2

The Need for Coordination Among Firms, with Special Reference to Network Industries*

Dennis W. Carlton† *and J. Mark Klamer*††

Coordination among firms presents a policy dilemma. Efficiency may require coordinated action, but coordinated action can stifle competition and make collusion more likely. This policy dilemma arises frequently, as, for example, in cases involving information exchanges among competing firms.[1] Knowing a competitor's price makes it easier not only to set prices in line with the market, but also to fix prices noncompetitively.

The setting of physical product standards[2] also illustrates the trade-off between efficiency and competition. Standards can have obvious efficiency effects, yet they can also be a tool by which established firms exclude entrants. The case of *Radiant Burners, Inc. v. Peoples Gas Light & Coke Co.*[3] demonstrates the way in which standard setting can be an anticompetitive practice.[4] The

---

* We wish to thank Douglas Baird, Frank Easterbrook, Daniel Fischel, William Landes, Warren Lavey, John Mooney, and Richard Posner for helpful comments. This work has been stimulated in part by associations with AT&T and Bell Laboratories, although the article reflects the views of the authors alone.

† Professor of Economics, University of Chicago Law School.

†† Harvard Law School (J.D. Class of 1985).

[1] *See, e.g.*, United States v. United States Gypsum Co., 438 U.S. 422 (1978); United States v. Container Corp. of Am., 393 U.S. 333 (1969); Maple Flooring Mfrs. Ass'n v. United States, 268 U.S. 563 (1925); American Column & Lumber Co. v. United States, 257 U.S. 377 (1921). *See also* Posner, *Information and Antitrust: Reflections on the* Gypsum *and* Engineers *Decisions*, 67 GEO. L.J. 1187 (1979).

For a game theoretic investigation of when independent actions of firms cannot be relied upon to lead to an efficient equilibrium, see L. TELSER, ECONOMIC THEORY AND THE CORE (1978). *See also* Bittlingmayer, *Decreasing Average Cost and Competition: A New Look at the Addyston Pipe Case*, 25 J.L. ECON. 201 (1982); L. Telser, Genesis of the Sherman Act (Dec. 1982) (unpublished working paper No. 24, Center for the Study of the Economy and the State, University of Chicago).

[2] Physical standards provide physical specifications for certain goods, such as screw sizes, railroad track size, and video and audio tape sizes. *See infra* notes 9-14 and accompanying text.

[3] 364 U.S. 656 (1961).

[4] For other examples in which standard setting has been alleged to exclude competitors, see J. MOONEY, R. SCHROEDER, D. GRAYBILL & W. LOVEJOY, STANDARDS AND CERTIFICATION, PROPOSED RULE AND STAFF REPORT 234-39 (1978).

and information costs and thus enhance competition. Physical standards can also have a substantial impact on dynamic efficiency. A recent FTC investigation of standards pointed out instances where innovation was likely retarded either because outdated standards were in force or because existing standards were too restrictive.[9]

The establishment of standard and uniform operating procedures, such as uniform accounting systems,[10] can also be very important in achieving efficient operations. Common operating procedures are especially critical for the efficient operation of a network industry because of the great degree of coordination required for efficient operations.

In assessing the benefits of coordination, it is important to understand how standards are set. Does any individual firm have an incentive to contact all the other firms in the industry to set common standards? The answer is no, unless the cost of organizing all the firms and negotiating the standards is very small. These conditions are most likely to be satisfied in industries whose products do not change rapidly over time. Unfortunately, such industries, especially if concentrated, may be prone to noncompetitive behavior,[11] so that one must be careful to insure that the setting of standards does not become a mechanism to exclude competition from new products. In the *Radiant Burners* case, for example, the Court recognized that standard setting could be an attempt to exclude competition and could support an antitrust cause of action.[12] In an industry with continual change in product design, by contrast, it would be much more costly to set and maintain standards. Indeed, in an industry where technology is rapidly changing, the costs of setting standards for newly evolving technologies may be so high as to provide no incentive for any independent firm to contribute to the setting of the standards, in which case it is unlikely that standards will be promulgated and followed.

Much standard setting in the United States is done under the auspices of the American National Standards Institute ("ANSI"), an organization of firms, trade associations, technological societies,

---

[9] *See* J. MOONEY, R. SCHROEDER, D. GRAYBILL & W. LOVEJOY, *supra* note 4, at 234-39.

[10] Uniform operating procedures often include management and accounting systems. Uniform bills of lading, for example, were critical to the development of railroad networks. *See infra* notes 55-58 and accompanying text.

[11] It is easier to agree on a price for a standardized product. R. POSNER & F. EASTERBROOK, ANTITRUST: CASES, ECONOMIC NOTES, AND OTHER MATERIALS 337 (2d ed. 1981).

[12] 364 U.S. at 659; *see supra* notes 3-5 and accompanying text.

consumer organizations, and government agencies.[13] ANSI oversees the process of setting voluntary standards covering such matters as sizes, weights, procedures, symbols, abbreviations, and definitions. It ensures that an appropriate degree of consensus is reached with regard to the proposed standard.[14]

---

[13] 1 ENCYCLOPEDIA OF ASSOCIATIONS 511 (D. Akey 17th ed. 1982).

[14] ANSI recognizes three possible ways to develop consensus for a standard: the canvass method, the accredited organization method, and the standards committee method. Under the canvass method, the sponsoring organization takes a canvass or mail poll of all organizations known to have concern or competence in the subject. The responses to the poll are submitted to ANSI for final approval. The canvass method is used only when an organization already has a set of standards that it wants considered as an American national standard. Some organizations, presumably, do not bother to seek national status for their standards.

When standards do not already exist, ANSI must use either the standards committee method or the accredited organization method. ANSI uses the standards committee method when more than one accredited organization is developing standards for a specific area or when a request for standards is made to ANSI and no accredited organization is working on it. ANSI establishes standards committees, many of which become permanent committees with responsibility for all standards in a certain technical area. An example of this is the X-3 standards committee, which has general jurisdiction over standards used for computers and information processing. The standards committee acts both as a referee for various organizations developing standards for a given area and as a developer of standards itself through the use of its technical subcommittees. The committees include representatives from business, consumer, and general interest groups. Membership is not limited in number, although a balance is maintained among the various groups. The secretariat, an organization that acts somewhat like a secretary for the standards committee, reviews membership and submits a membership roll to ANSI for approval.

The accredited-organization method begins by an organization applying to ANSI for accreditation. Approval depends on the organization's having acceptable methods for developing a consensus on a set of standards. The method of developing a consensus is usually similar to that of the standards-committee method.

Standard setting is a complicated procedure. An area is proposed for standardization. The matter is referred to the appropriate standards committee. The standards committee refers the matter to various technical committees, and perhaps to planning committees, for comment. The standards committee then decides whether to authorize the project. If the committee decides to go ahead, the matter is again referred to a technical committee, which begins collecting information from international standards organizations and/or other organizations on proposed standards. Successive drafts are drawn up and circulated to interested groups for comment. Any testing that is done is by private parties at their own expense. Eventually the technical committee submits a draft to the standards committee. Public review is held. Technical committees respond to critical comments and submit a new draft for public review and comments. The review process can be repeated any number of times. The standards committee eventually votes on the proposal. If at least two-thirds of the members vote for it, then it is submitted to ANSI, via the secretariat. If approved by ANSI, the standards are printed in the *Federal Register* and promulgated by the participating organizations through trade journals, university libraries, or labeling procedures.

The method outlined here for the development and adoption of national standards is largely followed at the international level as well. The principal international standard-setting group, the International Organization for Standardization ("IOS"), helps to coordinate the activities of over 300 international organizations. Members of the IOS include representatives from the national standards group of each participating nation. ANSI represents the

B. The Need for Coordination in Network Industries

It may be particularly difficult for a network industry to achieve efficiency without coordination. A network industry, such as the railroad or telephone industry, is composed of many different firms that interact with each other. We will often use the terminology of "nodes" and "links" to describe networks. A node is a point in a network where two or more links intersect. A link is a path between nodes. Any action of a firm that affects one link in the network can affect the costs of all firms using links in the network. One firm's action can create an externality that will not be accurately reflected in a price system. That is, one firm's actions can create costs that it does not bear, but that other firms do.[15] The simplest way to illustrate this point is by an example concerning the location of firms. Suppose there are three locations (nodes) and three firms. Each firm must locate at one site, as each site can accommodate only one firm. The firms ship products to each other (forming links between the nodes) so that a change of location by any one firm affects the costs of all the others.[16] The firms produce different products, and the firms differ in their profitability at each site.

It is well known that a decentralized price system,[17] with each firm choosing its most profitable location, may not always achieve the efficient allocation of firms to sites.[18] The reason is that each firm, in assessing where it should locate, ignores the effect its location has on other firms' transportation costs. The only way to induce each firm, acting in its own interest, to locate optimally would be to have a set of side-payment contracts among the firms that would specify a net payment from each firm to each other firm dependent on the network configuration.[19] Because total profits are

---

United States in the IOS.

[15] An externality occurs when an agent does not bear the full cost of his actions. For example, pollution represents an externality when polluting firms impose the costs of pollution on society but not on themselves.

[16] The change of one firm's location affects each firm's cost of shipping products between locations.

[17] A decentralized price system consists of prices of goods at each location, prices of each location, and a transport cost borne by the shipper.

[18] *See* Koopmans & Beckmann, *Assignment Problems and the Location of Economic Activities*, 25 ECONOMETRICA 53 (1957).

[19] *See* Hamilton, *Indivisibilities and Interplant Transportation Cost: Do They Cause Market Breakdown*, 7 J. URB. ECON. 31 (1980). Hamilton persuasively argues that the configuration of plants around any location is the unpriced resource that causes the inefficient allocation of firms in a decentralized price system, known as the Koopmans-Beckmann result. *Id.* at 38-40. *See generally supra* note 18 and accompanying text.

highest under the optimal allocation of firms to locations, there necessarily exists a set of side payments that will make all firms prefer the optimal spatial configuration. This example with three firms involves six possible network configurations, so that a total of eighteen contingent contracts would have to be specified correctly to induce self-interested firms to locate optimally.[20] As a network becomes large, the side-payment contract system becomes unwieldy. For twenty locations the number of contingencies would be 4.6×10^{20}.[21]

The fact that the decentralized price system alone cannot guarantee an optimal spatial configuration and that an unreasonably large number of contract contingencies is needed to overcome this defect of the price system is not the only problem in an uncoordinated network industry. Even if a network industry could establish an optimal spatial configuration, it would not be able to react properly to change. If a network must expand by one node,[22] a decentralized price system will fail to provide the correct incentives for the location of the new node. Each firm will want the extra node within its own territory, provided positive revenues result, even if such a decision will lead to greater costs or lower revenues elsewhere in the network. Because independent firms will establish additional locations within their territory without considering the effects such locations impose on the entire system, a network of private firms capable of expansion has a tendency to build excess capacity.

A special problem arises if the construction of a network entails large initial costs, but the use of the network involves constant or continuously declining marginal costs. For example, the added cost of sending one more ton of freight on an existing railroad network, the marginal cost of shipment, may be small compared to the high average fixed cost of the railroad's plant and equipment. In such natural monopolies, prices must exceed marginal costs if firms are to break even, because firms must build and maintain costly networks.[23] Agreeing on a price for the use of each

---

[20] Three firms, *A*, *B*, and *C*, could produce six different configurations: *ABC*, *ACB*, *BAC*, *BCA*, *CAB*, *CBA*. A complete system of side contracts would require a contract between each party. The six configurations would therefore produce 18 possible contracts.

[21] With 20 locations, there are 20! configurations, each of which involves ((20 x 19) ÷ 2) side contracts. $20! \times ((20 \times 19) \div 2) = 4.6 \times 10^{20}$.

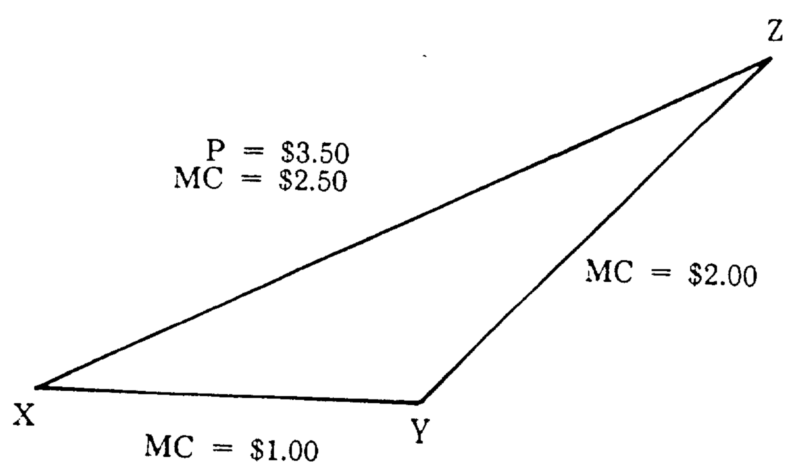
[22] An additional station in a railroad network or an additional telephone switching facility are examples of an additional node in a network.

[23] In natural monopolies, marginal costs are typically below average costs. A firm selling at marginal cost would never recoup its full average costs. More complicated pricing

link in the network may be difficult if the network includes independent firms which compete with each other in certain markets. Enforcing any price agreement reached may be even more difficult because each firm has an incentive to cut its price to obtain additional business as long as the price exceeds its marginal cost.[24]

Even if it were possible for firms to reach agreement and adhere to a pricing system with price above marginal cost, improper incentives regarding the use and expansion of the network would arise. Wherever price exceeds the marginal cost of using a link in the network, each firm will have an incentive to try to obtain traffic (e.g., phone calls, people, freight) over its link to gain revenue, regardless of whether the result is inefficient overall routing. In such a situation, firms will become concerned with developing their own feeder traffic, realizing that they cannot rely on other firms to provide them with traffic even if their route is the least costly one to use.

For example, suppose that firm *A* feeds traffic into node *X* and also has routes from *X* to *Y* and from *Y* to *Z*. The marginal cost of using link *XY* is $1 and *YZ* is $2. Firm *B* only has a route *XZ* whose marginal cost of use is $2.50. The facts of this example can be represented by the following network configuration:



schemes in which the price per unit is not constant could achieve marginal cost pricing. It is often quite difficult to implement such schemes.

[24] *See* R. Posner & F. Easterbrook, *supra* note 11, at 97-98. A famous railroad cartel, the Trans-Missouri Freight Association, attempted to solve the price-cutting problem with a complicated scheme of rate setting and review. The entire cartel was declared illegal in United States v. Trans-Missouri Freight Ass'n, 166 U.S. 290 (1897).

If price is in excess of marginal cost, firm *A* will have an incentive to route all of its traffic going from *X* to *Z* through its own routes (*XY*, *YZ*) whenever the price of firm *B*'s direct route exceeds the cost to firm *A* of using its own routes. In this example, if the price of using the *XZ* link is $3.50, firm *A* will use its own route, even though fewer resources would be used if firm *B*'s direct route (*XZ*) were used. Recognizing this, firm *B* might expand network capacity and develop its own feeder routes into point *X*. Inefficient routing and inefficient network expansion are thus the result.

Further problems for network industries involve innovation. Without coordinated action, firms in a network industry may be unwilling to introduce new cost-saving innovations. The benefit of a new technology at one location in a network may lower costs at other locations by reducing congestion in the network. Where the network is owned by several different firms, none of them will have the correct incentives to innovate because part of the benefits of the innovation may inure to other firms. Only a complicated set of side payments between firms could correct the situation. Moreover, even if the benefit inures to the innovator initially, the high degree of interaction among firms might make it easy for other firms to learn of and imitate the innovation. Also, since coordination among the inputs used in a network may be critical,[25] an input innovation may be valuable only if input suppliers to other firms in the network alter their product. But telling other input suppliers how to alter their product may reveal the innovation to these other firms. The fast reaction time of others might deprive the innovator of the ability to recoup his research and development ("R&D") investment, reducing the incentive to innovate.

Another problem with innovation arises when the innovation is valuable only if all members of the network adopt the innovation.[26] Any one firm in the network could threaten to render the innovation valueless by refusing to cooperate, and it could use the threat to extract the profits of the innovator. Without an assurance that firms in the network will collectively behave in their own long-run self-interest, an innovator may have little incentive to innovate.

[25] A network may require compatible machinery in order to operate correctly, for example.

[26] For example, development of a railroad engine that operates only on a particular rail design would be of little value unless all firms adopted the particular rail design.

C. The Market Structure of Network Industries

If it is very costly to reach consensus among independent firms in a network industry on standards, routing, and expansion, then horizontal integration might arise. The horizontally integrated firm (a single firm in control of an entire network) could internalize the externalities inherent in a network. For example, a horizontally integrated network industry avoids the spatial configuration problems noted above. Because the integrated firm bears all of the costs and receives all of the benefits of a particular location decision, the firm has the incentive to locate its operations correctly.

Standardization of operations and machine compatibility is likely to be very important in network industries. Vertical integration might be a method for a horizontally integrated firm to achieve standardization of its inputs. Vertical integration combined with horizontal integration might also be used to facilitate innovation in networks: since the firm itself would be both the network and its supplier, the firm would not have to worry about exploitation by other firms in the network or about imitation either by other firms in the network or by other suppliers to the network.

II. Applications

In this part, we illustrate many of the theoretical points made in part I about the setting of standards and the operation of a network by examining three network industries: the railroad industry, the telephone industry, and the new electronic funds transfer industry.

A. Railroads

The development of the railroad industry in the period 1850-1910 illustrates the problems of an industry in which efficient production requires coordination among producing firms. Before 1850, there was little need for coordination among railroads. Most railroads consisted of a single line connecting two points, usually two cities. As these lines expanded, however, efficiency and safety considerations spurred the coordination of geographically separate, but contiguous, sections of track.

The first intersectional railroad, the Western, was also the first to encounter problems with coordination.[27] Its line connecting Worcester and Albany, completed in 1840, consisted of three sec-

[27] A. Chandler, The Visible Hand 96 (1977).

tions, each of which was originally operated by the section's own staff.[28] A series of accidents from this decentralized operation culminated in a head-on collision of two passenger cars in 1841, killing two people.[29] The accident prompted the centralization of Western's operations and the creation of a common precise timetable.[30] As other lines began to expand regionally, they patterned themselves on Western's organization.[31]

As rail systems grew, cooperation between different regional railroads became necessary to create an efficient national overland transportation network.[32] The following discusses the railroads' efforts at cooperation, the integration of the rail industry, and the theoretical implications of the railroads' experiences.

1. *Early Efforts at Cooperation.* The first efforts at coordination among railroads began in the mid-1850's, when railroad executives began to hold meetings regarding freight classification, scheduling, and rates.[33] They reached agreement on classification and scheduling fairly easily and agreed upon a set of competing freight rates that prevailed from 1857 until the depression of 1873.[34] Although railroads expanded rapidly during this period, so did demand, particularly as the integration of the rail system made rail transportation increasingly attractive.[35] But as the depression mounted in 1873, so did financial pressures and the temptation to cheat on rates.

In 1874, the executives of all major northern rail lines, except one, met to set a formal rate agreement.[36] The other railroad, the Baltimore and Ohio ("B&O") declined the invitation, and when it completed its line to Chicago it lowered its Baltimore-Chicago fees

---

[28] Each of the railroad's three operating sections was a separate division, with its own management. The company ran three trains a day in each direction, on a single track, through mountainous terrain, without telegraphic signals. The trains moving in opposite directions met twelve times daily, requiring accurate coordination of schedules. *Id.*

[29] *Id.*

[30] *Id.* at 97.

[31] *Id.* at 98. The coordination of other lines was prompted by the volume of freight traffic rather than the safety concerns that prompted the Western's reforms.

[32] For example, in 1849, a freight shipment from Philadelphia to Chicago took nine weeks and required at least nine transshipments. A transshipment is the transfer of freight from one freight car to another. By 1859, coordination allowed the freight to pass in three days and required only one transshipment. *Id.* at 122.

[33] *Id.* at 125.

[34] *Id.* at 126.

[35] From 1865 to 1875 freight traffic carried by the nation's 13 major roads more than tripled. The 1880's saw rail freight traffic double again. THE STATISTICAL HISTORY OF THE UNITED STATES FROM COLONIAL TIMES TO THE PRESENT 727 (1976) (Series Q 280 & 283).

[36] A. CHANDLER, *supra* note 27, at 137.

to below the agreed-upon rate.[37] During the winter of 1875-76, the B&O demonstrated the profitability of its independent price cutting,[38] and other railroads followed the B&O in lowering prices.[39] Soon the low rates had everybody—even the B&O—worried, and the major rail executives met in 1877 to establish a joint executive committee to set rates and, just as important, to apportion traffic.[40] During 1877 and 1878 there was still comparatively little adherence to agreed-upon rates.[41] The year 1879 brought a new agreement that produced calm until 1880-81.[42] In 1882 a stronger pool was formed,[43] and this time money was also pooled to compensate those lines that did not get their apportioned share of traffic. This agreement, like its predecessors, succeeded only intermittently.[44]

It took the railroads longer to reach agreement concerning physical integration than it had to reach the initial rate agreements.[45] In 1861, railroads used different gauges and track designs,[46] and it was often the case that competing lines entering the same city did not meet.[47] Much of this incompatibility was designed to prevent other railroads from siphoning off feeder traffic.[48] Railroads eventually began to see the economic advantages of linking their systems and coordinating their operations. Throughout the 1860's and 1870's, numerous conventions of railroad managers were held, and many trade publications were written to foster resolution of these difficulties.[49] By the 1880's the process of

---

[37] *Id.* at 138; P. MacAvoy, The Economic Effects of Regulaton 45 (1965).

[38] P. MacAvoy, *supra* note 37, at 49.

[39] A. Chandler, *supra* note 27, at 138. New entrants also cut rates to obtain traffic. The Grand Trunk of Canada line, opened in 1875, entered the market with rates below the agreed-upon rate. *Id.*

[40] *Id.* The presidents of the major trunk lines asked Albert Fink, who was managing a similar system in the South, to run their new rate setting organization, the Eastern Trunk Line Association. *Id.*; P. MacAvoy, *supra* note 37, at 51-52.

[41] P. MacAvoy, *supra* note 37, at 52-56.

[42] *Id.* at 58, 79-91.

[43] *Id.* at 92.

[44] *Id.* at 92-95.

[45] Some physical integration was easy to accomplish. Railroad lines formed joint ventures to build and maintain connecting bridges and intracity belt lines. A. Chandler, *supra* note 27, at 124.

[46] Even by 1881, 119 different patterns and 27 different weights of rail were still in use. Fishlow, *Productivity and Technological Change in the Railroad Sector, 1840-1910*, in Output, Employment and Productivity in the United States after 1800, at 583, 633 (NBER Studies in Income and Wealth vol. 30, 1966).

[47] A. Chandler, *supra* note 27, at 122.

[48] *Id.*

[49] *Id.* at 130-32.

coordination that began in the 1850's was largely complete:[50] a rail shipment could finally move from one part of the country to another without a single transshipment.[51] Switching facilities and belt lines had been built,[52] a standard gauge was initiated in 1886,[53] and a standard rail design was in widespread use by the mid-1890's.[54]

Railroad managers also established uniform operating procedures. For example, on November 18, 1883, all railroads synchronized their clocks.[55] Some of the uniform operating procedures were spurred by outside competition. During the thirty-year period beginning in 1850, independent freight companies, such as Wells Fargo, began to serve as intermediaries between railroads and customers who desired to ship goods. These freight companies handled the complicated transactions with all the different railroads.[56] This business was extremely lucrative, and the railroads naturally wanted to obtain some of the profits. To do so, however, they needed to establish common operating procedures to reduce the expense of transacting with many railroads when transshipment across different railroads was required. Two innovations were crucial to accomplish this. First, a common bill of lading was introduced to give details of the goods being shipped, the route over which they were to be sent, and the charges levied.[57] Second, car account offices were established by the major companies to keep track of other firms' cars on their lines and their cars on other firms' lines.[58] By the 1880's, the railroads had little need for freight express companies. The railroad industry had been transformed into a small number of multi-unit enterprises, with much coordination of activities.

2. *Corporate Integration and Theoretical Implications.* By the mid-1880's most railroad executives realized that agreements would not be sufficient to ensure railroad cooperation on expansion, routing, or pricing. For the reasons presented above in the theoretical analysis, the railroads could not rely on other railroads

---

[50] *Id.* at 124.

[51] *Id.* at 123. *See supra* note 32.

[52] A. CHANDLER, *supra* note 27, at 124.

[53] *Id.* at 130.

[54] Fishlow, *supra* note 46, at 633.

[55] A. CHANDLER, *supra* note 27, at 130.

[56] The freight companies not only expedited freight shipments, but also controlled large fleets of freight cars. *Id.* at 127-28.

[57] *Id.* at 129.

[58] *Id.*

to supply them with the feeder traffic so crucial to their solvency. Most turned to integration by building nationwide systems to create their own through traffic. In 1887 the prohibition against railroad pools in the Interstate Commerce Act removed any last hope that interfirm coordination might work.[59] By 1906, the process of horizontal consolidation had continued to the point where two-thirds of the nation's rails were controlled by only seven groups.[60]

Railroad firms increased in size greatly during the last half of the nineteenth century. From 1860 to 1880, average firm size quintupled;[61] from 1880 to 1910, it quadrupled.[62] As our theory predicts, however, the increase in the network's capacity was not necessarily completed in the most efficient way. As the railroads pursued their empire building, a great deal of overbuilding occurred. In the 1880's more miles of track were built than in any other decade; in the 1890's more mileage was in bankruptcy than in any other decade.[63]

Consistent with our theory, the evolving coordination and integration of the nation's rail system was accompanied by consistent and large increases in productivity. Fishlow estimated that from 1839 to 1910, annual total factor productivity increases in railroads averaged 3.5% at a time when the aggregate factor productivity increase in the U.S. averaged less than 1.3%.[64] Only part of the productivity advance was the result of major technological change. Fishlow found that the gains in productivity due to four important mechanical advances[65] accounted for only half the increase in productivity from 1870 to 1910.[66] The other half was apparently due to residual technological advance and economies of scale.[67] In addition to technology, the blossoming of trade associations, which helped set standards and evaluated new technological proposals, contributed to efficiency.[68] Much of the period's technological pro-

[59] *See* Interstate Commerce Act, ch. 104, § 5, 24 Stat. 379, 380 (1887) (codified as amended at 49 U.S.C. § 5(1) (1976)); P. MacAvoy, *supra* note 37, at 112.

[60] A. Chandler, *supra* note 27, at 174.

[61] Fishlow, *supra* note 46, at 632.

[62] *Id.*

[63] A. Chandler, *supra* note 27, at 147.

[64] Fishlow, *supra* note 46, at 629.

[65] Fishlow examined the productivity effects of four important technological advances: steel rails, increased equipment capacity, air brakes, and automatic couplers. These innovations subsumed a host of lesser innovations. *Id.* at 634.

[66] *Id.* at 644.

[67] Fishlow did not estimate the productivity gains resulting solely from the increased operating efficiency of the railroads.

[68] Fishlow, *supra* note 46, at 632-33.

gress was linked to firm size: four of the five most important railroad inventions in the 1800's[69] were developed by large railroads, and the origin of the fifth is uncertain.[70] This confirms our theoretical expectation that vertical integration and innovation, that is, discovering an innovation and capturing the benefits of an innovation for one's own use, are likely to go hand in hand in a network industry.

The history of the American rail network illustrates the theory we presented earlier. It shows that firms gradually increased in size in an attempt to internalize the externalities associated with the operation of a network. The initial setting of standards, though time consuming and difficult, was accomplished without large scale horizontal integration. The eventual horizontal integration of the system was required to address the routing, expansion, and pricing problems of a network. Vertical integration into R&D proved to be the way to achieve technological advances.

It is important to remember that as long as independent firms in a network interact, our theory predicts that there will exist incentives for inefficient network operation. One excellent illustration is the recent case of *Bangor and Aroostook Railroad* [the "B&A"] *v. ICC*.[71] The B&A, a feeder railroad, agreed to feed its traffic to the Canadian Pacific Line ("CP"), rather than to others, even in cases where another rail line was the lowest cost shipper. The CP expanded and made payments to the B&A.[72] The First Circuit ruled that the B&A's actions violated the Interstate Commerce Act, which forbids diverting feeder traffic in a way that causes inefficient network utilization.[73] The *B&A* case demon-

---

[69] Based on frequency of citation in discussions of technological innovation in railroads, Fishlow claimed that the five most important innovations of the nineteenth century were the use of the telegraph to control train movements (1851), the substitution of steel rails for iron rails (1862), and the development of block signaling (1863), air brakes (1869), and automatic couplers (1873). *Id.* at 632.

[70] *Id.* The first use of air brakes is uncertain. Some authorities credit the B&O, but other authorities credit lesser lines. *Id.* at n.81.

[71] 574 F.2d 1096 (1st Cir.), *cert. denied*, 439 U.S. 837 (1978).

[72] *Id.* at 1102-03.

[73] The Act provides that "[a]ll carriers subject to the provisions of this chapter . . . shall not . . . unduly prejudice any connecting line in the distribution of traffic that is not specifically routed by the shipper." 49 U.S.C. § 3(4) (1976). The court agreed with a three-judge district court

> "that preferential solicitation when done on a 'preconcerted' and 'systematic' discriminatory basis . . . falls within the statutory prohibition of section 3(4) [as preferential routing]. The preferential solicitation dictated by the agreement is without concern for competitive benefits of similar lines and without relationship to the best possible service to the shipper."

strates that the rail system has not solved all of its externality problems, and that coordinated action is needed to achieve efficiency in a network industry.

B. The Telephone Industry

The telephone industry is another example of a network. When a long-distance call is made, the call is handled first by the caller's local phone company, then by a hierarchy of switching stations, and finally by the facilities of the receiver's local phone company. Because the phone system is not a single firm but instead consists of AT&T and several independent phone companies,[74] it is inevitable that the problems requiring interfirm cooperation will arise in the telephone network. The history and problems associated with operating and planning the long-distance network have been extensively documented elsewhere.[75] Here we discuss a few problems in the telephone industry to illustrate the difficulties uncovered in the theoretical section.

Revenue from long-distance calls must be allocated between local exchanges and long-distance companies. This sharing involves a complicated procedure based on the amount of capital devoted to long-distance usage. Since the division of long-distance revenue depends on the firm's capital devoted to handling long-distance calls, local phone companies have an incentive to increase the amount of equipment involved in handling long-distance calls. This incentive was at the heart of the dispute in *People's Telephone Cooperative v. Southwestern Bell Telephone Co.*[76] Long-distance calls originating in People's territory were transmitted over General Telephone lines to Bell. People's constructed its own toll lines to connect directly to Bell. Bell refused to interconnect with People's new lines. People's charged that Bell and General Telephone had conspired, in violation of federal antitrust law, to prevent it from increasing its share of capital devoted to long-distance calls and thereby prevent it from increasing its long-distance revenue.[77] The court stayed the antitrust claim pending exercise by the FCC of its primary jurisdiction over the matter.[78] *Doniphan Telephone Co. v.*

---

574 F.2d at 1103-04 (quoting Southern Pac. Ry. v. United States, 277 F. Supp. 671, 685 (D. Neb. 1967), *aff'd mem.*, 390 U.S. 744 (1968)).

[74] *See* Lavey, *Joint Network Planning in the Telephone Industry*, 34 FED. COM. L.J. 345, 346-48 (1982).

[75] *Id.*

[76] 399 F. Supp. 561 (E.D. Tex. 1975).

[77] *Id.* at 562.

[78] *Id.* at 562-63. The FCC ordered that the matter be investigated by an Administrative

AT&T[79] is a similar dispute. Doniphan, an independent telephone company, wanted to construct switching and transmission facilities with connections to Bell at higher levels of the switching hierarchy than was usual.[80] The new equipment would have quadrupled Doniphan's long-distance revenues.[81] The FCC denied Doniphan's request, finding it neither desirable nor in the public interest.[82] These examples demonstrate the incentive for excess capacity in a network that coordination could eliminate.

Perhaps the clearest instance of conflict in network planning and operation comes from the cases involving specialized common carriers who seek to provide their own interexchange service.[83] These companies have claimed that the design and operation of the telephone network has unfairly excluded them from competing. Recent court and regulatory decisions have allowed these independent interexchange companies a much greater role in the market. Moreover, the recent settlement of the government's antitrust suit against AT&T severs the link between the long-lines network and local operating companies, and it requires local phone companies to charge the same interconnect charge to all providers of interexchange service.[84] Joint network planning between the long-lines network and local phone companies will presumably continue, subject to antitrust law. How much scope this gives for joint planning remains to be seen, and some inefficiencies in network planning may result.

It may be that technological developments in interexchange service have made inefficiencies in network planning less important relative to the need for providing the opportunity for competition in interexchange service. A serious problem that could arise now, however, concerns the pricing of the local exchanges. Local regulators will be faced with the problem of generating sufficient reve-

---

Law Judge. People's Tel. Coop., Inc. v. Southwestern Bell Tel. Co., 62 F.C.C.2d 113 (1976).

[79] 34 F.C.C. 949 (1963).

[80] *Id.* at 962-64.

[81] *Id.* at 961.

[82] *Id.* at 967-73.

[83] *See, e.g.*, MCI Telecommunications Corp. v. FCC, 580 F.2d 590 (D.C. Cir.) (Execunet II) (AT&T ordered to provide interconnection), *cert. denied*, 439 U.S. 980 (1978); MCI Telecommunications Corp. v. FCC, 561 F.2d 365 (D.C. Cir. 1977) (Execunet I) (FCC erred in rejecting MCI tariff), *cert. denied*, 434 U.S. 1040 (1978).

[84] United States v. Western Elec. Co., 1982-2 Trade Cas. (CCH) ¶ 64,900, at 72,557 (1982) (§ II(B)(3)) (modification of final judgment). For an analysis of the modification of the final judgment, see W. Lavey & D. Carlton, Economic Goals and Remedies of the AT&T Modified Final Judgment (unpublished manuscript) (on file with *The University of Chicago Law Review*) (forthcoming in the *Georgetown Law Journal*).

nues to cover the nonusage-sensitive costs of the local phone companies. If local regulators attempt to charge interexchange carriers an access charge per call that is in excess of actual marginal costs, the interexchange carriers will be encouraged to bypass the local exchange.[85] Although bypass is still relatively rare, the use of existing bypass technology and the development of new bypass technologies would be encouraged by access charges in excess of marginal cost. Moreover, since a large fraction of all interexchange usage is concentrated among relatively few users, bypass could become a real problem within a few years. Of course, this shift away from use of the local exchange would not only be inefficient but would exacerbate the local regulator's problems of raising enough revenue to cover fixed costs. It is too early to tell whether local regulators will have the courage to move to more cost-justified rates, with the financing of fixed costs coming from nonusage-sensitive charges, such as a flat fee for the ability to use the local exchange.[86] Without such a policy, many of the inefficiencies in network usage we have demonstrated could develop as users adapt their behavior to avoid paying prices in excess of marginal costs.

C. Electronic Funds Transfer

The problems involved in the creation of an efficient electronic funds transfer ("EFT") network are analogous to those of the railroad industry of the nineteenth century and illustrate our theory. EFT's problems can be broken down into two general areas: the creation of common standards to facilitate communication between data networks, and the sharing of certain facilities to achieve cost savings. These considerations are not independent of each other.

The EFT industry owes its existence to rapid technological developments. EFT systems have a wide variety of uses. EFT could improve existing banking systems in the use of preauthorization techniques. The payment of a worker (or stockholder or welfare recipient) and his subsequent payment of recurrent obligations (rent, mortgage, utility bills) can involve the time-consuming transfer of pieces of paper between parties. Preauthorization and electronic funds transfer can eliminate the need for transfers between parties. Bill payments can be deposited automatically. Even if receipts are given to acknowledge the transactions, this procedure would save time and paper.[87]

[85] *See supra* notes 23-24 and accompanying text.

[86] Recent FCC rulemaking suggests that federal regulation of communications will move in the direction of cost based rates. *See, e.g.*, Access Charges; MTS and WATS Market Structure, 48 Fed. Reg. 10,319 (1983) (to be codified at 47 C.F.R. §§ 69.1-.610).

[87] Arthur D. Little, Inc., The Consequences of Electronic Funds Transfer 4 (1975).

Another area for the use of EFT is in automated banking services. Many institutions already have automated tellers, which provide around-the-clock service and allow a great expansion of a bank's operating area.[88] Still another area for EFT utilization involves point-of-sale devices, which could supplement existing cash, check, and credit card methods of financing purchases. There are many ways of implementing EFT in this area, ranging from on-site verification of a customer's check by electronic means to the immediate transfer of funds from the shopper's bank account to the store's account.[89] This is not an exhaustive survey of possible EFT uses, but it is indicative of the types of possible services.[90]

Cost considerations will spur institutions to contemplate sharing network facilities. A number of banks, for example, could split the cost of a single switching and processing facility for their automatic tellers. Even the teller devices themselves could be shared: the customer would simply identify the bank with which he wanted to communicate.[91] Point-of-sale devices might need to be shared not only for efficiency, but because of the retailer's reluctance to have the devices of several different firms on his premises. Finally, sharing increases the initial customer base, which might enable certain EFT operations to become profitable more quickly.[92]

Setting common standards is obviously crucial to the successful sharing of network facilities. Various procedures are needed for the different elements of the network to communicate with each other. There would also have to be consensus on measures for fraud protection, error correction, secure-access identification,[93] and the provision of an audit trail to trace transactions.[94] This audit trail is similar to the need for a common bill of lading in the

---

[88] *Id.*

[89] *Id.*

[90] For a description of other uses in banking and payment systems, see *id.* at 72-74.

[91] *See id.* at 152-53.

[92] *Id.* at 153.

[93] *Id.* at 22, 237.

[94] For a description of the problems of theft, erroneous transactions, system errors, and the mechanical and procedural means to prevent such problems, see NATIONAL COMMISSION ON ELECTRONIC FUND TRANSFERS, EFT IN THE UNITED STATES: POLICY RECOMMENDATIONS AND THE PUBLIC INTEREST 55-66, 183-94 (Final Report Oct. 1977) [hereinafter cited as NATIONAL COMMISSION].

railroad industry.[95] Coordination problems, if not encountered on a local level, certainly would be experienced as local networks combine to create regional networks and regional networks combine to create a national network.

As our theory would predict, standard setting in the rapidly changing EFT industry was slow in developing. The delay in developing standards is the result of (1) the consensual nature of standard setting and (2) the unwillingness of manufacturer or supplier groups to undertake the expense of determining whether a proposed standard is technically feasible.[96] The delay can have at least two direct effects: it can slow the development of integrated networks and can freeze the technology at the lowest common denominator.

Based on our theory, we expect that the EFT industry will become dominated by one nationwide or perhaps several large regional firms. The need for horizontal integration to facilitate standard setting is clear. We might also expect that once the network becomes more horizontally integrated, the horizontally integrated firms will vertically integrate into R&D.[97]

Because of the potential savings from sharing network facilities, other observers have suggested that future EFT systems might best be organized as a national public utility[98] or at least as interconnected regional utilities.[99] Concern over the consolidation of EFT networks led Congress in 1974 to establish the National Commission on Electronic Fund Transfers.[100] The Commission recommended that EFT systems should be licensed, not regulated, with some (unspecified) amount of cooperative arrangements allowed.[101] It further emphasized that antitrust law should apply in full force to any sharing arrangements.[102] These conflicting recommendations provide little guidance in determining the allowed amount of interfirm coordination, and this uncertainty has undoubtedly delayed the development of EFT.

---

[95] *See supra* notes 55-57 and accompanying text.

[96] *See* National Commission, *supra* note 94, at 172.

[97] For a detailed analysis of EFT, as well as a slightly different viewpoint, see W. Baxter, P. Cootner & K. Scott, Retail Banking in the Electronic Age (1977).

[98] *See* Arthur D. Little, Inc., *supra* note 87, at 153.

[99] *See id.* at 42 (best technical solution).

[100] Act of Oct. 28, 1974, Pub. L. No. 93-495, §§ 201-208, 88 Stat. 1500, 1508-11 (codified at 12 U.S.C §§ 2401-2408 (1976)).

[101] *See* National Commission, *supra* note 94, at 92-97.

[102] *See id.* at 97-98. *See also* National Commission on Electronic Fund Transfers, EFT and the Public Interest: A Report of the National Commission on Electronic Fund Transfers 51-52 (Feb. 1977).

Conclusion

This paper has presented a simple theory predicting the difficulties that arise when standard setting or networks are involved. We illustrated these difficulties with examples from the railroad and telephone industries and from the relatively new electronic funds transfer industry. We argued that changes in market structure through horizontal and vertical integration are likely to arise in response to these difficulties. The evolution of the railroad industry provides an illustration of these changes in market structure. The theory predicts that the relatively new electronic funds transfer industry will undergo similar horizontal and vertical integration.

It is not easy to balance the efficiency gains of coordinated action against the loss in competition that may result, but the special need for coordinated action in network industries must be recognized. In the early stages of development when an industry is evolving rapidly, coordinated action can have large payoffs. The loss of competition, though always a worry, is less of a worry in a rapidly developing industry with many potential entrants. Yet there is no doubt that industry fear of antitrust liability can retard network industries, especially in their early phases of development. Rules of reason therefore should guide government action regarding network industries to facilitate the gains of coordination.

Citation 1995 WL 728562 | Search Result | Rank 11 of 19 | Database SCT-BRIEF

<<For transcript see 1996 WL 12827 (U.S.Oral.Arg.)>>

LOTUS DEVELOPMENT CORPORATION, Petitioner,
v.
BORLAND INTERNATIONAL, INC., Respondent.
No. 94-2003.
United States Supreme Court Amicus Brief.
October Term, 1995.
December 8, 1995.

AMICUS BRIEF, U.S.S.CT.

On Writ Of Certiorari To The United States Court Of Appeals For The First Circuit

BRIEF AMICUS CURIAE OF ECONOMICS PROFESSORS AND SCHOLARS IN SUPPORT OF RESPONDENT

JOSHUA R. FLOUM (Counsel of Record) HELLER EHRMAN WHITE & MCAULIFFE 333 Bush Street #3100 San Francisco, California 94104-2878 (415) 772-6000 Attorneys for Amici Economics Professors and Scholars

*i TABLE OF CONTENTS

*iii TABLE OF AUTHORITIES

CASES

MISCELLANEOUS

***1** I. INTEREST AND IDENTITY OF THE AMICI

Amici are professors at Harvard University, Stanford University, Columbia University, the University of California, and other major universities, and other economic scholars who teach and write on economic issues. The economic conditions that prevail in markets such as the one before the Court in this case are subjects of intense interest and research among academic economists. Indeed, a number of amici have written scholarly papers addressing the application of intellectual property protection generally, and copyright law specifically, to "network" markets of the type at issue here. Amici do not represent either party in this action, and offer the following views on this matter in the public interest. [FN1] The parties have consented to the filing of this brief.

FN1. None of the amici listed in Appendix A are being compensated in any way for the work on this brief. The signatories to this brief exercised complete control over its editorial contents. Respondent Borland International, Inc. helped to defray the costs of preparation of this brief. One of the primary authors of this brief has performed a small amount of consulting services to Borland in the past.

II. SUMMARY OF ARGUMENT

Intellectual property policy balances increased incentives for innovation against the harms from monopoly. Patent law confers relatively strong protection but requires evidence of significant novelty, utility, and nonobviousness. Copyright law does not demand so significant an innovation, but traditionally protects only ***2** "expression" for which there exists close economic substitutes. In computer software, however, as users invest in training, the creation of data files, and the creation of macros, all based on the interfaces of the software they are using, and as more users adopt a particular interface, what were initially arbitrary choices in the design of an interface may become compelling choices. Alternatives that were initially close creative substitutes do not remain close economic substitutes. Thus, if copyright protects an interface, it may confer substantial monopoly power and foreclose subsequent innovation.

Such a monopoly may be an appropriate reward if the entrant's product is highly innovative, and amici do not advocate denying protection to successful software products. But in the case of software interfaces, the economic dynamics may confer this reward even if the product is not highly innovative. The monopoly power results not from the superiority of the copyright holder's creation, but from the accretion of users' investments. Thus, amici believe that uncritical copyright protection for interfaces in computer software is dangerous, and on balance undesirable when these economic dynamics prevail.

***3** III. ARGUMENT

A. Intellectual Property Policy Embodies an Economic Trade-off

1. Monopoly Power Is Generally Harmful

Economic analysis and experience alike teach that, in general, monopoly is harmful, for a variety of reasons. A single entity that controls a market may, through avarice or error, make inefficient choices; in consequence consumers suffer and have no recourse. Protected from competition, the monopoly may become wasteful. Would-be competitors and subsequent innovators may be stymied or handicapped; in the case of a legally-protected monopoly, their competitive efforts may be distorted to avoid infringing the monopoly. And - the classic pricing inefficiency of monopoly - economic value is destroyed when the seller charges prices above cost so that buyers are harmed by more than the seller benefits.

2. Intellectual Property Policy Tolerates These Harms to a Limited Extent, in Order to Reward Innovation

Such inefficiencies result even when the monopoly is granted for good reason, as is the case for much intellectual property protection. Competition in exploiting an invention would be much preferable to monopoly in exploiting the same invention, for all the above reasons, among others. But we must also take into account the incentives to invent or to create in the first place. Especially if imitation is cheap and effective, as is the case with literal copying of software "code," unrestrained ***4** competition in exploiting a creation may greatly reduce these incentives.

Therefore, economists see intellectual property law as embodying a trade-off: it should aim to confer just enough reward to encourage desirable innovation without creating unnecessary monopoly, and should protect in ways that minimize any incidental harm caused by monopoly. Substantial monopoly power should not be granted for creations that are not significantly innovative.

3. When (Close) Creative Alternatives Are (Close) Economic Alternatives, Copyright Does Not Confer Harmful Monopoly Power

Patent protection requires a showing of novelty, utility and non-obviousness. Copyright protection lacks these requirements, and therefore risks conferring monopoly power where no substantially innovative contribution needs to be rewarded.

In the traditional realms of copyright, such risks have perhaps not been excessive. Since copyright traditionally protects "expressions" for which there are good alternatives, and not the underlying "idea," it does not normally confer substantial control over the entire market: Expression generally has substitutes in the traditionally creative sense, which will also be substitutes in the economic sense, limiting the copyright holder's control of economic markets.

This reassuring argument assumes that good substitutes at the time of creation remain effective substitutes and can later compete as such. It breaks down if initially *5 arbitrary choices, for which there are good alternatives, become economically compelling through market dynamics.

B. Software Market Dynamics Can Turn Arbitrary Choices Into Compelling Choices

The initial design choices in a computer software interface may well be largely arbitrary, in the sense that comparably good alternatives are available. However, as users acquire experience in using the product, invest in learning and in writing macros and creating files, and as more and more users adopt an interface, those alternatives may no longer be comparably good. Thus, because of the nature of users' behavior in computer software markets, initially arbitrary interface choices, for which comparably good alternatives were readily available, can become uniquely desirable for users and therefore also for competitors. For brevity we will say they become "compelling." This happens through two related economic processes that economists call "network effects" and "user switching costs." [FN2]

FN2. The process by which these two economic forces combine to make copyright protection over software interfaces socially harmful is spelled out in Kenneth Baseman, Frederick Warren-Boulton and Glenn Woroch, "The Economics of Intellectual Property Protection of Software: the Proper Role for Copyright," StandardView 3, June 1995.

*6 1. Network Effects

The English language would look highly arbitrary from the viewpoint of a "language designer" working with a clean slate. From such a viewpoint, there are a plethora of alternatives, many equally good and, surely, some better. Yet, for instance, once hundreds of millions of Americans learn the English language, these alternatives are no longer comparable. For every user, the advantages of learning and using the language of her community outweigh any benefits of superior design (such as are sometimes claimed, for example, for Esperanto). The user values, above all, the ability to communicate and "interoperate" with other users. Through the subsequent cumulation of others' choices and learning investments, the initially arbitrary language has become compelling: users will favor it even if it is not particularly good.

The same forces operate in many economic markets; economists call these forces "network effects." The classic illustration of a network effect, which is also responsible for the name, is a telephone network: the value of phone service to any individual depends on how many other individuals are connected. More generally, a network effect is an economic force that makes a product more valuable to each user, the more other users own that product or a sufficiently compatible one. In addition to direct network effects such as the telephone example, "indirect" network effects may be created through greater supply of

complementary products.
*7 Network effects are important in software markets. [FN3] Users want to share data files and programs such as macros; they want to work on machines owned by others; they want access to a wide selection of complementary products (including third-party manuals, consulting services, training courses, and add-on software). Certain aspects of programs must be identical in order for users of different programs to share these network benefits; these aspects will predictably include "interfaces" and aspects of a program that define a language, such as a macro language. [FN4]

FN3. The presence of network effects was accepted by the court for personal computer operating system software in Apple Computer, Inc. v. Microsoft Corp., 717 F. Supp. 1428, 1431 (N.D. Cal. 1989).

FN4. Amicus Brief of Computer Scientists Re Copyrightability of Computer Languages, Lotus Development Corporation v. Borland International, Inc., December 1993, at 2 (J.A. 10).

2. User Switching Costs

Software users invest in complementary products and services, and in creating files and programs. Consider two programs that incorporate different arbitrary choices in their interfaces - choices that are equally good from the users' point of view prior to purchase and use. Because of these different interface specifications, the user's investments in learning, file creation, etc. are difficult or costly to transfer from one program to the other. Even if the user would be indifferent between the two interfaces ex ante, once she has invested in one system, she will substantially prefer it because she would have to *8 replicate these investments in order to switch to the other. [FN5]

FN5. As an analogy, consider the potential for introducing competition in local telephone service. One issue in this area is whether a subscriber should have the right to keep her telephone number if she switches to a competing carrier. The user has "invested" by telling her friends her number and printing it on checks and stationery, for instance. If the local (currently regulated) monopoly telephone company had "copyright" over subscribers' telephone numbers, she would be much more reluctant to switch to a competing supplier. Each person's number was initially arbitrary as far as she was concerned, but is now valuable to her.

Because of users' reluctance to switch, alternative interfaces that were equally good at the time of initial design do not remain equal and are not equal from the point of view of software designers who must choose an interface specification at a later date. Consequently, a new program attempting to compete with an established program will find that the first one's initially arbitrary interface choices have become economically compelling.

3. Network Effects and User Switching Costs Are Important in Software and in Spreadsheet Markets

Network effects and user switching costs are very strong in the computer software industry. Developers are keenly aware of the importance of compatibility to users. They take pains to ensure that new versions of a software package are compatible with earlier versions, both to minimize their own customers' switching costs and to *9 maximize their network effects. This lesson was convincingly driven home to Lotus when it launched the Release 2.0 version of its 1-2-3 spreadsheet that was not fully compatible with the previous 1A version. [FN6] Compatibility at the user interface is also crucial since users do not have to learn a new set of keystrokes nor to "unlearn" keystrokes which have become automatic. This is one reason that Borland's programs (and most other popular spreadsheet and word processing packages) often provide a "chameleon interface" that allows users to choose one familiar to them and avoid learning a new one, inefficiently replicating their investments.

FN6. "Compatibility was at the top of the list [of product design issues]. We actually had an experience around compatibility with Release 2.0 which was not totally nourishing for [Lotus], and it was after the release of Release 2.0 and the subsequent release of 2.01 where the importance of compatibility was firmly stamped on everyone's forehead as the single, unifying concept that we had to manage from generation to generation of our products." Deposition of Jim P. Manzi, Chief Executive Officer, Lotus Development Corp., August 22, 1991, p. 174, J.A. 715.

In the case of spreadsheet software, it clearly became compelling for competitors to offer compatibility with Lotus 1-2-3. [FN7] Econometric evidence confirms that users *10 express their preference for compatibility in their spreadsheet purchase decisions. [FN8]

FN7. It was important for Quattro to be compatible with files and macros created with 1-2-3 so that users would not have to replicate their investments. The Appeals Court fully appreciated the value of compatibility to users: "Under the district court's holding, if the user wrote a macro to shorten the time needed to perform a certain operation in Lotus 1-2-3, the user would be unable to use that macro to shorten the time needed to perform that same operation in another program. Rather, the user would have to rewrite his or her macro using that other program's menu command hierarchy. This is despite the fact that the macro is clearly the user's own work product." Lotus Development Corp. v. Borland International, Inc., 49 F.3d 807, 818 (1st Cir. 1995), Pet. App. at 20a.

FN8. Neil Gandal, "Hedonic Price Indexes for Spreadsheets and an Empirical Test of the Network Externalities," RAND Journal of Economics, 25 (1994), 160-170 finds that "consumers are willing to pay a significant premium for spreadsheets that are compatible with the Lotus platform."

To illustrate network effects and their impact on competition, consider a computer user who wishes to buy a spreadsheet program and has narrowed his choice to two competing spreadsheet products. The first product will give him access to a large selection of spreadsheet data files created by others using that product's data format: for instance, many publicly available government records use Lotus' data format. The second spreadsheet product has no such installed base, but has certain superior features desired by the prospective new user. He would prefer to buy the second product, but only if it can read the pre-existing data files which are based on the first product's format - in other words, only if it is compatible to that extent. [FN9]

FN9. Neil Gandal, "Competing Compatibility Standards and Network Externalities in the PC Software Market," Review of Economics and Statistics, November 1995, forthcoming, discusses these effects empirically in spreadsheet and database markets.

***11** 4. Our Usage of the Term "Interfaces" Is Defined By Economic Properties

Amici do not claim to know exactly which aspects of computer programs must be compatible in order for the programs to remain as competitive after the build-up of network effects and switching costs as they would be ex ante. In general, interface specifications must be compatible for this to occur. For convenience, therefore, we use the term "interface aspects" to mean those choices.

C. In the Presence of Network Effects and Switching Cost Dynamics, Copyright Protection May Confer Monopoly Power Even Absent Real Innovation

Whether or not network effects and switching costs limit competition depends crucially on whether or not vendors have proprietary control of the interfaces. If interfaces are public, competitors can make their products compatible, and users will be able to choose a program on the basis of its quality and price rather than on switching costs and installed base of users. If interfaces are protected by copyright, the copyright holder can prevent competitors from making their products compatible. In this way the intellectual property treatment of interfaces crucially affects the nature of competition.

If an established seller controls network effects, a competitor must either convince users that a new product will succeed broadly (as distinct from simply appealing to a particular user), or else persuade them that, despite the disadvantage in network effects, the product ***12** improvement is so dramatic that they should switch anyway. Similarly, if existing users must bear switching costs (must replicate their private investments) in order to buy from a competitor, the competitor operates at a disadvantage. It is well recognized in economics and in competitive strategy that these effects provide an advantage and an opportunity for long-term profits to an incumbent, even absent any inherent superiority of its product. [FN10]

FN10. Michael Porter, Competitive Strategy, The Free Press, 1980, at 10 and 114 (and elsewhere); Marvin Lieberman and David Montgomery, "First- Mover Advantages," Strategic Management Journal 9 (1988), 41-58; Joseph Farrell and Garth Saloner, "Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation," American Economic Review 76 (1986), 940-955.

In this way the established product, even if not highly innovative, may acquire substantial monopoly control through the copyright protection of its interfaces.

AMICUS BRIEF, U.S.S.CT.
Such a result is contrary to what we understand to be the usual pattern of copyright, which provides narrow protection by protecting only "expression" and refusing to protect an "idea," and to the usual pattern of patent law, which confers potentially broad control as a reward for demonstrably innovative contributions. Those usual patterns make economic sense in terms of the intellectual-property tradeoff described above, unlike the outcome when copyright confers broad control with no showing of innovativeness. [FN11]

FN11. When copyright protection confers large rewards on interface creations that are not particularly innovative, two further dynamic inefficiencies arise. Firms may deliberately create incompatible interfaces in the hope of being the lucky focus of network effects, but meanwhile the market is inefficiently splintered among incompatible interfaces. And firms may race to introduce products prematurely - an incentive that may be partly responsible for the prevalence of "bugs" in new software releases.

***13** D. Network Effects and Switching Cost Dynamics Amplify the Harm Caused by Monopoly
Monopoly power is likely to be particularly harmful in markets in which network effects and user switching costs are important. As with any monopoly, above-cost pricing will deter purchases by many potential users who value the product more than it costs to produce. Economic efficiency is thereby harmed in any market. But when network effects are important, there is an additional effect: those who do buy get a less valuable product as a result of the smaller network. Thus, where network effects are present, the ordinary pricing inefficiency of monopoly is likely to be amplified. [FN12]

FN12. See, for instance, Joseph Farrell and Carl Shapiro, "Standard Setting in High-Definition Television" Brookings Papers on Economic Activity, 1992, at 41-42, and Joseph Farrell, "Arguments for Weaker Intellectual Property Protection in Network Industries," StandardView 3, June 1995, 46-49. In principle the monopoly right holder could adopt "penetration pricing" and thus reward early purchasers for the benefits they provide to later users. Under this scheme prices start low and become higher as the product becomes established. More often, the tendency to "price skim" overwhelms any attempt at penetration pricing. The "price skimming" strategy is to set prices high initially to extract profits from users who value the product highly, and then gradually reduce price over time to make sales to other users. See Luis Cabral, David Salant and Glenn Woroch, "Monopoly Pricing with Network Externalities," forthcoming in International Journal of Industrial Organization.

***14** The pricing inefficiency of monopoly is not the only concern, however. In computer software, cumulative innovation is important - developers of the next generation of software products benefit from the breakthroughs, and try to avoid the pitfalls, of their predecessors. Consequently, it is highly desirable that all comers be able to build on the existing state of knowledge. [FN13] In cumulative innovation markets, overly strong intellectual property protection may actually retard rather than encourage innovation; thus there may not be any social benefits from increased incentives for innovation to weigh against the social costs of monopoly distortions. [FN14]

FN13. See Brief Amicus Curiae of Computer Scientists, Section III B 2.

FN14. William Landes and Richard Posner, "An Economic Analysis of Copyright Law," Journal of Legal Studies, XVIII, June 1989, 325, 348, argue that overprotection will reduce the number of products. Robert Merges and Richard Nelson, "The Complex Economics of Patent Scope," Columbia Law Review, 1990, and "On Limiting Or Encouraging Rivalry in Technical Progress: The Effect of Patent Scope Decisions," Journal of Economic Behavior and Organization 25 (1994), 1-24, describe how strong intellectual property protection has retarded cumulative innovation in a number of industries.

IV. CONCLUSION

For the reasons given above, amici believe that economic efficiency argues strongly against uncritical protection of interface aspects of computer software. It is economically harmful to protect, through copyright's uncritical mechanism, an aspect of computer software that is initially arbitrary but then becomes compelling. As ***15** copyright law does not generally protect compelling "choices," amici urge the Court to find that the initial or ex ante arbitrariness of interface design means that it should not be granted broad protection. Rather, only those aspects of a software program whose value, if any, stems from their originality and quality should be protected. Those aspects whose potential value will be due to network effects or user switching costs should not be. On amici's understanding of the facts in this case, when Borland introduced Quattro, it undertook the extra effort to make its product compatible largely in order to avoid imposing switching costs on Lotus users who might switch to Quattro and to be on an equal footing in respect of network effects.

Intellectual property protection should reward software developers for their innovative contributions. For economic efficiency, these returns should encourage innovators to create software products in number and quality so as to maximize the overall well-being of users and creators jointly. This almost certainly involves a prohibition on literal copying of code. It may also involve protection of broader aspects of a software product, especially if the creation is in fact highly innovative (and we express no view here on whether Lotus' interfaces were). This may well involve large rewards for highly innovative products and we certainly do not advocate punishing winners. But protection of software should not uncritically protect aspects that confer substantial monopoly power over a significant market segment, as amici believe will be the case if interfaces such as program ***16** menu commands are automatically protected by copyright.

***1a** APPENDIX A LIST OF SIGNATORIES TO THE BRIEF

[Primary Authors]

1. Joseph Farrell
Department of Economics

University of California, Berkeley

Joseph Farrell is Professor of Economics and Affiliate Professor of Business at the University of California, Berkeley. His teaching has included graduate level classes in industrial organization, microeconomics, and competitive strategy. He is (jointly) North American Editor of the Journal of Industrial Economics, and Associate Editor of The Economics of Innovation and New Technology. He has been a reviewer for the National Science Foundation, the National Academy of Sciences, and the Office of Technology Assessment on matters involving innovation and high technology. He has been a consultant for the US Department of Justice and for private firms in computer software and related industries. He has been a leader in developing the economic theory of compatibility standards and of user switching costs, and has published numerous academic articles on these subjects.

2. Glenn Woroch

Haas School of Business

University of California, Berkeley

Professor Woroch is presently Lecturer and Director, Consortium for Research on Telecommunications Policy, Haas School of Business at the University of California, Berkeley. He received an M.A. in Statistics and a Ph.D. in Economics from Berkeley. He teaches industrial organization, regulation and microeconomics at Berkeley, and he has ***2a** previously taught economics at the University of Rochester and at Stanford University. He was also a research economist at GTE Laboratories. He is currently a member of the editorial boards of Information Economics & Policy and The Journal of Regulatory Economics, and a member of the board of directors of the International Telecommunications Society. He has consulted for the Departments of Energy and Commerce on economic and regulatory issues and regularly serves on industry committees. Besides publishing numerous articles on regulation, antitrust and industrial organization, he has recently published research on the economics of intellectual property protection of computer software.

[Additional Signatories - In alphabetical order]

3. Kenneth J. Arrow

Joan Kenney Professor of Economics Emeritus and Professor of Operations Research Emeritus

Departments of Economics and Operations Research Stanford University

Professor Arrow has also been a member of the faculty at the University of Chicago and Harvard University and a Research Associate of the Cowles Commission for Research in Economics. He received his Ph.D. in Economics from Columbia University in 1951. He has published papers and books in the fields of social choice, general economic equilibrium, medical care, and the economics of information and innovation. He has been president of several learned societies and has received several honorary awards, including the Nobel Memorial Prize in Economic Science in 1972.

Statement: I agree fully with the general principles of this brief, especially the need to insist on a high degree of novelty for recognizing copyright ***3a** protection in interfaces. I am not acquainted with the specific facts in this case and take no stand about any of them.

4. W. Brian Arthur

Professor Arthur is Morrison Professor of Economics at Stanford and Citibank Professor at the Santa Fe Institute. He has written numerous articles and a book (Increasing Returns and Path Dependence in the Economy, University of Michigan Press, 1994) on the dynamics of network effects. He is a Fellow of the Econometric Society and was awarded the Schumpeter Prize in 1990.

5. Sanford V. Berg, Ph.D.

Department of Economics

University of Florida

Sanford V. Berg, Ph.D., is Distinguished Service Professor in the Department of Economics at the University of Florida. He is also the Florida Public Utilities Professor and the Director of the Public Utility Research Center where he organizes conferences and workshops on regulatory issues. In addition, he has served as a consultant to various private and public organizations including state regulatory commissions, corporations, the Congressional Office of Technology Assessment, and the World Bank. Presently, he is a project co-director of the Telecommunications Industry Analysis Project (TIAP). He was selected as the University of Florida Outstanding Undergraduate Teacher of the Year (1993). In 1994, he was the University's nominee for the Professor of the Year Award (Carnegie Foundation for the Advancement of Teaching). He has published widely on business and economics topics, including copyright protection, compatibility standards, and ***4a** the determinants of innovative activity. He is the co-author of several books, including Natural Monopoly Regulation: Principles and Practice (Cambridge University Press, 1989). Dr. Berg graduated from the University of Washington with honors in Economics, and received his Ph.D. degree from Yale University in 1970.

6. Jay Pil Choi

Department of Economics

Columbia University

Jay Pil Choi is Assistant Professor of Economics at Columbia University. He received his Ph.D. at Harvard in 1990 and was a Post-Doctoral Fellow at Tilburg University, the Netherlands. He is also a recipient of the prestigious Abe Fellowship. He has published numerous articles on intellectual property rights and R&D competition.

7. Paul A. David

Senior Research Fellow, All Souls College, Oxford University, and Professor of Economics, Stanford University.

Visiting Research Professor of Science and Technology, Rijksuniversitiet Limburg, Maastricht.

Quondam William Robertson Coe Professor of American Economic History, and former chair of Economics Department, Stanford University. Current Program Leader of Stanford University Center for Economic Policy Research's High Technology Impact Program. Fellow of American Academy of Arts and Sciences, Fellow of the British Academy, Fellow of ***5a** International Econometric Society. Former President of the Economic History Association.

Author of numerous articles and books on technology and economic growth, including recent studies of the economics of information networks, inter-operability standards, and the evolution of intellectual property protection regimes.

Consultant to National Academy of Sciences, National Science and Engineering Council of Canada, the World Bank, the European Commission, the OECD, etc.

8. Nicholas Economides

Professor of Economics at the Stern School of Business of New York University

His fields of specialization and research include industrial organization, the economics of networks, especially of telecommunications and of information, the economics of technical compatibility and standardization, and the structure and organization of financial markets. He has published widely in the areas of networks, telecommunications, oligopoly, positioning of differentiated products, and on liquidity and the organization of financial markets and exchanges. He holds a Ph.D. and a M.A. in Economics from the University of California at Berkeley as well as a B.Sc. (First Class Honors) in Mathematical Economics from the London School of Economics. He has previously taught at Columbia University (1981-1988) and at Stanford University (1988-1990). He is editor of the International Journal of Industrial Organization, and associate editor of Journal of Regional Science. He is currently editing a special issue of the International Journal of Industrial Organization on Network Economics. His book, ***6a** "Communications Convergence: Economic Perspectives on Quality and Market Evolution," jointly written with Bob Dansby, is forthcoming from MIT Press and the American Enterprise Institute.

9. Aaron Edlin

Department of Economics

University of California, Berkeley

Professor Edlin is on the faculty of the economics department of the University of California at Berkeley. He received his A.B. in the science and policy program of the Woodrow Wilson School at Princeton University, and his Ph.D. in economics and J.D. in law from Stanford University. In research, he specializes in industrial organization, law and economics, and public economics. He teaches industrial organization and public economics.

10. Neil Gandal

Assistant Professor of Economics

Tel Aviv University

Professor Gandal received his Ph.D. in Economics from the University of California-Berkeley in 1989. One of his areas of expertise is the Economics of Compatibility and Standardization. He has published or co-authored a number of the papers in this area, including:

"Competing Compatibility Standards and Network Externalities in the PC Software Market," Review of Economics and Statistics, November 1995.

"Hedonic Price Indexes for Spreadsheets and an Empirical Test for Network Externalities," 1994, RAND Journal of Economics, 25: 160-170.

***7a** 11. Jerry Richard Green

Department of Economics

Harvard University

Jerry Green is the John Leverett Professor in the University and the David A. Wells Professor of Political Economy in the Department of Economics. He joined the Harvard faculty in 1970, chaired the Economics Department from 1984 to 1987, and served as Provost of the University from 1992 to 1994.

Professor Green is a Fellow of the Econometric Society and served on its

Council from 1988 to 1994. He is a Fellow of the American Academy of Arts and Sciences and has been an Erskine Fellow at the University of Canterbury, and a Guggenheim Fellow. He is an Oversees Fellow of Churchill College, Cambridge University. In 1980, he received the J.K.Galbraith Prize for excellence in teaching. Professor Green chaired the National Science Foundation's Information Sciences Advisory Panel in 1980, prepared the Foundation's Ten-Year Outlook for the Social Sciences in 1983 and served on the National Academy of Sciences Panel on Taxpayer Compliance in 1984. He is a member of the Board of Trustees of the Beth Israel Hospital of Boston where he serves on the budget and finance committee and chairs the committee on conflict of interest policy. He has been an advisor to many universities and foundations.

Professor Green is known for his work on the theories of incentives, rational expectations, and behavior under uncertainty. He has contributed to a number of areas in applied economics, including tax policy, finance, health economics, higher education, and patent policy. He is the author of Incentives in Public Decision Making (with Jean-Jacques Laffont, 1978), Microeconomic Theory (with Andreu Mas-***8a** Colell and Michael Whinston, 1995) and over eighty scientific articles.

12. Michael D. Intriligator

Professor of Economics, Political Science and Policy Studies

University of California, Los Angeles

Michael D. Intriligator is Professor of Economics at the University of California, Los Angeles (UCLA), where he is also Professor of Political Science, Professor of Policy Studies in the School of Public Policy and Social Research, and Director of the Jacob Marschak Interdisciplinary Colloquium on Mathematics in the Behavioral Sciences. From 1982 to 1992 he was Director of the UCLA Center for International and Strategic Affairs. He has been a member of the UCLA faculty since 1963, the year he received his Ph.D. in Economics at MIT working under Robert M. Solow. He teaches courses in economic theory, econometrics, mathematical economics, and international relations. His papers in economics are in the areas of economic theory, econometrics, health economics, and the transition to a market economy. He has published more than 100 journal articles and other publications and is the author of Mathematical Optimization and Economic Theory (Prentice-Hall, 1971) and Econometric Models, Techniques, and Applications (Prentice-Hall 1978, second edition with Ronald G. Bodkin and Cheng Hsiao, forthcoming, 1995). He is a Fellow of the Econometric Society, a member of the Council on Foreign Relations (New York) and the International Institute for Strategic Studies (London), and is listed in Who's Who in America and Who's Who in Economics.

***9a** 13. Louis Kaplow

Harvard Law School

Louis Kaplow is a Professor of Law at Harvard Law School and a Research Associate at the National Bureau of Economic Research. He received his J.D. and Ph.D. (in economics) both from Harvard University. His teaching and research involve the application of economic analysis to law, with a specialization in competition policy. Among his writings in this area are an article on the relationship between intellectual property and competition policy and the text, Antitrust Analysis, co-authored with Phillip Areeda. Professor Kaplow also serves on the editorial board of a number of journals and as a referee for many of the leading economics journals that publish articles in this field. In addition, he has advised the Department of Justice and testified before Congress on issues pertaining to the appropriate relationship between intellectual property and competition policy.

14. Suzanne Scotchmer

Professor of Economics and Public Policy
Graduate School of Public Policy
University of California, Berkeley

Professor Scotchmer was previously Associate Professor of Economics at Harvard University, and has been Visiting Professor at the University of Paris I, University of Toronto, and New School of Economics, Academy of Sciences, Moscow, Russia. In the last several years she has held research fellowships at Yale University (Olin Fellow) and Stanford University (Hoover National Fellow). She received her M.A. in Statistics from U.C., Berkeley in 1979 and her Ph.D. in economics from U.C. Berkeley in 1980. She has published widely on the economics of intellectual property law, economics of crime with ***10a** an emphasis on rules of evidence in the law, economics of tax evasion, cooperative game theory, club theory, and evolutionary game theory. Her research in the past has been supported mostly by the National Science Foundation, by also the Sloan Foundation, the Olin Foundation, the Harris Trust, and Phi Beta Kappa.

Among her editorial activities, she has served on the editorial board of two of the three journals of the American Economic Association, the American Economic Review and Journal of Economic Perspectives, and also on the editorial boards of the Journal of Public Economics (published at the London School of Economics) and Regional Science and Urban Economics (a North-Holland Journal). She referees for all the major economics and policy journals.

15. Frederick R. Warren-Boulton

MiCRA
1875 I Street, N.W.
Washington, DC 20006

Frederick R. Warren-Boulton is a principal of MiCRA, a Washington-based economics consulting and research firm. He received a B.A. degree from Yale University, an M.P.A. from the Woodrow Wilson School of Princeton University, and a Ph.D. in Economics from Princeton University. From 1972 to 1983 he was an Assistant and then Associate Professor of Economics at Washington University in St. Louis, where he taught the graduate level courses in microeconomics and industrial organization. From 1983 to 1989, he served as the chief economist for the Antitrust Division of the U.S. Department of Justice, first as Director of its Economic Policy Office and then as Deputy Assistant Attorney General for Economic Analysis.

***11a** Since leaving the government, he has served as a Resident Scholar at the American Enterprise Institute, a Visiting Lecturer of Public and International Affairs at the Woodrow Wilson School at Princeton University, and Research Associate Professor of Psychology at The American University. He has published extensively in the areas of antitrust, regulation and intellectual property, and has served as an expert witness or consultant on a number of cases involving antitrust or intellectual property issues in the computer industry.

DIGEST

Lotus Development Corp. v. Borland Intern., Inc.

99 COPYRIGHTS AND INTELLECTUAL PROPERTY
99I Copyrights
99I(A) Nature and Subject Matter
99k3 Subjects of Copyright

99k10.4 k. Other works.
Should uncritical copyright protection not be granted for interfaces in computer software, given that copyright protection may confer monopoly power even absent real innovation?
Lotus Development Corp. v. Borland Intern., Inc.

99 COPYRIGHTS AND INTELLECTUAL PROPERTY
99I Copyrights
99I(A) Nature and Subject Matter
99k3 Subjects of Copyright

99k10.4 k. Other works.
Should only those aspects of computer software program whose value, if any, stems from their originality and quality have copyright protection, while those aspects whose potential value will be due to network effects or user switching costs should not have copyright protection?
U.S.Amicus.Brief,1995.
END OF DOCUMENT