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**UNITED STATES v. UNITED SHOE
MACHINERY CORPORATION:**

ON THE MERITS*

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United States v. United Shoe Machinery Corporation:

On the Merits*

I. Introduction.

Although *United States v. United Shoe Machinery Corporation*¹ ranks among the most famous of antitrust cases, the economic principles involved in the dispute have remained obscure. The most prominent economic issues have been the role of leasing as a solution to the durable-goods-monopoly problem, and the exclusionary potential of specific lease provisions. Of these, the durable-goods-monopoly rationale appears to have gained the greater acceptance among economists--an occurrence due in no small part to Chicago arguments challenging the logic of anticompetitive exclusion.²

Two developments, however, have stimulated renewed interest in United's motives and the overall merits of the case. The first was the realization that the duration of United's leases was inconsistent with the durable-goods-monopoly argument. Whereas short-term leasing facilitates monopoly pricing of durable goods by curbing the monopolist's temptation to cut prices to successive customers, United's leases were originally seventeen years in duration and were subsequently shortened (first to ten and later

¹110 F. Supp. 295 (D. Mass. 1953), affirmed; 347 U.S. 521 (1954) (hereafter cited as District Court Opinion).

²The Chicago views were developed by Director and Levi, Bowman, Posner, and Bork. Director and Levi argued in 1956 that exclusionary practices tended to be unprofitable because it is costly "to impose additional coercive restrictions on ... suppliers." Aaron Director & Edward Levi, "Law and the Future: Trade Regulation," 51 Nw U. L. Rev. 281 at 292 (1956). Bowman argued in the same year that Kaysen's analysis of United was flawed because, if customers preferred leases of shorter duration and less restrictive elements, they would have been willing to pay a premium. Ward S. Bowman, "Review of 'United States v. United Shoe Machinery Corporation, An Economic Analysis' by Carl Kaysen." 66 Yale L. J. 303 (1956). Posner cited United to illustrate his claim that suppliers must compensate customers for exclusionary contract provisions: "[C]ustomers of United would be unlikely to participate in a campaign to strengthen United's monopoly position without insisting on being compensated" Richard A. Posner, *Antitrust Law: An Economic Perspective* (1976), 203. Bork criticized the court's reasoning that United's practices could be anticompetitive without being predatory and concluded conversely that, in the absence of predatory behavior, the presumption must favor efficiency. Robert H. Bork, *The Antitrust Paradox* (1978). Bork, like the others, did not attempt to provide an affirmative efficiency explanation for the practices, however.

to five years) only at court direction.³ Second, new theoretical models have overcome the logical hurdle to exclusionary claims by demonstrating that exclusion may indeed be profitable despite the need to compensate customers or suppliers for the resulting loss of competition.⁴ If claims of anticompetitive exclusion cannot be rejected a priori, then lease terms and other contractual provisions that limit rivals' access to markets must be evaluated on their merits.

In this paper, we offer what we believe to be a tenable efficiency defense of United's practices against the charge of anticompetitive exclusion. Specifically, we argue that leasing served as an alternative to contractual warranties for assuring the quality of machines and as a way to foster the provision of a range of manufacturer services and information in support of the productive use of that equipment. Shoe machines were remarkably complex and heterogeneous instruments, costly to develop and prone to failure. The efficient operation of a shoe factory required a large number of these complex devices and an assortment of services that included guidance on the selection and configuration of shoe machines, training in their operation, timely and effective repairs, and the dissemination of technical advice on shoes and shoe manufacturing generally. The complexity of shoe machines and of related services would have left conventional contractual arrangements hopelessly incomplete and susceptible to conflicts. By making the proceeds from machinery transactions contingent on the retention and use of

³As originally expounded by Coase, buyers of durable goods will be reluctant to pay monopoly prices initially without a guarantee that prices will not be lowered in the future. Ronald Coase, 15 "Durability and Monopoly," 15 *J. of Law & Econ.* 143 (1972). Leasing offers such an assurance insofar as the manufacturer, by retaining ownership rights to the existing stock of capital, will bear some of the losses from additional production and distribution. The size of the manufacturer's losses, however, is inversely related to the length of the lease contract. Hence, shorter term leases offer more effective guarantees to buyers than do longer term leases. The inconsistency between the theory and the duration of United's leases has been previously noted by Victor P. Goldberg, "The United Shoe Machinery Leases" (undated manuscript); and John S. Wiley, Eric Rasmusen, & J. Mark Ramseyer, "The Monopolist that Leases," 37 *UCLA Law Rev.* 693 (1990).

⁴Specifically, Phillipe Aghion and Patrick Bolton show how a firm can profit from exclusionary practices despite the need to compensate customers for agreeing to exclusionary terms if the contract can be structured to extract economic rents from third parties, either potential rivals or future customers. Phillipe Aghion & Patrick Bolton, "Contracts as a Barrier to Entry," 77 *Am. Econ. Rev.* 388 (1987).

machines, leasing promoted the supply of quality machines and the generation and dissemination of nonpatentable innovations and knowhow without the need for comprehensive contracting.

The importance of innovation and knowhow to sustaining efficient production in the shoe industry also underlay the long term and exclusionary features of United's leases that were the central component of the government's complaint. Specifically, the government cited three provisions of United's leases for their exclusionary effect: (i) return charges due upon termination of a lease, (ii) minimum monthly usage charges on machines subject to per unit payments, and (iii) the "full capacity" clause that required lessees to "use the machine to its full capacity upon all shoes upon which the machine is capable of being used."⁵ Combined with the long term of the leases, these provisions can be justly interpreted as impeding adoption of competitor machines. The relevant question, however, is whether the impediments they created were excessive in relation to organizational problems encountered in the industry. We argue, to the contrary, that the duration and restrictive features of United's leases established appropriate incentives to retain and use machines and, in particular, were necessary to prevent customers from attempting to escape paying for information and services from which they had already benefitted and that could be profitably used with competitors' machines. More broadly, we contend that the structure of United's leases reflected the desire of transactors generally to economize on the costs associated with governing exchange and resolving disputes.

Our investigation has two advantages over recent studies by Victor Goldberg and by John Wiley, Eric Rasmusen, and Mark Ramseyer that also explore efficiency rationales for United's practices.⁶ First, although each suggests plausible efficiency justifications for leasing durable goods, neither attempts to reconcile their rationales for leasing with the specific provisions of United's leases. Second, these studies

⁵Civil No. 7198, District Court of Massachusetts, Filed 15 December 1947, 30 (hereafter cited as Complaint). The government also objected to United's practice of providing repair services without separate charges.

⁶Goldberg and Wiley et al., supra note 3.

also fail to account for United's selective use of leasing and pricing arrangements. Of the 342 machines United offered at the time of the case, only half were available on lease-only terms. Of those, half levied charges on a per-operation basis while the balance relied exclusively on monthly rental fees. A satisfactory theory should generate testable hypotheses regarding United's pricing and leasing policies as well as explain the important elements of the overall structure of its leases.

We begin in the next section with a description of the nature of the intermediate market for shoe machines. Then, in section III, we present two efficiency motives for leasing in such circumstances, discuss what form such leases should take, and present testable hypotheses regarding the use and structure of United's leases. Section IV contains econometric evidence that United selected the terms under which it offered its machines systematically to reflect these incentive considerations. A more thorough examination of the details of United's leases and their implementation shows United's practices to be broadly consistent with the efficiency arguments we present. Sections V and VI offer brief discussions of the practices of United's predecessors and competitors and of the aftermath of the case. We conclude with some observations on the implications of the United decision and on public policies toward exclusionary contracts generally.

II. An Industry Primer

The organizational problems encountered in the market for shoe machines trace ultimately to the nature of shoes and of shoe demand.⁷ From a mechanical standpoint, the most distinctive features of shoes are their complex shape and extreme heterogeneity. To accommodate the intricate curves and irregular surfaces of shoes, shoe machines had to perform complex motions in multiple spatial planes--

⁷The court record provides considerable detail on the nature of shoe production and the services provided by shoe machinery manufacturers. Following an extensive review of these facts, Judge Wyzanski questioned "not the accuracy, but the relevance of the generalizations." District Court Opinion, supra note 1, at 300-302, 329-332. See also, Carl Kaysen, *United States v. United Shoe Machinery Corporation: An Economic Analysis of an Antitrust Case* (1956).

actions that required major advances in machine technologies. At the same time, these machines had to be easily adjustable to the variety of styles, sizes, materials, and constructions in or of which shoes were made. There were at least 18 principal methods of producing a shoe,⁸ each of which entailed between 150 and 200 operations.⁹ Although wood, fabrics, and later rubber were also employed, the principal raw material remained leather, which varied almost continuously in its thickness, strength, and flexibility. To provide an approximate fit to feet of varying dimensions, shoe manufacturers normally produced over 100, and often over 200, size-width combinations for each shoe design, the attributes of which varied, in turn, with both function and fashion.¹⁰ Accordingly, shoe machines, unlike other manufacturing equipment of the period, could not be designed for repetitive operations on large, homogeneous lots. Rather, "[t]he machine-type performing each operation, though a special tool from the point of view of the operation performed, [had to] be a general tool in relation to each shoe in process requiring the operation."¹¹

The reliability of these complex devices was a critical concern to shoemakers. Shoe fashions were inherently unpredictable and transient. As a result, retailers initially placed orders for new styles in small volumes. Shoemakers were then expected to deliver repeat orders of successful styles on short order.¹² Delays in delivery implied missed sales opportunities and could lead to cancellations of orders.

⁸Request for Findings of Fact of the United Shoe Machinery Corporation in the District Court of the United States for the District of Massachusetts, 24 (hereafter cited as *United Facts*).

⁹"On Their Toes," *Baron's*, September 28, 1959, 3, 3; "Footwear's Desperate Drive for Productivity," *Business Week*, June 10, 1972, 68, 68. Approximately half of the operations to produce a shoe were performed by hand.

¹⁰*United Facts*, supra note 8, at 37.

¹¹*Id.* at 47.

¹²*Id.* at 38.

In addition, the failure of one machine could disrupt operations throughout a plant, idling both labor and other machinery.¹³

Surmounting the technical problems associated with designing machines capable of reliably performing the varied and intricate operations of producing a shoe required "advanced engineering skill, familiarity with the problems of shoe-making, and generally, prolonged expensive research,"¹⁴ to which endeavors United devoted considerable resources. At the beginning of 1950, United had 572 employees engaged in research on shoes, materials, machines, and processes and had spent approximately \$4.3 million on research during the preceding year. The only machinery manufacturer with a larger research laboratory was General Motors.¹⁵ Over the fifteen years or so leading up to the case, moreover, United had trained all of its own inventive talent.¹⁶ Its research and development efforts made it one of the five largest patent holders in the United States.¹⁷

The result of those efforts was the development of a large number of complex and interdependent machines, the productive use of which depended heavily on the initial provision and continued flow of a range of supplementary services. In 1948, United offered 342 types of machines, of which a shoe manufacturer would need from 37 to 100 to perform the operations required to produce a shoe.¹⁸ The efficient combination and arrangement of those machines varied depending on the manufacturing process adopted, the type and quality of shoes being produced, the scale of production, and the skills and

¹³According to United, production interruptions often led to "cancellations of orders, tying up of inventories, and strained labor relations." *Id.* at 48. Also see District Court Opinion, supra note 1, at 302.

¹⁴District Court Opinion, supra note 1, at 302.

¹⁵Kaysen, supra note 7, at 152.

¹⁶District Court Opinion, supra note 1, at 330.

¹⁷In addition, United devoted much of its research effort to improvements in existing machines, many of which were not patentable. Kaysen, supra note 7, at 171-76.

¹⁸District Court Opinion, supra note 1, at 314; and United Facts, supra note 8 at 42.

experience of employees.¹⁹ Identifying the best techniques and most productive combination and configuration of machines, and training the work force in their proper use and maintenance, demanded extensive knowledge of both shoe machines and manufacturing.

Once in operation, shoemakers were also in frequent need of advice on problems encountered during the course of production. This advice, which often had "little or nothing to do with any individual machine," included "the application of broad know-how along shoe making and manufacturing lines" and involved, in addition to technical advice on machine operations, "the analyzing of problems, whether arising from styles, materials, constructions, labor skills or any one of many factors[,] and the giving of expert advice and assistance to help the manufacturer to make more and better shoes at lower cost."²⁰

Finally, despite extensive efforts to improve reliability, the tasks expected of many shoe machines were so complicated that malfunctions were inevitable.²¹ When a breakdown did occur--the incidence of which increased during peak demand periods when machines were most intensively used--shoemakers wanted rapid and effective repair services. To meet those demands, a servicer had to have a comprehensive knowledge of both shoe machines and their interactions. Although malfunctions were often the consequence of parts wear or breakage on a particular machine, failures also resulted from defective materials or work performed by a machine or operator earlier in the manufacturing process.

¹⁹United Facts, supra note 8, at 25.

²⁰Brief for Appellant, Appeal from the United States District Court for the District of Massachusetts to the Supreme Court of the United States, 191 (hereafter cited as Appeal). United divided its services into four general categories. In addition to the application of general shoemaking knowhow, United listed three other types of service "essentially related to specific machines" that consisted of "the installation of new United machines, the instruction of operatives in their use, and their subsequent repair, maintenance, and adjustment" Id. at 192. Note that while installation and repair are specific to individual machines, machine layouts and training in the operation of a machine provides knowledge generalizable to similar equipment of other manufacturers.

²¹"No matter how skillfully designed, these complicated machine types will require frequent service." District Court Opinion, supra note 1, at 302.

Repairs that did not treat the ultimate source of the breakdown would lead to recurrent failures and repeated delays.²²

The parties best situated to provide the services auxiliary to shoe machinery were the machine manufacturers themselves. Much of the expertise needed to use and repair machines arose as a byproduct of their engineering and manufacture.²³ Repair activities, in turn, provided an important source of feedback on machine and manufacturing problems and on developments in shoe styles and constructions that aided in the improvement of existing machines as well as in the development of new machines and shoe production processes.²⁴ Hence, the production of shoe machinery and associated services exhibited significant scope economies grounded in the knowledge necessary to design, manufacture, and support machines.²⁵

In both the scope of services it offered and its size, United dominated the industry. To satisfy shoemakers' needs for information and service, United developed and maintained, in addition to its machine engineering personnel, a sizable staff of experts on the problems of shoe production. Its Planning Department offered assistance "to shoe manufacturers desiring engineering surveys on production methods, on costs, on factory layouts, and other matters,"²⁶ while its Shoe Ex Department

²²United called its ability to trace the source of failures throughout the shoe manufacturing process its "most important service." United Facts, supra note 8, at 49.

²³United discussed at length the sources of its expertise and the advantages of its breadth of experience relative to shoemakers in developing and maintaining a stock of knowledge on the manufacturing of shoes. Appeal, supra note 20, at 204-206.

²⁴United kept extensive records of machine breakdowns and problems. See District Court Opinion, supra note 1, at 323.

²⁵There also appeared to be economies of convenience for shoemakers in dealing with a single provider of a wide range of related products and services. See District Court Opinion, supra note 1, at 340. As Teece has noted, problems in the transfer of knowhow rather than joint-production economies per se determine whether production should occur within a single organization. David Teece, "Economies of Scope and the Scope of the Enterprise," 1 J. of Econ. Behavior & Org. 223 (1980).

²⁶District Court Opinion, supra note 1, at 322. Also see United Facts, supra note 8, at 238-241.

existed solely to tackle difficult shoemaking problems encountered by its customers. To meet repair needs, United kept an inventory of 107,000 types of spare parts²⁷ and maintained a staff of 1500 employees in 16 branch and 29 sub-offices in 17 states responsible for keeping its machines in good working order.²⁸ Of these, 828 were "roadmen" who, in addition to repairing machines, installed new machines, instructed operators in their use, and, when asked, would "give expert advice on how to improve the quality of shoe production, give help in various technical shoemaking and shoe factory problems, and, in general, [be] available for all sorts of counsel and cooperation."²⁹

United was also the only manufacturer offering a full line of shoe machines. Yet, despite an average market share of approximately 85%, potential competition plus a sizable group of active competitors limited United's ability to exercise market power. In 1947, United faced a competitive fringe consisting of more than 80 firms, including 22 known competitors for its major machines.³⁰ Competitor machines, moreover, were available for all essential steps in the shoe manufacturing process.³¹ An indication of the depth of United's concern with competition from rival machinery was its efforts to keep track of that machinery; at the time of the case, United had about 76,000 so-called Outside Machine Reports in its files, detailing the installation, use, and removal of non-United machines in its customers factories.³² Evidence that this competition prevented United from exercising market power is its apparent failure to capture the substantial value created by shoe machines. Although labor savings from

²⁷United Facts, supra note 8, at 313-14.

²⁸District Court Opinion, supra note 1, at 322.

²⁹Id. at 322.

³⁰Kaysen, supra note 7, at 52-53.

³¹District Court Opinion, supra note 1, at 339. Of the 1460 shoe firms operating 1650 factories in the U.S., approximately 1220 were United customers. Hence, at least 240 firms produced shoes in the U.S. without United equipment. Kaysen, supra note 7, at 27; District Court Opinion, supra note 1, at 322.

³²District Court Opinion, supra note 1, at 303-4, 332.

the mechanization of shoe production were enormous, shoe machinery costs represented only about 2% of the wholesale price of a shoe.³³ Consistent with this, the court found "no evidence that United has secured a monopoly profit on its total operations, or on the machinery branch as a whole."³⁴

In sum, the shoe machinery industry was one in which research, information, and service were paramount.³⁵ Despite United's conspicuous dominance of the market, the availability of numerous complex yet dependable machines and the efficient provision of a range of supplier services--rather than United's monopoly power--were shoemakers' foremost concerns.³⁶ Testifying in court, an officer of Compo, United's main rival, stated, "The shoe machinery manufacturing industry is really a service industry....When a shoe manufacturer leases a Compo machine, he becomes the beneficiary of a service system which is made up of the skills, 'know-how', knowledge and experience of the whole Compo organization whose primary business is to see to it that he is successful in making cemented shoes."³⁷ The organizational problem confronting the industry was how best to assure that that knowhow and experience would be efficiently applied to the development, manufacture, and support of shoe machinery.

³³District Court Opinion, supra note 1, at 340. To produce a thousand men's welt shoes a day without the aid of shoe machinery would have required roughly a thousand skilled craftsmen. With a full line of shoe machines, the same number of shoes could have been produced with between 50 and 60 workers. Improvements in shoe machinery since United's formation in 1899 alone were estimated to have reduced the number of workers needed to produce a given number of shoes by 35%. United Facts, supra note 8, at 428. Labor costs, by comparison, accounted for approximately 25% of the wholesale price of a shoe at the time of the case. Id. at 35.

³⁴Id. and 325.

³⁵According to Kaysen, less than 20% of United's machinery expenses reflected manufacturing costs, with research, service, distribution, and administrative activities accounting for approximately equal shares of the remainder. Kaysen, supra note 7, at 118.

³⁶According to Kaysen, "As seen by the shoe manufacturer, United's activities are clearly benevolent. The testimony of 15 shoe manufacturers, representing a wide variety of firms in terms of size, location, types and price of shoe manufactured, and general history, leaves no doubt of this. The testimony occupied some 900 pages of the transcript, and nearly the whole of it shows that the shoe manufacturers consider themselves well and cheaply served by United." Kaysen, supra note 7, at 202. Also, see testimony cited in United Facts, supra note 8, at 230-41.

³⁷Appeal, supra note 20, at 224.

III. A Belated Defense

As stated in the introduction, a satisfactory explanation of United's leasing practices should account for both United's selective use of leasing and the overall structure of its leases. We begin this section with a discussion of leasing's dual roles in fostering the provision of quality machinery and the dissemination of knowhow, and then consider how these functions of leasing interact with the design and restrictiveness of lease agreements.

A. A Comparative Analysis of Leasing

1. Why lease? Leasing offers two distinct, albeit related, benefits:

(i) Assuring machine quality. When the prospective reliability and other performance attributes of complex, durable goods are difficult to discern at the time of purchase, outright sales pose well-known moral hazards problems. Receiving payment up front, a manufacturer has no interest, beyond its reputation, in the ultimate performance of its product.³⁸ A common solution to the durable-goods-quality problem is for the manufacturer to warrant the product.³⁹ But warranties are fundamentally contractual obligations and, as such, face the same obstacles in formation and enforcement as contracts

³⁸ On the role of reputation in contracts generally, see Benjamin Klein and Keith B. Leffler, "The Role of

generally.⁴⁰ Aside again from reputational considerations, a manufacturer's only incentive to honor its warranty is the legal sanctions a dissatisfied customer can bring to bear. The larger the cost of meeting its contractual obligations, the greater the incentive to evade performance. Where the product and its associated environment are complex, the difficulty of exploring contingencies, allocating responsibilities, adjudicating disputes, and crafting effective remedies is likely to undermine the utility of contractual guarantees.

Leasing offers an alternative to the double-edged sword of contractual guarantees.

practical limitations associated with contractual warranties. In particular, by affording the customer the threat of terminating the exchange, leasing makes the proceeds from machinery transactions contingent on the realized value of machines. The prospective loss of revenues on current (as well as future) transactions provides manufacturers the incentive to keep machines operational ex post and, knowing this, to develop quality machines ex ante.⁴¹ More importantly, leasing makes the incentives to develop and support quality machinery largely self-enforcing and thus avoids the practical limitations of contractual guarantees. As long as nothing in either the contract or the nature of the transaction prevents it, a

returning the machine.⁴² In effect, leasing transforms the transaction from the discrete sale of durable machines to the continuous sale of instantaneous machine services.⁴³

(ii) Contracting for knowledge. Leasing may also serve as a practical means of motivating the development and provision of expert advice where direct contracting for the transfer of information is infeasible. The problems of selling information where the customer does not know the value of the information beforehand are well-known.⁴⁴ But even where the potential value of a supplier's information is understood, the customer may be unable to determine whether the information and advice actually obtained was the best the supplier had to offer and would almost surely be unable to prove the contrary in court. Answers to questions such as 'Was the instruction of operators as conscientious as it should have been?' and 'Were engineering surveys thorough and machine layouts the best feasible?' are known ultimately only to the provider of the information. As a result, contractual assurances may do

⁴²Leases would have to leave the right to terminate the lease largely unconditional to avoid introducing the prospect of litigation. Generally, the fewer the restrictions on returns and the shorter the lease term, the stronger the incentives to produce quality products. On the length and structure of United's leases, see below.

⁴³The advantages of leasing could not, moreover, be replicated by selling machines with service contracts that made payments for service contingent on the performance of machines. Examples are service contracts for copiers and laser printers that charge for service on a per copy rather than per visit basis. Specifically, service calls are made free of charge for the duration of the contract, which is specified in terms of a total number of copies. The contract is more likely to be renewed and will be renewed sooner if the service firm promptly and effectively repairs machines so that machine output is not interrupted.

Sales with service contracts and leasing differ in evasion incentives, however. To replicate fully the incentives of leases, manufacturers would have to provide machines (virtually) free and collect compensation exclusively through cancelable charges for service. Under such terms, however, a customer who discovers that he has received a high quality machine will wish to cancel the contingent payments to avoid paying for the machine, to which the manufacturer would have no effective recourse. Alternatively, a sale that capitalized a large part of the expected value of a machine in an initial payment (with correspondingly lower contingent payments) would invite the manufacturer to produce poor quality equipment and either deteriorate service or contrive cancellation of the contract by claiming customer mistreatment of the assets. Whereas the only recourse available to disputants under a service contract is litigation, leasing relies on self-help. Specifically, under leasing, the manufacturer has the unilateral option of retrieving and the customer of returning the machine if the other behaves opportunistically. Attempts to structure installment contract sales to mimic leases would pose similar problems.

It is possible that the existence of sale and service contract arrangements are at least partly the byproduct of antitrust challenges to manufacturer leasing of durable goods.

⁴⁴See Kenneth Arrow, Essays in the Theory of Risk Bearing (1971), 152; Oliver E. Williamson, Markets and Hierarchies (1975), 31-33; and Teece, supra note 25.

little to guarantee a machine manufacturer's complete and enthusiastic conveyance of its expertise and knowhow.

If the value of information received is correlated with some measurable index such as the output of the firm, compensating suppliers for the provision of information as a function of that index has desirable properties.⁴⁵ Thus, to the extent information contributes to the success of machinery users, attaching an "information premium" to the rental price of machines would establish an incentive for a manufacturer to supply such information. The more machines employed, the longer each machine is retained, and, if usage-based charges are assessed, the more intensively a machine is used, the larger will be the total implicit payment.

Circumstances in the intermediate market for shoe machines supported leasing for both its warranting and information-transfer purposes. As the record reviewed in section II makes clear, shoemakers cared about the supply and quality of a wide range of services and information as well as about the quality of the machines themselves. Shoe machines and the tasks they were designed to perform, meanwhile, were often so complicated that complete specification of their performance attributes would have been infeasible, leaving ambiguity as to the expectations of the parties and abundant scope for opportunistic efforts to shift responsibility or contrive cancellation of contractual guarantees.⁴⁶ Even where blame lay clearly with the manufacturer, problems securing the timely repair of defective or broken

⁴⁵See William P. Rogerson, "Profit Regulation of Defense Contractors and Prizes for Innovation," 97 J. of Pol. Econ. 1284 (1989). Rogerson applies this argument to awarding prizes for innovation to defense contractors. The discussion below shows that Rogerson's analysis extends beyond regulatory settings to anywhere the quality of information cannot be judicially verified but is correlated with a verifiable index. Parallels can also be drawn to the role of royalty payments in motivating the supply of manufacturer services such as national advertising in franchise arrangements.

⁴⁶With performance expectations imprecisely defined, determining the optimal allocation of responsibility for individual failures would, in a large number of cases, have been virtually impossible. Operator errors and the use of faulty materials, for instance, were common sources of machinery malfunctions. Whether responsibility for a failure rested ultimately on the shoemaker, however, would have been unclear given that machine versatility, particularly its adaptability to varying sizes, styles, and materials, was a valued but largely unspecifiable aspect of machine design.

equipment would have diminished the value of contractual warranties. Optimal response time to a call for repairs varied as a function both of when the breakdown occurred (peak versus non-peak periods, for instance) and the opportunity cost of allocating repair personnel and parts across customers. The complex and variable nature of servicing needs across factories and individual machines would have precluded comprehensive specification of timing requirements and damages for delays. Relying on court interpretations of contract stipulations for "timely" or "prompt" repairs, on the other hand, would have been unpredictable and expensive where legitimate delays were likely to be indistinguishable from strategic ones.⁴⁷

2. Lease versus sale. The features common to the warranting and information-transfer functions of leasing are, first, the limitations of contracting that make explicit stipulation and direct compensation for the desired commodity impractical, and second, the contingent nature of the payment stream that motivates performance of any activity that increases the demand for the services of the leased good. Against leasing's advantages, however, must be weighed its limitations. First, under leasing, residual rights of control and claims on the residual value of assets do not reside with the party that actually uses the equipment, diminishing the high-powered incentives to maintain and use machines with appropriate care.⁴⁸ Although a lessor may discipline a lessee for misuse or abuse of machinery by refusing to renew

⁴⁷Legitimate delays might result from temporary shortages of spare parts, employee turnover or illness, or the precedence of customers with greater urgency of demand. The frequency and potentially high cost of machine failures exposed shoe machine users to the threat of holdups on repairs. The ability to provide prompt repairs required a stock of spare parts and a ready, proximate, and knowledgeable repair staff. By threatening to delay repairs, an opportunistic supplier could attempt to extract a premium on repairs. Masten, Meehan, and Snyder refer to the source of holdups that derive from the need for precise timing of performance as temporal specificity. Scott E. Masten, James W. Meehan, and Edward A. Snyder, "The Costs of Organization," 7 J. of L. Econ. & Org. 1 (1991).

⁴⁸Thus, the transfer of ownership under leasing relative to sales raises many of the same issues and tradeoffs involved in the analysis of integration decisions. Obviously, if transactors could contract over all possible actions effecting the value of the machine, ownership would be irrelevant. Typically, however, some actions are left unspecified, wherein ownership allocates all residual rights over the asset in question. See Sanford J. Grossman and Oliver D. Hart, "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," 94 J.

a lease or, depending on the terms of the lease, by repossessing machines, detecting abuse requires active monitoring by the lessor, which can be accomplished, obviously, only at additional cost. Second, rewarding information supply via machine transactions distorts machine-usage incentives. Because information charges attached to machines must exceed the cost of transferring the information to motivate its supply, paying for information indirectly through lease charges inefficiently discourages use of machines at the margin.⁴⁹

Where information is of a type that can be priced and sold independently and where the attributes of assets are sufficiently simple that quality can be adequately discerned or described at the outset of the transaction and responsibilities for breakdowns assigned ex post, sales will generally be preferred.⁵⁰ As assets become more complex and their quality more important, however, the costs of writing and enforcing contractual warranties are likely to grow relative to the benefits of customer ownership, raising the likelihood that leasing will become the favored organizational arrangement. Similarly, the more important and complex the information to be transferred, the more difficult it will be to sell information directly, and the greater the advantage of charging implicitly for information through machine rentals.⁵¹

of Pol. Econ. 691 (1986). In the analogy to integration decisions, sales, which are dependent on contractual assurances of quality; correspond to the contractual or market mode, and leasing to integration. On the relationship between ownership and high-powered and low-powered incentives, see Oliver E. Williamson, *The Economic Institutions of Capitalism* (1985).

⁴⁹Another, more mundane, drawback of leasing is simply the additional bookkeeping costs that must be incurred collecting and recording periodic payments under leases compared with one-time sales.

⁵⁰Also, a customer is more likely to be able to accomplish repairs of simple machines personally. ("[M]achines ... of simpler construction [are] not likely to develop troubles too complicated to be attended to by the operator or the shoe manufacturer's own mechanics." *United Facts*, *supra* note 8, at 229.)

⁵¹An alternative to leasing would have been forward integration into shoe manufacturing. Forward integration would have forfeited the high-powered incentives of the large number of independent shoemakers and would likely have posed antitrust problems of its own.

B. Lease Design

1. Lease duration, termination, and exclusion. The arguments of the preceding sections suggest that leases should generally allow both customers and manufacturers broad scope to terminate the transaction. For leases to warrant quality, the lessee must be able to curtail payments if quality or service decline. The quicker the response, the greater the discipline customers exercise over manufacturers. Similarly, leasing will only serve its information-transfer function if the lessor's revenue varies with the quality of the information provided. The longer and more restrictive the lease, the more closely leasing resembles sales. Hence, the warranting function of leasing requires that leases should be short term, readily terminable or, in the case of usage-based charges, that usage levels should be freely and continuously variable.⁵² Finally, leases should also afford manufacturers wide discretion to repossess machines. To the extent leasing reduces customer incentives to operate machines with appropriate levels of care, manufacturers would want to monitor machine use and retrieve abused equipment, thereby terminating the stream of quasi-rents accruing to the customer's use of the machine.⁵³ The power of that threat will be greatest in leases that facilitate detection of abuse and retrieval of equipment.

The advantages of unrestricted, unilateral termination may be reduced, however, where circumstances enable one or the other party to act opportunistically. Generally, transactors enter long-term contracts either to limit costly haggling over appropriable quasi-rents or to control free-riding on services and information provided by one of them. Thus, were shoe machines specially designed for particular shoe factories, a lessee or lessor might have been tempted to exploit his termination authority

⁵²Although Wiley, et al., noted the inconsistency between the duration of United's leases and the durable-goods-monopoly rationale (see note 3 supra), they apparently did not recognize the same inconsistency in the durable-goods-quality explanation.

⁵³Compare Benjamin Klein and Kevin M. Murphy, "Vertical Restraints as Contract Enforcement Mechanisms," 31 J. of L. & Econ. 265 (1988).

strategically, subverting leasing's critical self-enforcing character.⁵⁴ In actuality, however, shoe machines were neither specialized to particular customers nor expensive to relocate.

Free riding, in contrast, was a genuine concern. First, most of United's machinery improvements, though important, were not patentable.⁵⁵ As the court acknowledged, elimination of United's ability to exclude would "confer upon United's competitors the unearned opportunity to copy the unpatented features of United's machines. These competitors get a free ride."⁵⁶ Second, the implicit pricing of information and services gave shoemakers an incentive to free ride on United's investments in shoemaking knowhow. As the description of United's services in Section II indicated, much of the information United provided was, in fact, of a type that could be profitably used with competitors' equipment. Although installation and repairs were wholly specific to individual machines, the selection and layout of machines, operator training, and general shoemaking knowhow all provided knowledge that was in varying degrees generalizable to similar equipment from other manufacturers. Where the benefits of information accrue over an extended period but are not specific to a particular manufacturer's product, customers may seek to avoid implicit information charges embodied in the price of a full-service supplier by switching to alternative suppliers for some portion of their needs. Having acquired that knowledge, shoemakers had an incentive to return or reduce usage on the machine or machines to which implicit information premia had been attached and substitute similar equipment from a "no-frills" supplier.

⁵⁴If opportunistic terminations are difficult to distinguish from legitimate ones, the self-enforcement advantages of leasing over warranties disappear. An untested prediction of our theory is that sale (customer ownership) is likely to be preferred to leasing where durable goods are customer specific.

⁵⁵The court cited "United's practice of continuing improvement of existing machine types and models by so-called Blue-Bulletin changes, representing both patented and unpatented improvements, the advantages of which are made available to lessees through installation of the parts required by each change." Appeal, supra note 20, at 247. According to Kaysen, the vast majority of United's machinery improvements were not patentable; on average, machinery research resulted in approximately 8 patentable and 192 nonpatentable (blue-bulletin) improvements over the life of a machine. Kaysen, supra note 7, at 171-174.

⁵⁶District Court Opinion, supra note 1, at 350. Also see Kaysen, supra note 7, at 76.

To prevent free riding from undermining the supply of free-ridable services, transactors would want to restrict in some way lessees' ability to substitute competitors' equipment.⁵⁷ Stipulation of monetary deterrents to switching within long-term agreements would serve this purpose. In addition, transactors would want to attach information premia to machines most crucial to the production process and for which hand labor is a poor substitute to hinder a lessee's ability to escape paying implicit charges by bypassing machines. Finally, offering machines on lease-only terms would prevent the direct substitution of nonlease equipment and the development of a market in second-hand machines that could substitute for leased machines. To preserve the benefits that motivated leasing in the first place, however, deterrents to returning machines should be conditional on machines being abandoned opportunistically to escape paying for information received. Customer returns or usage reductions for other reasons should be afforded far more latitude.

2. Lease pricing. Both the warranty and information functions of leasing described above depend on the revenues of the manufacturer correlating with the performance of machines, a correlation established whether flat rental rates or usage-based charges are imposed. The greater sensitivity of usage-based charges to variations in demand and machine performance, however, may, under certain conditions, justify the added cost of monitoring machine operations.⁵⁸ With flat rental fees, revenue fluctuations occur only if a customer returns or leases an additional machine, whereas receipts from so-called unit

⁵⁷Howard Marvel has cited free riding on manufacturer promotional efforts to justify the use of exclusive dealing arrangements in the context of retail sales. Howard P. Marvel, "Exclusive Dealing," 25 J. of L. & Econ. 1 (1982). Prior to 1918, some of United's leases contained a set of "exclusive-use" clauses limiting the ability of customers to use competitor machines on certain operations. See Kaysen, supra note 7, at 13-16. In that year, the Supreme Court upheld a lower court ruling that these clauses violated Section 3 of the recently enacted Clayton Act. The practice of leasing, the then 17 year duration, and other terms including return charges and the full capacity clause were held to be reasonable and lawful at the time. Appeal, supra note 20, at 25; Kaysen, supra note 7, at 15.

⁵⁸Unit charges would also tend to discourage use of machines on the margin. The costs of metering usage would have been essentially the same on all shoe machines with moving parts. Note that policing usage was not a major problem given that roadmen made frequent visits to factories and that discrepancies in factory output or in usage rates across machines would have been detectable.

charges vary continuously with intensity of machine usage. Where the number of machines adopted varies little with the success of a factory, for instance, changes in revenue under monthly-rental leases may be too discrete to motivate machine improvements or the supply of information and services on the margin. Consequently, unit charges would be more desirable where the capacity of a machine dictates the use of only one or a small number of machines of a particular type.

The adoption of unit charges is also likely to be related to the expected cost of machine failures. The higher the expected cost of failures, the greater is the need for prompt repairs and for ongoing improvements to avert breakdowns in the first place. The probability and cost of breakdowns, in turn, are likely to be related to the complexity of a machine and its importance to the production process. More complex machines would tend to be less tolerant of errors and thus more likely to malfunction, have more components subject to wear and breakage, and be more difficult to repair, while the failure of machines central to the production process could impede production throughout the factory.⁵⁹ Tying the manufacturer's revenues to the continued operation of these machines through unit charges effectively internalizes to the manufacturer the costs to customers of production interruptions. Indeed, by comparing the reduction of unit-charge revenues from various factories, a machinery manufacturer would have had approximately the correct incentives to allocate repair services and parts across customers.⁶⁰

⁵⁹The opportunity for machine improvements was also likely to be greater on more complex machines. Indeed, the number of Blue Bulletins (which documented improvements (see note 55 *supra*)) issued on a machine correlated positively with the measure of machine complexity described below.

⁶⁰In fact, United sometimes "borrowed" parts from underutilized machines in the factory of one shoe firm to use in another firm's equipment when replacement parts were temporarily unavailable. United Facts, *supra* note 8, at 235. The argument with regard to the role of unit charges is not an "as if" one; United explicitly asserted this function in its defense: "It is obviously to United's interest to give the best possible service to its lessees. Its revenue depends on keeping machines in efficient running order." *Id.* at 247. This role of unit charges has also been noted by Wiley, et al., and Goldberg, *supra* note 3; and by Kaysen, *supra* note 7, at 191.

The metering of machine output is also consistent with traditional price discrimination explanations for such practices. Price discrimination, however, fails to explain the choice between sale and monthly-rental leases as well as many important elements of United's lease structure.

C. Summary

The preceding analysis provides several specific predictions about United's practices and the structure of its leases:

1. The merits of leasing relative to sales are likely to be greatest where (i) the need for assurances about the quality and reliability of durable goods and the costs of specifying and enforcing performance of contractual warranties are great; or (ii) productive use of machinery requires the development and dissemination of manufacturer-supplied information. The importance of reliability is likely to be greatest on machines critical to the production process, while the difficulty of contracting for machine quality, the need for repairs and technical advice on machine operations, and the opportunity for machine improvements will tend to be higher on more complex machines.

2. For leasing to serve its warranting function, primary responsibility and the expense of repairs must rest with the manufacturer.

3. To motivate the provision of information and repair services, these services should be priced implicitly in the rental price of machines.

4. To discourage free-riding on manufacturers' investments on nonpatentable innovations and general knowhow, (i) information premia should be attached to the most important and widely adopted machines, (ii) such machines should be offered for "lease only," and (iii) those leases should be long term and penalize inefficient switching. Because customers must be able to return machines to discipline manufacturer supply of quality and services, however, return or usage penalties should apply discriminatorily against returns to substitute competitors' machines.

5. To deter lessee misuse of borrowed equipment, lease agreements should authorize the lessor to monitor use and to repossess abused machines.

6. Finally, unit charges should be preferred to flat rental rates (i) where the expected cost of breakdowns and the opportunity for ongoing improvements are greatest (that is, for machines that are most complex and critical to the production process) and (ii) where variations across factories in the number of machines adopted is small.

IV. United's Practices

In this section, we consider United's actual distribution practices in light of the preceding analysis. We begin by examining evidence regarding United's selective use of leasing and pricing arrangements. We then discuss the nature and implementation of United's standard lease provisions.

A. Evidence.

At the time of the case, United distributed shoe machines under five types of arrangements. Those arrangements and the number of machine types offered under each were: sale only, 42; optional sale or lease, 122; lease with monthly rental charges only (no unit charges), 88; lease with monthly rental plus unit charges, 85; and lease with unit charges only (no monthly rental), 6.⁶¹ Hence, almost half, 164 out of 342, of United's machine offerings were available for purchase. Moreover, thirty-five percent or 9,472 out of the 27,140 optional sale-or-lease machines outstanding in 1947 had been sold, indicating that sale was a real alternative for these machines, contrary to the government's complaint.⁶²

⁶¹Exhibits B, C, D1, D2, and D3, annexed to the Defendant's Answer to the Complaint. Each machine type was offered exclusively under one of these five arrangements. Optional-sale-or-lease machines were let under monthly-rental but no unit-charges. Most optional-sale-or-lease machines and a few lease-only machines also required an initial payment.

⁶²Exhibits G-446 and S-59. The sales figure includes only machines sold over the period 1931 to 1947. Since many machines sold prior to 1931 would still have been in operation, these figures understate the true number of sale machines outstanding in 1947.

Analytically, United faced a two-tiered sequence of decisions consisting of, first, whether to sell or lease machines, and second, if it chose to lease, the method by which to price machines. The analysis of the preceding sections predicts that United should have offered the most complex and important machines for lease only. Simpler, less important machines pose fewer of the incentive problems discussed earlier and should therefore have been more likely to have been offered for sale. Of those machines that United offered for lease, unit charges should have been most common on machines for which adoption rates varied little with the size of the factory and for which the expected cost of breakdowns and opportunity for machine improvements were greatest, again, on the most complex machines and those most critical to the production process.

To test these propositions, we assembled data from the trial record and from information obtained directly from United. Definitions of variables and descriptive statistics for the sample are provided in table 1. To gauge the complexity of machines offered by United, we constructed a variable, PARTS, consisting of the number of parts listed in parts manuals for the original machines. We were able to locate manuals for 193 of the 342 machines United offered at the time of the case.⁶³

As a measure of the importance of a machine in the shoe production process, we employed a classification adopted by the government in the case. Specifically, the government divided machines into two categories: major and minor. Major machines were those that performed "[t]he principal procedures

bottoming and making "64 Minor machines in contrast were "either auxiliary to major machines in

Table 2 presents logit results on the decision of whether or not to employ unit charges on lease-only machines. Both PARTS and MAJOR are positive and significant, as expected. MACH/FACT, meanwhile, is negative and significant. Hence, conditional on a machine being offered for lease only, unit charges were more likely to be adopted on major, complex machines and where the number of machines per factory was smaller. We also estimated the model employing a quadratic of the year in which the machine was introduced to control for the possibility that the observed correlation between leasing practices and variations in the number of machines outstanding reflected machinery life-cycle considerations.⁶⁷ The results suggest that United's use of unit charges on its leased machines did not vary systemically over time.

Table 3 reports results on the lease-versus-sale decision. Columns (1) and (2) contain results from standard logit estimations. Columns (3) through (5) present nested logit estimates where the "inclusive value," INCLU, was calculated using the coefficients in column (3) of table 2.⁶⁸ The coefficients on PARTS are positive and significant under all five specifications, indicating that more complex machines are less likely to be offered for sale. MAJOR is also positive and is significant in all but column (5). In addition, the results indicate that machines adopted in large numbers were more likely to be sold. Finally, the results suggest a modest trend in favor of leasing over the period covered by our sample.

⁶⁷Older machines that are becoming obsolete and newer machines that have only recently been introduced are likely to have fewer machines outstanding, other things the same. United rarely altered its decisions changed distribution arrangements for particular machine models after their introduction. Hence, the year variables capture trends over time in the decision to lease or employ unit charges on new models.

⁶⁸The nested logit estimation of the lease-versus-sale decision accounts for the option to lease with or without unit charges. Unlike multinomial logit, nested logit avoids the assumption of independence of irrelevant alternatives. See G.S. Maddala, Limited Dependent and Qualitative Variables in Econometrics (1983), 68-69. For comparison purposes, we estimated the choice of lease, sale, and pricing alternatives using multinomial logit and ordered probit models. The results were consistent with those presented. In particular, the choice categories "ordered" correctly in both models.

Finally, the tendency for more important and complex machines to be leased remains even when customers are given a choice between purchasing and leasing. Table 4 contains results relating the frequency of leasing and sales among the optional term machines to the characteristics of those machines. The results indicate that the percent of machines leased tends to be larger for the relatively more important and complex machines within this set.

Thus, overall, United's choice of leasing and pricing arrangements is consistent with the efficiency motives identified above. In particular, minor machines with fewer parts were more likely to be offered for sale, while among leased machines, complex, major machines were more likely to be offered for lease with unit charges. The average number of machines outstanding also reduced the likelihood of using unit charges and increased the probability of a machine being sold.⁶⁹

B. The structure and implementation of United's leases.

Although the uniform construction of United's leases precludes formal tests of each of our predictions regarding the structure of those agreements, a more detailed examination of United's lease provisions--and of some significant departures in the way United implemented those provisions--is nevertheless illuminating. Even where United's nominal lease provisions and the hypothesized structure appear to deviate, United's actual practices are consistent with the theory. Moreover, the anomalous lease provisions can be fairly interpreted to support the interests of the parties in effecting low-cost, efficient adaptations by establishing contractual defaults that facilitate "self-help" responses to opportunistic behavior.

⁶⁹We ran the regressions in tables 2 and 3 including market share and found that leasing and unit charge adoption were both positively correlated with market share. Other qualitative results were unaffected. Given the endogeneity of market share, correlations between market share and distribution arrangements have no clear interpretation. Regression of market share on PARTS, MAJOR, YEAR, and YEARSQ revealed a positive but weak correlation of market share to PARTS and MAJOR, with all four variables explaining less than 10% of the variation in market share.

1. Exclusionary features. As already noted, United's leases at the time of the case were ten years in duration (having been shortened at court direction from 17 years) and contained three allegedly exclusionary provisions: (i) return charges, or "deferred payments," due upon return of leased machines;⁷⁰ (ii) minimum usage charges for operation of unit-charge machines below a specified level; and (iii) a full capacity clause obligating lessees of unit-charge machines to "use the leased machinery to its full capacity upon all boots, shoes or other footwear or parts thereof made by...the lessee in the manufacture or preparation of which such machinery is capable of being used...."⁷¹ In addition to these express terms, United assessed a commutation charge of 25% of monthly rentals or 50% of minimum usage charges on the balance of the lease term for machines returned prior to the expiration of the lease.⁷²

Although the application of these terms was nominally uniform, United applied the commutation charges and full capacity clause discriminatorily in practice. Specifically, United waived the monthly rental and minimum-usage balances due on unexpired leases when machinery returns were made for reasons other than the substitution of a competitor's machine.⁷³ Similarly, failure to employ a machine at full capacity violated the full capacity clause only if "the lessee fail[ed] to use the machine on work for which the machine [was] capable of being used, and instead perform[ed] such work by using a competitor's machine."⁷⁴ Penalties were not assessed, on the other hand, where machine use was

⁷⁰With the exception of three minor machine types, all leased machines were subject to this provision. District Court Opinion, supra note 1, at 320. Note that return charges were assessed even upon returns at the expiration of the lease and were thus not conditional on premature termination. In effect, return charges were deferred initial payments and, with the exception of interest considerations, were equivalent to lump-sum transfers.

⁷¹Id. at 316. Violations of the full capacity clause were remedied by billing the customer for use of the machine to its appraised capacity.

⁷²Id. at 320.

⁷³Id.

⁷⁴Id.

attenuated as the result of demand shifts, product abandonment, conversion to manual operations, or replacement with another United machine.⁷⁵

Both the existence and discriminatory application of return and usage restrictions in United's leases are consistent with efficiency motives. Even in the absence of free-rider considerations, efficient lease incentives would justify return charges in proportion to the expenses associated with repossessing and re-leasing returned machines.⁷⁶ Where rental prices also include premia for the provision of information that is potentially free-ridable, the need to counter customer incentives to circumvent those premia by substituting competitor machines warrants additional deterrents applied in a discriminatory fashion.

The congruity between United's practices and efficiency concerns does not, however, preclude anticompetitive motives and effects. The profitability of exclusion, for instance, was conceivably greatest on the most complex and important machines. An excluding monopolist, moreover, would want to exclude efficiently.⁷⁷ Consequently, the question of whether particular contractual arrangements are anticompetitive turns on the magnitude of the switching costs they create. Specifically, to be

⁷⁵Id. The government cited 88 instances between 1932 and 1948 involving 20 companies in which United invoked provisions of its leases to discourage substitution of a non-United for a United machine. Plaintiff's Request for Findings of Fact and Conclusions of Law, January 29, 1953, 125-165.

⁷⁶In general, optimal return fees or damages for breach of lease may also include the lessor's profits on the unexpired portion of the lease. Ignoring incidental costs associated with the return, it is efficient to return a machine only if the value to the lessee of retaining it falls below the manufacturer's opportunity cost of leaving it with the lessee. Without return fees, however, a lessee would wish to return a machine whenever his valuation fell below the stream of payments required to retain it. To the extent a lessor earned economic rents on the transaction, the alternative value to him of a leased machine is its marginal revenue--equated (in expected terms) to its marginal cost--rather than the rental price. In legal terms, the manufacturer is a "lost-volume" seller and is entitled to the difference between price and cost. Uniform Commercial Code, section 2-708, comment 2. See also section 2A-528(2) of the proposed Uniform Commercial Code article dealing with leases. Awarding lost profits, however, would remove the contingent nature of the seller's profits that was argued earlier to support the provision of quality goods and information. Hence, where leasing has been adopted for these purposes, damages should be limited to incidental costs connected with the return.

⁷⁷The optimal barrier to switching in Aghion and Bolton's model of strategic contracting is a function of the efficient level of damages as well as strategic factors. See Scott Masten and Edward Snyder, "The Design and Duration of Contracts: Strategic and Efficiency Considerations," 52 L. & Contemporary Problems 63 (1989), 68.

anticompetitive, a contract restriction must deter efficient switching. In the absence of free-rider considerations, this means that the incremental price (conditional on retention or use) of a machine must be below the lessor's opportunity cost of leaving the machine with the lessee or, equivalently, that the size of the damage stipulated in the contract exceed the actual damages caused by the termination.⁷⁸ Hence, a contract restriction cannot be exclusionary unless it would constitute a penalty under common law.⁷⁹

By this standard, the nondiscriminatory restrictions contained in United's leases do not appear unreasonable. On unit charge machines, which accounted for over 80% of United's lease revenues,⁸⁰ return charges amounted to approximately one to two month's rent.⁸¹ Hence, over 98% of prospective revenues from United's most complex and important machines were contingent on the use and retention of the equipment. Even on monthly-rental machines, where return charges ranged more typically between five and ten month's rentals, over 92% of potential lease revenue reflected contingent payments.⁸²

⁷⁸Id. The desired incentives can be established in either of two ways: by stipulating a price, p , and damages, d ; or through a two-part price schedule with fixed component, F , and incremental price, p' . Under the former contract, the buyer pays p if he keeps the machine (or accepts delivery) and d if he returns it, whence the cost to the buyer of keeping the machine is $p - d$. Under the two-part price contract, the buyer pays $F + p'$ if he keeps the machine and F if he returns it, the cost of retaining the machine being simply p' . The incentives created by the two contracts are equivalent if $p = F + p'$ and $d = F$. Efficiency requires that the cost to the buyer of retaining the machine equal the value or savings to the seller of the buyer's retention, say c . This can be accomplished by setting either $d = p - c$ or $p' = c$. A contract is exclusionary only if $d > p - c$ or $p' < c$.

⁷⁹Specifically, the common law requires that damages stipulated in a contract be "reasonable in light of the anticipated or actual loss caused by the breach;" terms that fix damages in excess of that amount are considered penalties and unenforceable. Restatement (Second) of Contracts sect. 356 (1979). See also section 2A-504(1) of the proposed Uniform Commercial Code article dealing with leases.

⁸⁰Kaysen, supra note 7, at 139.

⁸¹These estimates are based on normal machine usage rates and on pre-decree price information contained in Report of United Shoe Machinery Corporation Under Decree Paragraph 18, Appendix D, filed December 15, 1964 (hereafter cited as United Report). Goldberg arrives at a similar estimate using a smaller sample of lease terms reported in the District Court Opinion, supra note 1, at 314. See Goldberg, supra note 3, at 4.

⁸²The average was approximately 8 months. Optional sale-or-lease machines had somewhat higher return charges and also required initial, or up-front, payments. Hence, optional lease machines had terms that made them closer in nature to sales. Although return charges were larger on monthly-rental than on unit-charge machines in percentage terms, the dollar amount averaged approximately \$67 on monthly-rental equipment compared to \$247

Stated differently, the fixed component of United's lease revenues, averaged across leased machines, was equivalent to liquidated damages of less than 3% of the price of a machine.⁸³

The size of the switching deterrent was, of course, larger where a machine was being returned for the purpose of substituting competitors' equipment. As already noted, lessees who replaced a United machine with a competitor's machine were required to pay 25% of monthly rentals on monthly-rental only machines and 50% of minimum usage charges on unit-charge machines due on the unexpired balance of the lease. Since minimum usage charges represented about 10% of revenues expected from unit-charge machines used at full capacity and unit-charge machines accounted for over 80% of lease revenue, these additional charges were compatible with a value of free-ridable information equal to approximately 8 or 9% of total lease revenue. Although the record does not permit a precise estimate of the cost of providing those services, United's expenditures on all research and service activities accounted for over 40% of its machinery expenses.⁸⁴ Hence, if even a quarter of United's research and service efforts reflected expenditures on nonpatentable machinery improvements or free-ridable knowhow, United's commutation charges would have fallen well within the range of reasonable values for damages caused by the return of machines to free ride on those investments. Note, moreover, that because the commutation charge applied to the unexpired portion of the lease, the size of this deterrent declined linearly over the course of the lease. Whereas exclusionary motives provide no basis to expect the

on unit-charge machines. The percentage figures reported in the text represent total undiscounted lease revenues minus the fraction of that total represented by the return charges. Since the return charges are deferred to the end of the lease, the appropriately discounted fraction of prospective lease revenue represented by the monthly charges would be even smaller.

⁸³The court in this case did not address the reasonableness of United's return fees relative to the common law standard. An appeals court did address this issue in an earlier case, however, and concluded that deferred fees in United's earlier leases were "not unreasonable compensation for the costs to [United] of replacing the machines in use after the end of a prior lease" and therefore did not constitute penalties. *In re Diana Shoe Corporation*, 80 F.2d 827 at 829 (1936). United's practice was to salvage parts from returned machines for use in the manufacture of new machines. United Facts, *supra* note 8, at 484. Parts accounted for approximately 90% and assembly 10% of United's manufacturing costs. *Id.* at 483.

⁸⁴Kaysen, *supra* note 7, at 118. Also see note 55 *supra*.

strategic component of lease restrictions to decrease over time, a declining schedule of damages is consistent with the desire to adjust deterrents to free riding in proportion to the benefits of information accrued but not paid for.

United's minimum-usage provisions implied a similarly small deterrent. Under the formula adopted by United, a lessee who used a machine at a level (q) less than the minimum number of pairs designated in the lease (q_m) was obligated to pay, in addition to unit charges on that output, a proportion of a stipulated minimum monthly payment (M) equal to the ratio of the deficiency to the minimum number of pairs; or $pq + M(q_m - q)/q_m$.⁸⁵ The effect was to reduce by M/q_m the marginal cost of producing an additional pair of shoes at output rates below q_m . In practice, the minimum quantity was typically set at approximately 25% of machine capacity and the minimum payment at 40% of the unit charges for that quantity.⁸⁶ As a result, the incremental cost of an additional operation over the first 25% of capacity equalled approximately 60% of the nominal unit charge. Hence, in contrast to standard minimum bill provisions, United's restriction implied a substantial incremental cost of use below the minimum.⁸⁷ Moreover, the implied reduction in unit charges at low levels of production established incentives that are consistent with the fact that machines that were being used less intensively needed to be repaired with less haste.

Finally, United's implementation of its lease provisions deviated from their formal terms in ways that increased flexibility. For example, although the formal provisions provided for their uniform application, United waived the minimum-usage charge for four months each year to lessen their burden

⁸⁵United Facts, *supra* note 8, at 196.

⁸⁶*Id.* at 197; and District Court Opinion, *supra* note 1, at 320.

⁸⁷For a discussion of minimum bill provisions, see Scott E. Masten, "Minimum Bill Contracts: Theory and Policy," 37 *J. of Ind. Econ.* 85 (1988). For an opinion (written by Judge Richard Posner) interpreting minimum bill provisions as creating penalties, see *Lake River Corp. v. Carborundum Co.*, 769 F.2d 1284 (7th Cir. 1985).

during periods of slack demand.⁸⁸ More significantly, United also established what it called a "Right of Deduction Fund" under which four percent of all unit and rental charges was credited to an account that lessees in good standing could use to pay return, minimum-usage, and commutation charges.⁸⁹ A lessee who had leased a large number of United machines over an extended period gained substantial flexibility to return or reduce usage of United equipment.⁹⁰

In sum, the size, nature, and implementation of United's exclusionary lease provisions are hard to reconcile with anticompetitive motives. The monetary deterrents to returning or ceasing to use United's machines were small relative to the total value of the lease and appear to have been proportionate to the harm caused United. Even ignoring the moderating effects of the Right of Deduction Fund, the discriminatory charges applied to returns or usage reductions for purposes of substituting a rival's equipment were modest and declined as the term of the lease progressed, suggesting that United's objective was not to discourage efficient returns but only large-scale free riding on the advice and technical information it provided.⁹¹

2. Lessor monitoring and termination. To police against machine abuse and detect tampering with usage indicators, a shoe manufacturer would want easy access to its machines and the ability to observe

⁸⁸District Court Opinion, supra note 1, at 321. The application of this waiver was automatic. If the lessee failed to select which four months he wanted waived, United would select those most favorable to him. The waiver also applied to the calculation of commutation charges. In addition, United made available "peak-load" machines and offered 30 day trial period installations on its machines. Id.

⁸⁹Id. at 320. Balances in the Right of Deduction Fund could be applied to any leased machine.

⁹⁰The government acknowledged that the accumulated credits were generally "adequate to take care of current returns of a factory which is in operation, having a large number of United machines." Plaintiff's Requests For Findings of Facts and Conclusions of Law, supra note 75, 117. See also Hanover Shoe Inc. v. United Shoe Machinery Corp., 245 F. Supp. 258 at 258 (1965).

⁹¹Returns, in fact, occurred in significant numbers; the district court estimated that between twenty and twenty-five percent of leased machines were returned within five years. District Court Opinion, supra note 1, at 319. Turnover among shoe manufacturers, meanwhile, was ten to twelve percent a year. See Kaysen, supra note 7, at 55. Also see Posner, supra note 2, at 203.

their operation. United's leases provided explicitly for such access, reserving to United the right "at all times [to] have free access to the leased machinery for the purpose of inspecting it or watching its use and operation, or of altering, repairing, improving, or adding to it, or determining the nature or extent of its use...."⁹² United also required lessees to keep records and file reports on the use of its equipment.⁹³ Where a "breach or default in the performance of any of the conditions contained in the lease" was detected, United reserved the right to terminate the lease "forthwith,"⁹⁴ whereupon United was authorized to enter the customer's premises and repossess machines.⁹⁵ Hence, United's leases sought to lower the costs of detecting and punishing lessee misconduct.

3. Maintenance and repairs. Contrary to our prediction (and the representations of many commentators), the responsibility and expense of maintaining and repairing machines under the lease rested with the lessee and not with United. Specifically, United required the lessee "at all times and at his own expense [to] keep the leased machinery in good and efficient working order and condition."⁹⁶ Should the lessee fail to maintain machinery in a satisfactory manner, United reserved the right to make any necessary repairs itself and to bill the lessee accordingly.⁹⁷ In practice, however, United consistently assumed the burden of repairing its leased machines and charged only for the cost of replacement parts.⁹⁸

⁹²District Court Opinion, supra note 1, at 315.

⁹³Id. at 317.

⁹⁴Id. at 317.

⁹⁵Id. at 318. Leased machinery remained the property of United and neither the machinery nor the lease could be transferred to another firm.

⁹⁶Id. at 315.

⁹⁷Id.

⁹⁸Id. at 322.

This discrepancy between the de jure and de facto responsibility for repairs under United's leases is consistent with a desire to avoid costly legal disputes by reducing the scope for contract evasion. As long as a machine was not abused or its indicator tampered with, United had no incentive to terminate a lease and, moreover, had substantial incentives given the contingent nature of payment under leasing to maintain and repair its machinery. Formal assignment of the obligation to maintain machines to United would have done nothing to augment those incentives and could have provided the lessee with an avenue to contrive cancellation of the lease by claiming unsatisfactory performance on the part of United. Given the difficulty of defining satisfactory performance contractually and the high incidence of breakdowns on even the highest-quality and best-maintained machines, an opportunistic lessee wishing to return a machine to avoid the implicit charges for information would likely have been able to construct a credible claim of dissatisfaction and thereby evade performance.

Legal assignment of the material and financial burden of caring for machines to the lessee, on the other hand, reinforced United's legal authority to punish customer tampering and abuse by repossessing machines. Lessees were, in effect, always in gross violation of the lease's maintenance requirements and would thus have found it difficult to challenge a termination by United. Moreover, since United had nothing to gain from prematurely terminating a lease to a productive shoemaker, United could not exploit its termination authority opportunistically. Thus, again, the formal structure of United's leases appear to support desired performance with minimum risk of costly adjudication.

V. Competitor and Predecessor Practices

Leasing of shoe machines did not originate with United but was a common practice among both United's predecessors and competitors. The practice of leasing shoe machinery had begun as early as the Civil War with the McKay Sewing Machine.⁹⁹ Gordon McKay, the industry's most renowned

⁹⁹*Id.* at 314; *United Facts*, *supra* note 8, at 192.

figure, developed a leasing system with royalty charges to overcome resistance to the adoption of his machines.¹⁰⁰ In addition, the four companies that merged to form United in 1899 had all offered machines for lease-only with lease provisions similar to United's, including return fees, minimum usage charges, and the full capacity clause.¹⁰¹ Like United, these companies provided service and training in the use of machines; "McKay's corps of repairmen kept machines in top condition and taught operators and shoe manufacturers this wholly different system of shoemaking."¹⁰²

Although detailed information on the terms under which United's rivals supplied machines is not available, leasing was clearly the predominant mode of distribution.¹⁰³ The record does indicate, moreover, that Compo, a full-service shoe machinery supplier¹⁰⁴ and United's largest competitor with roughly 2% of the market,¹⁰⁵ also offered its most important machines for lease only¹⁰⁶ and that its leases contained return charges.¹⁰⁷ That shoe machine manufacturers in substantially different market positions responded to the underlying organizational problems in a like manner is additional support for an efficiency interpretation of United's practices.

¹⁰⁰Martin L. Lindahl and William A. Carter, *Corporate Concentration and Public Policy* (1959), 226.

¹⁰¹U.S. v. United Shoe Machinery Co., 222 Fed. Rep. 349 (1915), at 385-86; U.S. v. United Shoe Machinery Co., 247 U.S. 32 (1911), at 62; Brief for United Shoe Machinery Corporation, January 1952, 278.

¹⁰²"A Legend and How it Began," *USM Today*, Vol. 1, 1974, at 4. The level of services provided by United's predecessors, however, was not as high as United's, nor were repair services as prompt. U.S. v. United Shoe Machinery Co. (1915), *supra* note 101, at 369-72.

¹⁰³See District Court Opinion, *supra* note 1, at 314; United Facts, *supra* note 8, at 193.

¹⁰⁴See text at note 37 *supra*.

¹⁰⁵Kaysen, *supra* note 7, at 52-53.

¹⁰⁶Reply of United Shoe Machinery Corporation to Brief of the United States on Relief, April 11, 1952, at 27.

¹⁰⁷United Facts, *supra* note 8, at 201.

VI. The Aftermath

In February, 1953, Judge Wyzanski ruled that United had illegally monopolized the shoe machinery market and that United's leasing practices were the means by which it had done so. Rejecting the government's call for dissolution, he issued a decree having three central features. First, he required that United make all of its machines available for sale under terms that "do not make it substantially more advantageous for a shoe factory to lease rather than to buy a machine." Second, he directed that United's leases be shortened to five years and "be purged of their restrictive features." In particular, the full capacity and minimum usage requirements were completely prohibited, while return fees were sharply restricted and their discriminatory application forbidden. Finally, the decree allowed United to provide instruction and repair services free of charge for thirty days following installation but required that United charge separately for all services, including repairs, rendered thereafter. Thus, the decree circumscribed both United's ability to lease and the structure of its leases.¹⁰⁸

As a result of the decree, United lost several of the principal instruments through which it fashioned incentives and governed the exchange of machines and services. In particular, the court's restrictions on the size and implementation of switching penalties reduced United's ability to curb free riding and, thereby, its incentive to invest in generating nonpatentable knowhow. The requirement that machines be sold on favorable terms (about half of the machines previously leased were purchased between 1953 and 1963¹⁰⁹) limited the ability of United and its customers to realize leasing's advantages in warranting machines and in safeguarding information transfers and, by creating a new alternative to United's leased machines in the form of sale and second-hand machines, aggravated the free-riding problem. Finally, segregating repair charges undermined United's incentive to provide prompt repairs

¹⁰⁸The decree did not limit the leasing practices of other shoe machinery manufacturers. District Court Opinion, *supra* note 1, at 349.

¹⁰⁹Brief for Respondent United Shoe Machinery Corp., June 3, 1968, 10.

and interfered with the warranting function of leasing by weakening the link between machine performance and United's profits.

As might be expected, United sought to mitigate the harm caused by the ruling by adjusting the terms of its leases within the constraints of the decree. Thus, for instance, one effect of the ruling was to alter the relative merits of monthly rental and unit charges. Whereas the court condoned limited return charges on monthly rentals,¹¹⁰ by voiding the minimum usage and full capacity provisions, the decree abolished all deterrents to free-riding through reductions in machine usage. In response, United eliminated unit charges on 8 of the 88 unit charge machines it offered in 1954 and reduced them on all but one of the remainder, while increasing the size of both monthly rentals and initial payments on these machines.¹¹¹

But the more important consequence of the decree, and one harder to quantify, was its effect on real variables like the quality of United's machinery and services and its research effort to develop new techniques and other shoemaking knowhow. One measure of United's service was its employment of roadmen, United's principal conduit for machine repairs and day-to-day advice on shoemaking problems. As table 5 reveals, the number of roadmen declined precipitously, both in absolute terms (column 2) and relative to machines outstanding (column 6), following the loss of the appeal to the Supreme Court in 1954¹¹² and implementation of the decree beginning in 1955. To the extent this reduction is indicative

¹¹⁰The decree limited the size of return fees to three monthly rental payments. Paragraph 6 of the Final Decree, February 18, 1953, as modified by orders of the Court, July 12, 1954 and September 17, 1954, as reported in the District Court Opinion, supra note 1, at 351-354.

¹¹¹The decrease in unit charges averaged 30%. Kaysen estimated repair costs to average 13.3 percent of total lease costs prior to the decree. Kaysen, supra note 7, at 326. Monthly rentals on unit charge machines rose from an average of \$5.73 to \$29.19 and initial payments from \$2.27 to \$65.98, compared to average increases from \$8.07 to \$18.68 in monthly rentals and from \$90.36 to \$170.08 in initial payments on all leased machinery. Pre- and post-decree lease terms are reported in United Report, supra note 82, Appendix D. Note that the segregation of repair charges might also have led to a reduction in unit charges but would not by itself have dictated increases in other lease charges.

¹¹²The Supreme Court issued a per curium opinion on May 17, 1954. 347 U.S. 521 (1954).

of an overall decline in United's support for its machines, it implies a major deterioration in United's performance.

Finally, although attributing the decline of the shoe industry in the United States to the decision in United Shoe would be overly heroic, it is true nevertheless that the industry went into a sharp decline in the decades following the decree. The share of imported shoes rose from a tiny fraction prior to 1950 to twenty-five percent by 1964 and continued to rise thereafter. Furthermore, United's decline definitely preceded that of the domestic shoe industry. Despite the increasing growth of imports, domestic shoe production rose 32% during the 1950's and remained at around 725 million pairs during much of the 1960's. By contrast, United had lost over a third of its pre-decision market share by 1963.¹¹³

VII. Concluding Remarks

A reexamination of United States v. United Shoe Machinery Corp. is of more than historical interest. First, equipment leasing is an important organizational form, accounting for \$36.8 billion worth of transactions in the U.S. in 1988.¹¹⁴ Its growing significance is evidenced by the recent creation of a separate Uniform Commercial Code article concerned exclusively with leasing. Understanding the role leasing plays in commercial transactions is fundamental to assessing the quality of such legal rules and can help inform judges as to their appropriate application in individual cases. Second, judges are repeatedly asked to rule on charges of anticompetitive exclusion, a contemporary example being the

¹¹³United Report, supra note 82, at 19.

¹¹⁴298 Aviation Daily 251 (November 7, 1989). Interestingly, the three largest categories of leased equipment--computers, aircraft, and telecommunications equipment--are, like shoe machinery, complex, durable, and redeployable. IBM lawyers apparently represented a sizable and attentive section of the audience at United's trial. Conversation with John Meuse, chairman of United Shoe Machinery Corp., December 18, 1990. IBM's leasing practices were themselves the subject of private antitrust charges in the 1970's. See Masten and Snyder, supra note 78, at 74, 82-83, and cites therein.

litigation over the contract terms governing airline computer reservation systems.¹¹⁵ Were recently developed theories of strategic exclusion to stimulate widespread antitrust challenges of contracting practices, United would furnish the legal precedent for courts to dictate the details of commercial dealings. Not only did the case target a variety of specific lease terms, but the court, after ruling against United, entered a judgement that essentially rewrote United's contracts. What limited evidence is available suggests that external interference in the incentive provisions of contracts can seriously diminish the efficiency of contractual exchange.¹¹⁶

We have argued here that United's leasing practices represented a coherent and measured response to the incentive and governance problems encountered in these transactions. Specifically, leasing performed two distinct but related functions. First, leasing served as an alternative to contractual warranties in motivating the development, production, and servicing of a large number of complex machines. Second, leasing provided a means of indirectly rewarding shoe machine manufacturers for the provision of a wide range of technical advice and shoe manufacturing knowhow and thus offered a partial solution to now-familiar information transfer problems.

United appears, moreover, to have framed its leases, within the practical limitations on contracting, to promote the efficient provision and use of its machines and services. The long-term and "exclusionary" features of United's leases, for instance, were necessary to prevent customers from renegeing on implied promises to pay for manufacturer information and advice through the use of machines. Even United's discriminatory application of return and usage restrictions is consistent with efficiency; to preserve the benefits of leasing while deterring free riding, the magnitude of switching costs

¹¹⁵See, for instance, United Airlines, Inc., v. Austin Travel Corporation, 867 F.2nd 737 (1989) (defendant claimed that liquidated damages in computer reservation system agreements were unreasonable and violated antitrust statutes). See also, the federal carrier owned computer reservation system regulations codified at 14 C.F.R. 255 (1989).

¹¹⁶See Keith J. Crocker and Scott E. Masten, "Mitigating Contractual Hazards: Unilateral Options and Contract Length," 19 Rand J. of Econ. 327 (1988).

should be conditional on machines being returned to substitute competitor equipment. On a broader level, the assignment of powers and responsibilities within United's leases was consistent with a goal of minimizing costly court adjudication in favor of unilateral responses to lease violations.

Finally, data on United's leasing and pricing practices provide evidence that United chose distribution arrangements systematically to reflect the incentive and transaction-cost considerations identified in this paper. While it is true, as the prosecution claimed, that United offered its most important machines for lease only, the efficiency advantages of leasing relative to sales were greatest on the most important and complex machines where the limitations of contractual warranties and the hazards of free-riding were most acute. The fact that service-oriented shoe machine manufacturers both preceding and following United's formation leased machines under similar terms further supports the view that leasing was a solution to fundamental organizational problems in the industry.

Evidence that contracting practices were sensitive to efficiency concerns does not preclude anticompetitive motives. Doing so requires a showing either (i) that the conditions necessary to sustain anticompetitive behavior are absent or (ii) that the restrictions imposed by the contract are insufficient to have an anticompetitive effect. The conditions required for strategic behavior in the few models that explore the exclusionary potential of contracts have not been adequately enumerated and scrutinized. What efforts have been made in that regard suggest either that the circumstances in which contractual exclusion can occur are limited¹¹⁷ or that distinguishing between strategic and efficiency motives using market screens is difficult.¹¹⁸ As a result, it will often be necessary to assess the reasonableness of specific restrictions on a case-by-case basis. One's willingness to subject widely used contract terms to

¹¹⁷See Masten and Snyder, *supra* note 78; and Eric Rasmusen, "Recent Developments in the Economics of Exclusionary Contracts," in R.S. Khemani and W.T. Stanbury (eds.), Canadian Competition Law and Policy at the Centenary (1991).

¹¹⁸Edward A. Snyder and Thomas E. Kauper, "Misuse of the Antitrust Laws: The Competitor Plaintiff," 90 *Michigan Law Review* 551 (October 1990).

antitrust review will depend in part on one's confidence in the ability of judges to recognize the many legitimate purposes served by contract restrictions in diverse and multifaceted business transactions. In our view, the decision in United stands as an illustration of the hazards inherent in such a policy.

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Table 2

Logit Unit Charge versus Monthly Rental Estimations
 (dependent variable is UC)
 (t-statistics in parentheses)

| | (1) | (2) | (3) |
|-------------------|--------------------|--------------------|--------------------|
| CONSTANT | -1.480 (-3.421) | -1.504 (-3.202) | 2105.3 (.262) |
| PARTS | .0020 (2.947) | .0025 (3.118) | .0026 (3.029) |
| MAJOR | 1.052 (1.989) | 1.702 (2.756) | 1.664 (2.644) |
| MACH/FACT | | -.4213 (-2.023) | -.4323 (-2.062) |
| YEAR | | | -2.1641 (-.259) |
| YEAR ² | | | .0006 (.255) |
| N | 106 | 106 | 100 |
| Log-Likelihood | -57.348 | -52.151 | -47.563 |

Table 3

Logit and Nested Logit Lease versus Sale Estimations
 (dependent variable is LEASEONLY)
 (t-statistics in parentheses)

| | | | | | |
|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| CONSTANT | -1.576 (-4.695) | 7817.30 (1.355) | -1.344 (-3.720) | 9035.8 (1.449) | 6384.1 (1.108) |
| PARTS | .0042 (5.143) | .0033 (3.824) | .0028 (2.708) | .0043 (2.557) | .0018 (1.844) |
| MAJOR | 1.449 (2.495) | 2.622 (3.103) | 1.503 (1.656) | 3.593 (2.238) | 1.161 (1.460) |
| MACH/FACT | -2.478 (-2.253) | -.2724 (-2.344) | | -.4175 (-1.805) | |
| YEAR | | -8.179 (-1.362) | | -9.438 (1.505) | -6.698 (-1.117) |
| YEAR ² | | .0021 (1.369) | | .0025 (1.511) | .0018 (1.126) |
| INCLU | | | .3321 (.413) | -1.029 (-.757) | 1.352 (1.571) |
| N | 193 | 171 | 171 | 171 | 171 |
| Log-Likelihood | -98.231 | -83.887 | -88.713 | -82.640 | -84.098 |

Table 4

Percent of Optional Term Machines Leased

$$\text{PCTLEASED}^* = \begin{array}{ccccccc} -.21635 & + & 1.7868*\text{MAJOR} & + & .00314*\text{PARTS} & - & .23991*\text{MACH/FACT} \\ (-.676) & & (2.857) & & (3.749) & & (-1.208) \end{array}$$

$$R^2 = .235$$

$$N = 67$$

Percent of machines leased: mean = 63% maximum = 95% minimum = 5%

$$*\text{PCTLEASED} = -\log[(100/\text{percent of machines leased}) - 1]$$

Table 5

Changes in United's Roadmen and Machines Outstanding

| <u>Year</u> | <u>Roadmen</u> | <u>Leased Machines</u> | <u>Total Machines</u> | <u>Ratio of Leased to Total</u> | <u>Ratio of Roadmen to Total Machines</u> |
|-------------|------------------|----------------------------|---------------------------|---|---|
| 1920 | 700 ^a | 95,595 ^b | 108,631 ^b | .880 | .00644 |
| 1955 | 846 ^c | 100,525 ^d | 113,928 ^d | .882 | .00743 |
| 1964 | 349 ^c | 28,819 ^d | 94,355 ^d | .305 | .00370 |

^a264 Fed Rep 138 at 143-44.

^bEstimate based on Kaysen at 28, and 264 Fed Rep, 138 at 163.

^cUnited Report at 41

^dUnited Report at 8, 10, 18.