm and no consumer, can affect the prices at which it can make purchases and sales. Buyers face perfectly elastic supply schedules and sellers face perfectly elastic demand schedules. Third, monopoly becomes identified with the power to affect prices. There is a departure from perfect competition whenever the quantity that a buyer takes affects the terms of sale offered to him or when the quantity that a seller offers affects the price he can get.

Monopoly is an anomaly in the theory of general equilibrium. Although there were other influential lines of economic theory that had room for natural monopoly, monopoly was regarded as exceptional and therefore, required special policies to restrain it. In the theory of general equilibrium, profit maximizing goals by producers and utility maximizing by consumers leads to an equilibrium where the maximum profit is actually zero. But monopoly profits are positive and their acquisition stands as a temptation to competitors. So competition is a fragile flower that may not survive the profit seeking forces leading to monopoly. Walras, Pareto, Knight and their mathematically sophisticated descendants brought the theory of general equilibrium and perfect competition to its present state, regarded with awe by the practicing economist and taken as the ideal toward which the actual economy should be directed.

Cournot, Edgeworth, and Böhm-Bawerk laid the foundations of other approaches to economics which received a powerful new ally in the Theory of Games and Economic Behavior of von Neumann and Morgenstern. These alternative theories place powerful new tools in the hands of economists. With these tools we can come to grips with the task of analyzing the consequences of nonconvexities, indivisibilities, economies of scale, externalities, and rivalry among small numbers of firms.

The technology and cost conditions that prevail in a modern and highly industrialized economy such as the United States do not fit the theory of general equilibrium. Railroads, which constitute the first important instance of a modern industry, illustrate why this is so. One major economist was very well aware of this fact - J. M. Clark in his influential book Studies in the Economics of Overhead Costs (1923). Both the presence of substantial overhead

costs in railroads and the necessity of coordinating the operations of a railroad help explain why the neoclassical model does not apply.

The railroad industry exhibits the problem of obtaining the maximum efficiency by means of an optimal balance between cooperation and rivalry. The railroad industry faced, for example, the problem of the choice of the width of the railroad tracks. Initially, each railroad chose the size of its tracks on its own. When a shipment had to pass from the lines of one railroad to another, it was necessary to unload the freight from one train and reload it on another. The savings that would accrue from a common gauge soon became apparent. There was agreement among the railroads on a common gauge for their tracks (with some exceptions in the West). This illustrates how cooperation can raise efficiency. Even with a common gauge, the railroads had the problem of how to share the revenue from a shipment that passed over the tracks of more than one railroad. A shipment is a joint product of complementary inputs that are the sequences of starting and ending points from origin to the final destination. Nor is this all. Except on the most heavily traveled lines there is only a single track. One train can pass another only at points where there are sidings. Coordination is necessary to schedule the trains over a common route so that the slow freights do not interfere with the fast passenger trains. Another example is the problem of the empty box cars. The volume of freight going from west to east exceeds the volume going in the reverse direction. Empty freight cars must go from east to west. Who should bear the cost of moving the empty freight cars? Shippers all benefit from the use of a common track. The cost of the track, the signaling system, the sorting yards and the locomotive are common to all. How should the shippers share in the cost of these? Some shippers want occasional service while others

can guarantee a steady volume of business at regular intervals. These impose different costs that the railroad may wish to reflect in the rates they charge. It would be an error to regard the railroad industry as the exception to which the standard economic theory, which assumes a concave production function, continuous divisibility of inputs and outputs, and the like, does not apply. On the contrary, the railroad industry is the most conspicuous example of a large species in the modern economy. Economists in the late Nineteenth century such as J. B. Clark knew that legislative prohibitions against cooperation among the firms in an industry may well sacrifice lower costs.

This brief historical survey would be seriously deficient if it did not mention the growth of the factory system in the New England textile industry before the Civil War. It was water power and not the steam engine that explains the aggregation under one roof of the looms. These factories were still small enough so that the necessary capital could come from investors who knew personally the major owners who ran their own companies. A New Englander, Eli Whitney, well known for his invention of the cotton gin, is also responsible for the invention of substantially interchangeable parts used in the manufacture of firearms. This was an important stepping stone toward the assembly line and mass production. One should not underestimate the logistical difficulties of these methods of production. Much planning is necessary. Inventories of parts must be on hand so that production can proceed smoothly at a steady rate. Efficiency requires all sections of an assembly line operate at the same rate properly defined; otherwise the sections that can run the fastest are underutilized so that a bottleneck develops. The iron and steel industries grew to satisfy the demands of the railroads and other industries.

I doubt whether an economist living at the conclusion of the Civil War could have predicted in which industry there would appear the first systematic application of rational planning to secure the least cost no matter how much this would be at variance with prevailing practices. It was the oil industry. The Standard Oil Company was incorporated in 1870. It was preceded by a group of companies under the leadership of John D. Rockefeller who brought about astonishing reductions in the real price of oil and commensurate increases in output. It was not owing to new inventions and technology but to careful thought about organization and a logical analysis that today we might call operations research which is responsible for these real gains. There was vertical integration of the production of crude oil, refining, shipping and storage, including a transition from rail to pipeline, and marketing to the final consumer. By the 1880's nearly the whole oil industry came under the control of Standard Oil and its profits were very large. Standard Oil became a model for others because it demonstrated what new management practices could accomplish (Tarbell, 1904; Chandler, 1977).

Even in the late Nineteenth century, corporations were subject to many more restrictions than they are now. For instance, holding corporations were not allowed. This means that a corporation could not own stock in another corporation. New Jersey changed its laws of incorporations to remove this restriction in the late 1890's. The problem seems to be this. As a result of new technology, business firms encountered many new problems in their relations with each other and with their customers. The least cost methods of production required the substitution of fixed for variable inputs. It became more difficult to impute particular costs to particular sources of demand.

Pricing formulas had to be found so that suppliers, investors and customers could share the common costs. Companies sought new arrangements that would be flexible enough to realize the savings from new methods of production. In some areas competition would lead to lower costs while in others cooperation would do so. One approach did lay open to the firms. In order to obtain cooperation, one firm could buy another. This would create the problem of giving the managers of the new divisions resulting from these purchases and mergers a strong enough incentive to choose the most profitable actions. This is the difficulty facing a joint stock company that Adam Smith discusses. One with his own stake in the enterprise is more likely to combine the proper amount of prudence and daring than is an employee. Owners of independent firms who run their own business do have the proper incentives. The less able ones earn less and may not survive in competition with the more able. Let a corporation form by a merger of independent concerns and it faces the problem of how to preserve the advantages of independence and individual ownership while securing the benefits of cooperation. It was the chief counsel of the Standard Oil Company who hit upon a possible solution of this problem that seemed to conform with the prevailing laws. The trust was a well known device to manage estates left to their heirs by the deceased. Why not use the trust as a form for a legal alliance among the firms in an industry? This promised to give a flexible enough arrangement to secure the advantages of independent actions in some areas combined with the advantages of cooperation in other areas.

By the late 1880's there were many trusts and much public agitation against them. Some trusts seemed to be very profitable. The firms outside the trusts seemed to be much less profitable. The most conspicuous trust, Standard Oil,

was very profitable indeed. To the public and their elected representatives both the cause of the problem and its remedy were plain. The high profits of the trusts must result from their restraints of trade akin to the methods of monopoly though not equivalent to monopoly. The cure, therefore, is also plain. Pass a law against the trusts and restraints of trade under this or any other form. In July 1890 Congress passed the Sherman Antitrust Act almost by acclamation.

Three years earlier Congress had passed the Interstate Commerce Act in order to eliminate the main perceived abuses in the railroad industry. The purpose of this Act was not to prevent collusion among railroads or, as some would now have it, to render collusion easier. The language of the statute is plain. According to Johnson (1909, p.368) the purposes of the ICC Act were to prohibit unreasonable discrimination between local and through traffic, to prohibit personal discrimination among shippers so that different shippers of the same freight would pay the same rates, to require freight rates to be posted and to prohibit changes of the posted rates without prior notice of at least 15 days, to prohibit railroads from entering into the production or manufacture of the goods they carry, and to assert that only published rates were lawful. In addition, the railroads were prohibited from pooling freights or their aggregates or net earnings. The Interstate Commerce Commission, established by the Act, had no authority to set the maximum rates.

Many shippers complained of unfair treatment by the railroads. Among those complaining were farmers who had considerable political power, more then than now. Others as well, including firms in competition with Standard Oil, complained of unfair rail rates. For example, those who sent freight over a shorter distance sometimes paid more per ton-mile than shippers of the same

commodity over a longer distance. There were many complaints of discrimination. Not all shippers of the same commodity paid the same rate. Some shippers got rebates from the railroads. Standard Oil was the leading example. Not only did it receive lower rates on its own shipments but it also received rebates on shipments of its competitors' oil carried by the railroads. The main purpose of the ICC Act of 1887 was to eliminate some forms of apparent price discrimination. It was not to control the levels of railroad rates, to prevent entry or exit, to determine the amount, quality or nature of railroad services, to prevent abandonment of rail service, to force railroads to provide services or to do many of the other things that we have come to associate with the Interstate Commerce Commission. All of this came much later. For instance, the important aspect, namely, control over the actual level of freight rates, did not occur until more than 30 years after the passage of the Act.

It would be incorrect to argue that Congress passed the Sherman Act because of disappointment with the results of the ICC Act. A more plausible interpretation of the history is this. Both the ICC Act and the Sherman Act were parts of the same program. The former dealt with some of the abuses in one industry. Although it prohibited pools of revenues and shipments among railroads it did not touch directly the issue of collusion among them. The Sherman Act seems to be an attempt to secure the benefits of competition by making illegal all attempts to collude in all lines of commerce and industry including the railroad industry.

As Letwin (1965) points out, one must expect some time to pass before the Justice Department can bring cases to enforce new legislation. The Sherman Act was no exception. One must also recognize that a prosecutor, the Attorney



General and his deputies, play a dual role because they have both a quasi-judicial function as well as a plaintiff's function. This is partly because the Justice Department is subject to a budget constraint. Therefore, having received many complaints of violations of the Sherman Act, they must decide which few to prosecute. Although it would seem that the decision not to prosecute after having obtained the results of an investigation would indicate there was no violation of the law, this is a decision by the prosecuting attorney, not by a judge. In this way, therefore, the prosecutor acts as a judge.

For the first decade after passage of the Sherman Act, the Attorney General gave wide latitude and discretion to the U.S. District Attorneys. Only a few cases were brought during this period. Since the Act was a major innovation, this is hardly surprising. It was necessary for the lawyers in the Justice Department to study the probable scope of the Act. For instance, what kinds of commerce were subject to it? Did it apply to manufacturing in a single State or only to manufacturers whose products actually crossed State lines? As Bork (1978) points out, there are perplexing issues about what constitutes collusion. For instance, in a single law firm, the partners may decide who will deal with which kinds of legal problems. One partner may specialize in labor law and another in tax law. However, if separate law firms consistently referred certain types of clients to each other they would risk prosecution under the Sherman Act. It might smack of a market sharing agreement. If they could not do this as separate firms, could they do this after merger as a single firm? From the outset it became clear that the Sherman Act did not raise simple issues of black and white, good and evil. It brought before the courts some of the most difficult problems of economics.

The first important case that was to acquire landmark significance was the Addyston Pipe Case decided in favor of the government after appeal in the U.S. Circuit Court of Appeals in 1898. The decision of the Circuit Court, written by William Howard Taft who was to become President of the United States and later Chief Justice, reversed the decision of the U.S. District Court which had found in favor of the defendants.

The subsequent importance of the Addyston decision explains why it deserves our attention. Contemporary accounts suggests that its importance grew slowly with the passage of time. This case is instructive not only because of its legal status but also because it affords an opportunity to obtain a detailed look at an industry, high pressure cast iron pipe, that was typical of many others, especially in the iron and steel industry, of the time. It is also revealing about the nature of the collusion among the firms. I shall draw on the work in an unpublished doctoral dissertation by one of my students, Bittlingmayer (1981) (but see also his 1982 article). High pressure cast iron pipe was used to carry water to residences and business firms. Most buyers of this pipe are local governments and their agencies. A city, for example, would advertise specifications and solicit bids. The usual practice was to obtain sealed bids and award the contract to the lowest bidder. This led to an interesting problem which the firms in the business were soon to recognize. Unless the contract is awarded to the lowest bidder at a price just below the second lowest bid, a sealed bid auction does not give an efficient outcome. This is to say it does not replicate the results of an English auction. Since some of this may be unfamiliar, I shall digress and explain some of the results of theoretical analysis of auctions stemming primarily from the major contribution of Vickrey (1961).

The simplest way to explain what rules can make a sealed bid auction give an efficient outcome so that the least cost producer will get the business is to start with an analysis of an English auction. In an English auction, the bidders are competing buyers. If there is more than one bidder at the current bid, the auctioneer asks for a higher bid. He continues this process until the prevailing bid is so high that only one bidder remains. Now the sequence of bids goes up in prescribed increments known in advance to potential bidders. Suppose we are at a stage where there are two bidders willing to pay the prevailing bid, say it is \$100. The bids go up in, say, \$5 increments. Suppose the more eager bidder would be willing to go as high as \$120 while the less eager bidder places a maximum valuation on the commodity of \$110. The auctioneer asks whether anyone will bid \$105 and he sees two hands go up. So he asks whether anyone would bid \$110 and once more two hands go up. The next round of bids must be at \$115 and this time only one hand will go up. The successful bidder is the one who most values the object out of all of those present at the auction and he is able to buy it at a price of \$115 though his valuation is given by \$120 since this is the most he would be willing to pay for it. Observe that the most eager buyer does not generally have to buy the good at the highest price he would be willing to pay for it. He is able to buy it at a price equal to the second highest price plus an advance. Therefore, in a sealed bid auction he would be willing to reveal the highest price he would be willing to pay for the object in a sealed bid given to the auctioneer if he knew that the actual price he must pay equals the second highest bid plus an advance. This is to say that he would not always and inevitably be forced to pay a price equal to the highest price he would be willing to pay. Therefore, under such a rule

he would be willing to reveal to the auctioneer his true maximum price provided he had confidence in the honesty of the auctioneer. We may conclude from this analysis that under the rule whereby in a sealed bid auction the commodity goes to the highest bidder at a price equal to the second highest bid plus an advance, the result is that bidders have an incentive to reveal their true maximum valuation to the auctioneer and the buyer will be the one who values the good the most.

The situation is the same when the purpose of the auction is to determine which seller is willing to perform the work at the lowest price. In this case the optimal rule in a sealed bid auction is to award the contract to the lowest bidder at a price equal to the second lowest bid minus a prescribed decrement. However, if the contract goes to the lowest bidder at a price equal to his actual bid, then he will have a definite incentive to make his actual bid exceed the lowest price he would be willing to accept. No bidder has an incentive to submit a bid equal to the lowest acceptable price under this rule. The outcome of the sealed bid auction cannot be expected to be efficient. Thus there would be no assurance that the contract would go to the firm with the lowest cost. This implies a loss of efficiency for the economy as a whole.

This analysis applies to the Addyston Pipe Case. Contracts for cast iron pipe were awarded to the lowest bidder in sealed bid auctions at a price equal to the lowest bid. On its face, therefore, the outcome was inefficient. However, before the official sealed bid auction, the firms, the defendants in Addyston Pipe, held another auction. In this auction the firms bid for the business under the familiar rules of an English auction. Having discovered by this means which firm was most eager for the contract, the firms colluded

in the sealed bids offered to the municipality that was soliciting the bids. The lowest bidder was in fact the one decided by the prior auction among the firms themselves and the remaining firms all submitted higher bids. In this way the contract did go to the least cost producer but at a higher price than he would have been willing to accept. Nor is this all. The firm who got the contract shared the profits with the other firms in the cartel according to a formula based on their capacities. In this industry the collusion had two effects. It brought about efficiency in the economy. It forced the buyers of pipe to pay higher prices than had they adopted an English auction or an equivalent sealed bid auction.

The Addyston Pipe Case has more to teach us. It was only with respect to pricing that the firms colluded. The firms opened new plants, closed old ones, expanded and contracted the capacities of their existing plants and, in short, seemed to act independently in all respects other than pricing. It would seem, therefore, that the firms were more competitive than are the outlets in a typical franchise chain. The defense in the case included much testimony from the buyers of pipe, who stated that they had paid reasonable prices for the pipe. Taft laid down the rule that no prices arrived at by collusion are legal, whether or not they may be regarded as reasonable by the buyers. Though the Addyston Case was not the first to make price fixing an offense, the *Trans-Missouri Freight Association*, 166 U.S. 290 (1897) deserves this claim, it was a milestone on the road toward price fixing as a per se offense. This became definitive in the *Trenton Potteries Case*, 273 U.S. 392 (1927).<sup>1</sup> Once there has been a determination of a price fixing conspiracy, it follows inevitably as night follows day that there has been a violation of the Sherman Act and there is no defense.

After the decision by the Court of Appeals in February, 1898, which was upheld by the Supreme Court in November, 1899, a new firm was formed by merger of the six defendants in the case together with five other cast iron pipe producers who were not defendants in the case. Very soon after with the addition of still another nondefendent firm, there was born the U.S. Cast Iron Pipe and Foundry, which had 68 percent of total U.S. melting capacity in 1900. The six defendants in the case had 38 percent of the total 1900 U.S. capacity (Bittlingmeyer, 1981, Table 3.5). One year after the Court decision the new company, the result of a merger among 12 firms, could now legally do what was illegal when they were 12 separate firms. Since merger was a feasible and a legal but an unused alternative before the Court decision, there is a presumption that it is the less efficient alternative.

This was by no means the only merger. Between 1899 and 1902 there was in the United States a wave of mergers never to have been surpassed. According to Thorelli (1954), more than 60 percent of the market value of the firms listed on the New York Stock exchange were involved in mergers at this time. While this may include some firms who were involved in a sequence of mergers, there is little doubt that the total number of mergers is very large (Nelson, 1959, and Historical Statistics of the United States, 1975, Series V 38-40). The peak occurred in 1899. It would be premature to conclude that the Addyston Pipe decision was the direct cause of this peak. It is plausible nevertheless that the passage of the Sherman Act would have the result that the informal alliances among firms would need replacement by formal arrangements via merger. Formal marriage contracts replaced informal living together arrangements. We do have some evidence of an increase in mergers in Great Britain at this time

(Hannah, 1974), but this was not comparable in either scope or magnitude to the U.S. mergers. This still begs the question of why there was an increase in mergers in Britain at the same time as in the U.S. The most plausible explanation is an implication of the business recovery that took place in both countries at this time. There was a rise in the prices of equity shares in the stock markets of both countries. There is also a positive association between the number of mergers and the level of stock prices. So this empirical result would apply to the rise in mergers for 1899 to 1901. But the far larger increase in the number of mergers in the U.S. is more plausibly the result of the special circumstances in the U.S., namely, the Sherman Antitrust Act.

### 3. What Prices Can and Cannot Do

The price system can accomplish wonders, but is still subject to definite limitations. The formal problem of economic theory is to determine under what conditions there exists a set of prices such that individual firms will offer quantities that will maximize their profits at these prices, and their customers will be willing to buy these quantities at these prices. Moreover, the quantities the customers are willing to buy maximize their utilities subject to a budget constraint. In the theory of general equilibrium it is shown that all of these conditions can be satisfied if there are constant returns to scale for the whole economy and if individual consumers have convex preference sets (Debreu, 1959).

Given these conditions about the technology and the preferences, the theory of the core can furnish a result equivalent to that of general equilibrium. In the theory of the core we assume that individuals may form coalitions. They will not accept an outcome unless it is at least as good as the outcome they can get as members of some coalition. Consequently, the acceptable outcomes, the ones that are said to be in the core, cannot be improved upon. The theory of the core combines two important forces, competition and cooperation. Coalitions compete for members. It is this competition among the coalitions that determines the returns to the individuals. Simultaneously, within the coalition there is cooperation among the members in order to attain the goals of the coalition. The core is nonempty when it is possible to find a set of outcomes that can satisfy all of the demands imposed by the result of competition among all possible coalitions for members. Edgeworth (1881) was the first to apply the logic of this approach in his analysis of market exchange. Instead of coalitions, he spoke of contracts and



instead of forming new coalitions he spoke of recontracting. The outcomes acceptable to a group of traders in a market are on the Edgeworth contract curve. In the limit as the number of traders increases, the acceptable outcomes become more and more constrained until the only ones remaining are the competitive equilibria. If a competitive equilibrium exists, it must be in the core. Application of core theory to situations where it is known by other means that a competitive equilibrium exists, always gives outcomes in the core. There may be outcomes in the core even when the neoclassical competitive equilibrium does not exist. I maintain that in such cases it is the theory of the core that deserves precedence. This is because the theory of the core represents the forces of competition as they are present in the actual economy more closely than does the neoclassical theory. Indeed a nonempty core is a necessary condition for the existence of a neoclassical competitive equilibrium.

These results and the appeal of the inherent logic of the theory of the core led me to apply this theory to a variety of situations including many where the standard theory has nothing to say (Telser, 1978). One result is striking. Consider an industry with  $n$  identical firms so that each firm has the same cost function. Let marginal cost be an increasing function of the firm output rate and let average cost attain a unique minimum at some positive output rate. Average cost as a function of the output rate has a U-shape. This is the familiar case that Viner (1931) discusses, so I call these Viner industries. It turns out to have an empty core. Therefore, a Viner industry has no competitive equilibrium in the sense of the neoclassical theory. We can interpret the situation in which average cost has a minimum at some positive output rate to indicate the presence of overhead or fixed costs. The presence of such costs is not in itself sufficient to give an empty core. If the

### 3.3

production function for the industry is concave and exhibits constant returns to scale so that the long run supply curve is perfectly elastic, there will be fixed costs representing the inputs of capital and nevertheless the core is nonempty. To have an empty core it is sufficient that there be some positive lower bound for all firms in the industry. This is to say there is a minimum scale of operation applicable to all of the firms in the industry. Even so, if this minimum scale is small relative to the total demand for the product so the industry has room for a large number of firms, then, although the core is empty, the outcome is very close to a nonempty core. It is within epsilon of a nonempty core. Consequently, there is an approximation to a nonempty core that becomes increasingly better, the smaller is the minimally optimal scale relative to the total demand for the product. This is not to say there is virtue in an industry where there is a large number of firms. It does say that in such industries there is a close approximation to the conditions where the neoclassical theory does apply. The important point is this. When the minimal scale of operation is large relative to the total demand for the product, a neoclassical competitive equilibrium does not exist. In order to have the product made under efficient conditions that will best serve the interests of producers and their customers, some form of cooperation among producers and their customers is necessary.

An empty core means there does not exist constant-unit prices capable of giving an equilibrium. By constant-unit prices I mean prices at which individuals can buy or sell any amounts that they please. When equilibrium prices do not exist, it follows that prices alone cannot convey enough information to the participants, firms and their customers, so that the results which are optimal in the eyes of the individuals will also be efficient for the group

as a whole. Consequently, there is a conflict between optimality for individuals and coalitions and efficient outcomes for the whole group. Another way of making this point is as follows. When the core is empty, any outcome efficient for the group as a whole is objectionable to at least one coalition. When the core is not empty, there are outcomes efficient for the whole group acceptable to every individual and to every coalition. It is plain that an empty core represents a serious problem. It poses a conflict of interest between the group and some of its members. A nonempty core means there is a harmony of interest. An empty core signifies disharmony.

There are simple examples that can illustrate the nature of the difficulty. In order to demonstrate the relevant points with the least possible complication, the example is simple and appears unrealistic. The simplifications are for convenience. Making the example more realistic will not cause the problem to disappear. Those who wish to study the problem in more detail can read my book (1978, chaps. 2-4). Assume there are 2 sellers and 4 buyers. Seller 1, call him  $A_1$ , has a capacity of 2 and an avoidable cost of 5. This means he is willing to sell his 2 units for any amount greater than or equal to 5. If he sells nothing, he incurs no cost. Hence the cost is avoidable. It is the same whether he sells 1 unit or 2 units. We may think of the sellers as airplanes so that the capacity gives the number of passengers they can carry. The avoidable cost represents the cost of flying the airplane from the origin to the destination and this cost does not depend on the number of passengers on the plane. It only depends on the flight distance. If the plane does not make the trip, it incurs no cost. The second seller,  $A_2$ , has a capacity of 3 and an avoidable cost of 7. Each buyer is willing to pay at most 3 per unit and each wants to buy at most 1 unit. The efficient outcome is for  $A_2$  to sell 3 units

to the 3 buyers and for the first seller,  $A_1$ , to sell nothing. Let  $x_i$  denote the return to seller  $i$  and let  $y$  denote the gain to a buyer. The gain is the difference between the maximum amount the buyer is willing to pay and the amount he does pay. The core constraints are as follows:

$$x_1 + 2y \geq \text{Max} \langle 5, 2 \times 3 \rangle = 6;$$

$$x_2 + 3y \geq \text{Max} \langle 7, 3 \times 3 \rangle = 9;$$

$$x_1 \geq 5;$$

$$x_2 \geq 7;$$

$$y \geq 0;$$

$$x_1 + x_2 + 4y \leq \text{Max} \langle 7 + 2 \times 3, 5 + 3 \times 3 \rangle = 14.$$

The first 2 inequalities represent possible arrangements between each of the sellers and enough buyers to use up the whole capacity of the seller. Thus, the first constraint is a coalition between  $A_1$  and the 2 buyers. No final outcome would be acceptable to these 3 individuals unless the total exceeds 6 because they can assure themselves of this amount no matter what the others may do. The right-hand side of the first inequality represents the security value of the coalition consisting of  $A_1$  and any 2 of the 4 buyers. The interpretation of the second inequality is the same. The next 3 inequalities represent the lower bounds on what is acceptable to an individual. Since the avoidable cost for  $A_1$  is 5, he would not accept any return that is below 5. The same argument applies for  $A_2$  whose avoidable cost is 7. Since the buyers may refuse to buy anything, their net gain must be nonnegative so  $y \geq 0$ . The last inequality represents the feasibility constraint. The left side of this equality gives the sum of the outcomes for all of the buyers and sellers. The right side gives the maximum attainable outcome. This maximum occurs if  $A_1$  sells nothing and  $A_2$  sells

3 units. It is not hard to verify that these inequalities have no solution so the core is empty. It is useful to explore the reasons for the empty core.

Observe that in order to attain the maximum, 3 of the 4 buyers can make purchases. It follows that the price must be high enough so that it becomes a matter of indifference to any potential customer whether he actually can make a purchase. This is to say that the net gain to all of the buyers must be 0. This implies the price would have to be 3 so that  $y$  could be 0. But then  $A_1$  would be willing to offer 2 of the potential customers a lower price since  $A_1$  and any 2 of the buyers can assure themselves of a return of 6. In fact  $A_1$  could offer the buyers a price of 2.5 so each could have a gain of  $1/2$ . But this would not be compatible with the efficient outcome. Indeed, having lost 1 customer under this arrangement,  $A_2$  could offer a still lower price of  $2 \frac{1}{3}$  giving each customer a gain of  $2/3$ . But even if  $A_1$  gets 5, and  $A_2$  gets 7, it would not be feasible to give all 4 of the potential buyers a gain of  $2/3$  each. In short, there is no way of satisfying all of the core constraints in this example by means of constant-unit prices. It would be possible to have an efficient outcome if  $A_1$  were prevented from making any sales. More generally, for the kind of cost and demand conditions of which the example is a special case, an equilibrium is possible either if all of the sellers act collectively, so there is monopoly, or if all buyers act collectively, so there is monopsony. Some restrictions are necessary on the individuals' freedom to form coalitions, which is equivalent to restrictions on the amount of competition, in order to have an efficient equilibrium.

The conclusion that the core is empty remains valid if not all the buyers are alike, the sellers have costs that vary with their output rates as well as

avoidable cost, if there are fixed costs, if demand is subject to random variations, and if the capacities and avoidable costs of the sellers are chosen in advance in order to satisfy ex ante expectations about levels of demand. What is crucial is the presence of costs akin to the avoidable costs. This is to say there are costs depending on firm capacities but not on actual output rates such that the firms incur these costs only if they have positive output rates, but not otherwise. In the presence of such costs, unrestricted competition among all buyers and sellers leads to an empty core.

This theory helps explain the nature of the arrangements among the firms in the cast-iron pipe industry. As Bittlingmayer's analysis shows, the cost conditions in this industry imply an empty core so that some forms of cooperation among the firms in this industry was necessary in order to operate at the least total cost. When as a result of the Courts' decisions informal arrangements became illegal, the firms turned to merger as the second best route to efficiency.

#### 4. Conclusions

The nature of economic organizations changed in response to the industrial revolution. Large scale, highly mechanized and intricate methods of production required new ways of organizing economic activities. In the United States the most important new economic actor on the scene was the corporation. Under its aegis there arose new methods of finance for the means of production and new pricing formulas that would allow a proper sharing of the costs and benefits of the new technology. There also arose a tension between the benefits of cooperation and the benefits of competition. Cooperation can be a means of attaining efficiency for the economy as a whole. Competition can become excessive and reduce the efficiency of the economy. The Sherman Act was seen initially as a means of preserving the benefits of competition by imposing legal barriers to cooperation among independent companies. But the practical problems in the real economy forced recognition of the cost in terms of efficiency that results from excessive competition. This point of view is gaining support among economists who use the tools furnished by the theory of games. In particular, the theory of the core enables us to study a wide variety of cost conditions beyond the reach of neoclassical economics. By so doing we can discover the limits of simple pricing systems. The existence of an equilibrium requires cooperation among the firms and constraints on competition under cost conditions that are common in a modern, complicated economy. From this point of view, the Sherman Antitrust Act may be regarded as a conservative reaction to the new economic forces that threw into the courts some of the most difficult problems arising in a modern economy.

## NOTES

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1. I owe this account of the history of price fixing as a per se offense to Frank Easterbrook.



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