KILL THE KING: MONOPOLIES, ALLIANCES, AND LITIGATION IN THE AMERICAN COMPUTER INDUSTRY

by

MATTHEW ZEIDENBERG

A thesis submitted in partial fulfillment of
the requirements for the degree of

MASTER OF SCIENCE
(SOCIOLOGY)

at the

UNIVERSITY OF WISCONSIN-MADISON

1996

KILL THE KING: MONOPOLIES, ALLIANCES, AND LITIGATION IN THE AMERICAN COMPUTER INDUSTRY

> **"**Myth**:** Without intellectual property, no one will produce original work. Given that intellectual property law made its debut in 1623, we may correctly consider any work produced before this time to dispel the myth. Man created for millennia before the advent of intellectual property; he will create for many more millennia after it is abandoned.**"**
> -- The Anti-Copyright Website
>
> "We are such stuff as dreams are made of, and our little life is rounded with a sleep."
> -- Prospero in Shakespeare's "The Tempest", written c. 1610-1611, toward the end of Shakespeare's life.

INTRODUCTION

In understanding the structure of the computer industry, and competition, cooperation, and legal conflict, including litigation, it is important to understand some facts. First of all, the computer industry, since its inception, has been monopolistic, with no one firm dominating the whole industry, but with dominant firms in each of many market sub-sectors, taking advantage of the fact that the markets for computers have been highly differentiated on the basis of price, and, in the case of software, specific functionality (Brock, 1991; Hall et al., 1983). The main reasons for this monopolistic nature have been threefold; first, the early entry of IBM and the development of the IBM model of customer service, which, early on, created standards defined by IBM; second, the consequent importance of standards in computing and the high opportunity cost to the computer purchaser in adopting a non-standard machine; and third, the role of the state in protecting the "intellectual property" of the monopolist and discouraging imitators ("clones").

Investments in computer software and hardware involve a high degree of asset specificity (Williamson, 1985). This is because there is substantial effort involved in training people to use a particular piece of software, and this investment is lost if the company

switches to a different piece of software, insofar as the new software is not compatible with the old software. Also, the cost of conversion of data files may be non-trivial. Insofar as the state allows copyright of the "look and feel" of a piece of software, the costs of converting to a different software/hardware combination may remain high, because it will be illegal for competitors to duplicate the way that a program is used.

Transaction-cost economics typically finds that as asset specificity increases, firms may find it more to their advantage to produce an asset internally as opposed to purchasing it on the market. However, since the cost of producing software is high, and is increasingly undertaken, as software becomes more complex, by large firms (such as Microsoft and Lotus), it is not feasible for any but the largest firms to produce software for in-house use. Thus, software companies can reap part of the cost of changing software packages in a monopoly rent.

The users of a particular software package, computer, or operating system constitute a social network, and the usefulness of the package increases as more people use it. This is because if most people use the same software, people don't need to master several packages as they move around (visiting customers, suppliers, or other sections of the same company), and data is easier to interchange. This is referred to as a network externality in the economics literature (e.g. Economides 1994).

This is why markets for particular varieties of software tend to be dominated by one or two software packages. For instance, currently the market for word-processing software is dominated by two packages: Microsoft Word and WordPerfect. No other package has significant market share. This situation leads to yet another reason why one would expect software prices to be significantly above the competitive level. The speed of technical

improvement in both software and hardware most likely makes the higher prices more palatable to consumers.

Note that all the above arguments also apply to computer hardware. However, there has been more success in cloning hardware than software, perhaps because software changes more continuously. For instance, Advanced Micro Devices has been very successful in cloning Intel's 80x86 line of microprocessors, which are the basis of most IBM-compatible microcomputers. Insofar as clones can capture market share away from a monopolist (in this case Intel), prices will be lowered in the direction of the competitive level. However, there are typically only two or three clones in such a capital-intensive industry as microprocessors. Also, even if clones are perfect replicas of the original (which they seldom are), consumers may lack confidence that they are so, and may stay with the major vendor's product.

As a result of the market power exercised by particular firms at particular points in time, other firms that do not hold substantial market shares in a particular sub-sector employ a variety of strategies to attempt to dislodge the monopolist, beyond the ordinary competitive strategies of marketing, price competition, and quality/performance competition.

First of all, they may attempt to clone the monopolist's product. Typically, they try to duplicate all the functionality of the monopolist's product and also add some functions, while selling the clone at a lower price. Or, they may provide a greatly enhanced product, while retaining compatibility with all of the functions of the monopolist's product. In following one of these strategies, they leave themselves open to intellectual property

litigation (Claps, Lynch and Steinberg, 1987; Harvard Law Review, 1990; Phillips, 1992; Samuelson, 1990; Spivak, 1988).

Another approach for a non-monopolist firm is to pursue alliances between with other firms to co-develop products to dislodge the monopolist's product. These alliances exploit economies of scale in R&D and marketing, and attempt to match the resources of the "big guy" by "ganging up" on him. However, these alliances, as in all cases of cooperation between firms, can go awry. Firms can disagree over how to define their collaborative standard, or over the sharing of the fruits of the collaboration, or one party may feel that the other party has not lived up to its responsibilities. Contract litigation may ensue. Another danger of alliances is antitrust litigation, if the state or other firms can make the case that a collaboration between firms constitutes unfair competition under the law.

Alliances are intermediate between hierarchies (bureaucratic structures) and markets as a governance structure (Hollingsworth, Schmitter, and Streeck, 1994). Although alliances are contractual, like market transactions, they are far from the idealized arms-length anonymous transactions of the hypothetical competitive market. Instead, firms enter into a medium or long-term agreement to co-develop, and often to co-market, a product. Typically, the justification given for the agreement is that each firm has expertise, intellectual property, or capital in a particular area, and that these areas complement each other.

In practice, however, these capabilities do not complement one another perfectly, and points of conflict occur where overlap of capabilities exists. For instance, if two companies are each developing their own system software, and are co-developing hardware, then they may not share their software with one another, or make both systems run on both machines. This may disadvantage the final, joint product, because of the network

externalities illustrated above. This is what has happened in the case of the Apple/IBM/Motorola agreement to co-develop machines based on the PowerPC.

Related to, and entwined with, these product development alliances are standards bodies. Typically, all significant firms, including the monopolist, participate in standards bodies, which, with the explosion in the use of computer technology, have become more and more common. Firms, the state, professional organizations, user groups, and universities often contend over the formulation of a standard. This standard is often based on a monopoly product, for compatibility's sake, and for the sake of the viability of the standard. This often has the dual effect of legitimating the monopoly product and taking some control over its evolution away from the monopoly product.

A good example of this is the Institute of Electronics and Electrical Engineers (IEEE) Posix standard for user interfaces, which is based on the user interface of AT&T's Unix (which was recently acquired by Novell). If the IEEE can encourage the development of Posix-compatible products, users will begin to look to Posix as the standard. Control of the standard will then slip away from Novell and be turned over to the IEEE. This may actually be desirable to Novell, since then they can claim that they are providing a product that is officially sanctioned by an "impartial" group. In practice, all large firms participate in standards bodies whenever they can. However, standards that are created by standards bodies do not always have the force of the de-facto standards created by the market.

Yet another strategy for non-monopolist firms is the pursuit of antitrust or other litigation to dislodge the monopolist. Private antitrust claims are usually filed on the basis of allegations of unfair competition, which often consists of predatory pricing. Industry actors,

such as firms or interested consumers, may also bring pressure on the state to bring public antitrust action or regulatory action against the monopolist.

As has been stressed in much previous work (e.g. Galanter and Rogers, 1991), litigation should be understood as a result of strains in social relations, as defined by law and custom. Disputes that are litigated represent only a small portion of all disputes, which can arise out of cooperative, and competitive, social relations. Thus litigation cannot be studied in isolation, but only with respect to these social relations. In the case of the computer industry, firms are called upon to cooperate and to compete under various circumstances, and strains in these relationships can cause litigation. One cannot understand divorce without understanding marriage.

Much of the above discussion would also be applicable to other industries, especially other technology-based industries such as the pharmaceutical industry or the telecommunications industry. I do not have the view that all industries are the same ("production functions") and can all be understood on the same terms. One goal of sectoral governance studies such as this one should be to differentiate that which is specific to each particular industry, and what is general to all industries or to a certain type of industry. I will, in what follows, have that goal in mind.

A BRIEF HISTORY OF THE COMPUTER INDUSTRY

The most prominent monopolist in the computer industry has been IBM, which emerged around 1950, roughly coincident with the birth of the modern industry. More recently new product markets have emerged, the best known being minicomputers, in which there was oligopoly domination by a few firms, the most prominent of which was Digital (Rifkin, 1988), and microcomputers, which has been dominated, on the processor side, by

Intel (Hof 1992) and on the operating system side, by Microsoft (Markoff, 1992).The minicomputer revolution occurred about 1970; the microcomputer revolution, about 1980. Both events took chunks of the computer business away from IBM and other makers of large computers.[1] Each new market is typically exploited by a new firm, or a small group of firms (Brock 1991).

IBM became the first monopolist in the computer industry by developing a model of customer relations that became a model for the rest of the industry. They developed a highly-trained sales and technical support staff that provided "complete solutions" for customers. That is, IBM would sell the customer a computer, and then provide extensive support and software as part of the package. IBM cultivated long-term relationships with its customers, which originally were all large companies, governments, or other large institutions.

By using this strategy before anyone else, and by deploying a vast, worldwide sales force, IBM was able to dominate the market (Brock 1991). As this occurred, opportunity costs of using machines other than IBM's rose, since IBM had the widest variety of software. Computer personnel came to become more familiar with IBM software than that of other firms. Also, each site often had some need to share data with other sites, which were likely to be IBM-based. (This latter reason has increased in importance in recent years with the development of networks and transportable media, such as floppy disks, as rapid methods of data sharing.)

These events created some of the justification for the Reagan Justice Department to drop, in 1982, the antitrust suit that it had been pursuing against IBM since 1968 (DeLamarter, 1986; Fisher, 1983)

Because of the particular high investments involved in the development of customer-specific solutions, IBM was able to achieve a "lock" on its customers, because the costs of switching to another vendor became very high. IBM introduced a practice that has become commonplace in the computer industry, the practice of "backwards compatibility" or "downwards compatibility".

That is, when you bought a new computer system from IBM, it was designed to run the same software that your earlier system ran. Therefore, the costs of switching to another vendor were very high, since you had a long-term investment in your software, which would only run on IBM's machines. In transaction-cost economics terms, IBM was able to get its customers to make a large asset-specific investment, which led to long-term continuing relations. IBM was able to use the monopoly profits it extracted from these customers to build its sales organization, its marketing, its research and development, and its reputation. Thus IBM had, by 1980, acquired a legendary reputation in the business community (Brock, 1990).

As a result of being able to acquire a dominant market share in the computer business, IBM defined was able to define de facto standards for mainframe computers. For instance, IBM's database language, SQL, became popular, even on non-IBM computers.

The two major legal strategies involving monopoly, intellectual property protection and antitrust, also came into play. Other manufacturers, trying to rain on IBM's parade, developed plug-compatible components, such as tape and disk drives, that were cheaper and compatible with IBM's computers. One manufacturer (Amdahl) even cloned one of IBM's most popular lines of computers, the System 360/370 series, and others followed.

IBM responded with patent litigation, lowered prices, long-term contract discounts, and an attempt to change the standards quickly to make it hard for competitors to keep up (Brock, 1990.) IBM's competitors responded with private antitrust actions. From 1969 onward, the U.S. Justice Department was preparing its antitrust case against IBM (which was later dropped, in 1982) (Brock, 1990.) There were also several cases of competitors suing IBM for patent infringement.

Thus some of the patterns of governance in the computer industry were being established. In the legally "contested terrain" of industry structure, intellectual property law was the weapon of both the monopolist and its competitors, and antitrust the weapon of the competitors and the state.

In the 1970s IBM was slow to exploit the new technology of minicomputers. These were cheaper, smaller computers that could be used by businesses that were smaller than IBM’s typical customer. This created a large opportunity for IBM's competitors, notably Digital, which rapidly developed its own dominant market position in this sub-sector. Digital was able to provide information technology to smaller institutions than IBM previously had serviced. IBM and others also entered the minicomputer business, but were not able to displace Digital from its dominant position. Again, this set a pattern for periodic revolutions in the industry; typically, a new market sub-sector is not exploited by existing, dominant companies, but by new entrants, which quickly acquire a dominant position in the sub-sector.

In the late 1970s and early 1980s the invention of the microprocessor and the availability of increasingly powerful versions of it created an entire new sub-sector, the microcomputer industry. It also, for the first time, created a mass consumer market for

computers. Apple was the earliest major entrant, mainly penetrating (and largely creating) the home and educational markets. However, the introduction of the IBM PC in 1981 began the ligitimation of the personal computer for business use, and vastly expanded the market. It ran on a microprocessor made by Intel and operating system software written by Microsoft. Ironically, since the IBM PC was dependent on technologies proprietary to Intel and Microsoft, IBM made the emergence of IBM compatibles possible and ceded much of the dominance of the microcomputer sector to Intel and Microsoft. This was because Intel and Microsoft were free to sell or license their technologies to other manufacturers, and did so.

The three most significant episodes of monopoly domination in the computer industry have been: IBM, in large "mainframe" computers, Digital, in minicomputers, and Intel and Microsoft in microcomputers. One can also cite many instances of domination in smaller computer hardware and software vertical markets: For instance, Adobe has a very strong market position with its "Postscript" page description language for laser printers used in desktop publishing, HP has a strong position in laser printers, and Lotus has a strong position in spreadsheet software (but is rapidly losing it to Microsoft.) A strong Unix-based workstation market, pioneered by Sun and Apollo, capitalized on the popularity of Unix in the state-subsidized university sector. Engineers and scientists prefer these machines because they are more powerful than ordinary PCs and they run the same operating system they used in school (Unix). Since Novell owns Unix, Novell and Sun profit from a strong position in this market, which, because of some significant technical edges over other types of computers, is growing and may in time become the largest computer sub-sector.

Early entry is key in developing a large monopoly position. The early entrant can get a large amount of market share, and raise the opportunity costs to users of choosing a late-entering competitor. The firm also becomes identified with the product in the minds of consumers. This was IBM's great success; through intensive marketing in the 1950s and 1960s, getting business executives to think of IBM whenever they thought of buying a computer.

However, the firm often cannot hold on to its large market share indefinitely. For instance, Visicorp, the firm that invented the spreadsheet, was able to garner a large market share initially, but it was displaced by Lotus. The key point is that the market, at any given point in time, is highly monopolistic, with one vendor holding a large chunk, say 40-60% of the market, and a couple of other vendors holding 20% or less, and the rest holding a small part of the market. This is because the costs of non-compatibility are so high.

IBM, in its initial introduction of the IBM PC, gave the "blessing" to Intel and Microsoft (Hof, 1992; Wallace and Erickson, 1992). It needed a microprocessor and an operating system for its new computer. At the time, it had little internal experience in either of these areas, so it turned to Intel for the microprocessor and Microsoft for the operating system. In not retaining proprietary control of the operating system of the IBM PC, IBM probably made one of the most serious mistakes in computer business history, and perhaps in all of business history . However, at the time, IBM had little choice, due to its lack of expertise (although it could have hired people with expertise, instead of contracting out), and if it hadn't hired Microsoft, the IBM PC might not have been such a success. In retrospect, IBM probably should have acquired Intel and Microsoft. In order to recognize the imperative for doing this, IBM would have had to anticipate the incredible importance of

the PC to the computer industry. It was Intel and Microsoft's autonomy that allowed for the emergence of IBM PC compatibles. However, without the compatibles, the IBM PC might not have become the standard in personal computers.

By blessing Intel and Microsoft, IBM created rogue elephants, since the IBM BIOS (Basic Input/Output System) that was the basis of the IBM PC, as well as the machine's architecture, was easy to clone. Anyone who could buy an Intel microprocessor, Microsoft's MS-DOS, and a clone of the BIOS, as well as other components readily available on the open market, could clone an IBM PC. IBM PC compatibles thereupon became the most popular personal computer, largely due to the prestige and marketing power of IBM. Large companies, such as Dell and Compaq, have grown up in the clone business. By 1992, only Apple Computer had significant market share in the personal computer market with a machine that was not IBM compatible, although the prices of low-end Unix workstations were becoming competitive with high-end PCs typically based on Intel 80486 and (in the case of Apple) Motorola 68040 microprocessors.

Thus the industry in 1995 has a complex sub-sectoral structure. The world of PCs is competitive on the side of the computer manufacturers, but highly monopolistic in terms of the inputs to those manufacturers. Virtually anyone with a modest amount of start-up capital can build an IBM PC compatible, but by 1995, it was necessary to sell machines that could run Microsoft Windows and Microsoft MS/DOS, and to a lesser extent, an Intel microprocessor (since some Intel clones were on the market, notably those manufactured by Advanced Micro Devices, or Chips and Technologies). It is difficult to gauge the degree of excess profits extracted from consumers via clone manufacturers by Intel and Microsoft; these excess profits are sometimes justified (usually by the monopolists themselves) from a

public policy standpoint as providing capital for further research and development. (This argument, however, may not be completely self-serving: it is important to remember that many of the most important technological innovations of this century were made at AT&T and IBM during their heyday as monopolies.)

As an illustration of the market power that Microsoft had acquired, consider the case of Windows 3.0, introduced in 1990. This was the first version of Windows, a graphically oriented operating system for IBM PC compatibles, that was comparable in quality to Apple's Macintosh in terms of attractiveness and ease of use. Microsoft had been trying to clone the Macintosh with the first two versions of Windows, but these versions weren't up to snuff. Immediately, Microsoft sold millions of copies, and Windows became Microsoft's major strategy for the evolution of the MS-DOS operating system (which still underpinned Windows, and is currently in version 6.2). Users could have attained the same functionality a few years earlier, but at a high price: they would have had to abandon their IBM clones and software and move to a line of machines (the Macintosh line) that were more expensive and did not conform to the main standard. The market power of Microsoft also facilitated the acceptance of Windows.

In 1995, there are three main sub-sectors: PCs, Unix-based workstations, and mainframes (the minicomputer business has largely been displaced by workstations.) The dominant firms in each of these sectors were, respectively, Intel and Microsoft, Sun and Novell, and IBM. There is some competition between these sectors: that is, high-end PCs compete with low-end workstations, and high-end workstations compete with mainframes, but the market sub-sectors remain largely autonomous. Also, users in any one sector are still tied to their hardware and system software vendor by the "proprietary lock," that is, the costs

involved in changing to a new computer system, getting new software, translating their data into the new format, and retraining personnel are substantial, although hardware and software vendors were rapidly attempting to lower these costs by developing new hardware and software systems that were able to read older data and run older programs. IBM and Apple, in one attempt to weaken Microsoft's market control, were attempting to build a system that could run MS/DOS, Windows, Unix, and Macintosh software (Sheldon, Linderholm, and Marsall, 1992) .But they were in a position of playing catch-up with Microsoft, which was already attempting to build some of the features of Unix into Windows, via its new product Windows NT (Rebello and Schwartz, 1992).

THE COMPUTER INDUSTRY'S STRUCTURE: MONOPOLISTIC OR COMPETITIVE?

The reason the computer industry is so monopolistic can be summed up in a single word: standards. Computers are used to process and store data, and it is greatly desirable for to be able to use the same data and programs in several different computers. Users require that data and programs be interchanged with other users at other computers, and they also need to be able to run their old software when they buy new computers. Users are constantly upgrading and replacing their systems, because price/performance ratios in computers have been improving at a rate unprecedented in any other industry.

Standards in the computer industry are difficult to maintain, because there is such a rapid pace of technological change. However, if users are to get any work done at all, they cannot change their software and hardware too frequently, and whatever new hardware or software that they do change to needs to be compatible with their earlier software.

Generally, users will cling to a dying standard until the advantages they get with switching outweigh the costs of the switch.

Generally the compromise between rapidly changing technologies and the need to maintain standards has led to the development of obligational networks (Hollingsworth 1991), which are networks between firms that are attempting to maintain long-term relationships. For instance, a large IBM compatible manufacturer (such as Compaq) might engage in long-term relationships with a microchip manufacturer (usually Intel), a operating system vendor (usually Microsoft), a manufacturer of disk drives (e.g. Sony or Conner), and with some retailers. Other components might be purchased on spot markets (e.g. memory chips). These obligational networks are more flexible than hierarchically-structured organizations, while allowing for more coordination between firms with interdependent products than markets would.

These obligational networks usually involve the large-firm monopolists in the particular market sub-sector. Note that, unlike the auto industry, the large firms are typically not the manufacturers of the finished goods, but the suppliers of key components.

The monopolists have more bargaining power than any other participant in the network. For instance, Microsoft to a large extent can dictate the licensing arrangements for its software. It has built market share by keeping license fees relatively low while encouraging PC makers to ship Microsoft software with every system. For instance, they have given discounts of up to 60% to companies that will buy a copy of Microsoft's MS-DOS for every system they ship. This has been one of the behaviors that sparked the Federal Trade Commission investigation of Microsoft (Moeller and Magee 1993).

Beyond the standard areas of competition, which are sales, marketing, performance, and price, and the legal weapons of antitrust and intellectual property litigation, there are other possibilities for competition. One is the establishment of alliances to attempt to dislodge the monopolist. One of the main theses of this paper is that a typical mechanism that is employed in a monopoly situation in the computer industry (and this applies to some other industries as well) is the establishment of alliances between firms to compat monopolists.

Typically, monopolists have established the de-facto standard. The costs to new consumers of not adopting this standard are high. (For instance, that is why it is nearly impossible to sell a personal computer that is not an IBM-compatible or an Apple.) The sales and marketing costs to any single, non-monopolist firm of establishing a new standard, unless they have a clear technological edge, are large. The research and development costs may be large as well. Thus, typically, the rest of the firms in a sub-sector team up to promote a new standard (Weber, 1991; Sheldon, Linderholm and Marshall 1992; Economist 1991b.) They are often treading in treacherous water with respect to the antitrust laws, but these alliances are often the only hope that firms have of creating a standard that will be competitive with the monopolist.

The computer industry is somewhat different from most other industries in that the customer has a long-term relationship with the vendor of his or her computer. This is true in almost all situations where there is a proprietary component to the system they have purchased, and there almost always is. For instance, if you purchase an IBM compatible PC, you are dependent on Microsoft for system software and individual software vendors for

particular pieces of software. As we have seen in the case of IBM's large systems, this is known as the "proprietary lock."

The proprietary "lock" makes it possible for a company, once it has acquired a base of customers, to begin charging non-competitive prices due to the exit costs that a customer must pay in order to move to another vendor, the costs of purchasing new software, rewriting customized software, retraining personnel, etc. These non-competitive prices may be inflated until they reflect a substantial chunk of the exit costs. However, insofar as there is competition between proprietary vendors in a market sub-sector, the inflated prices will not reflect the full exit costs. For instance, when price competition heated up in IBM PC clone business in 1989-92, Apple was forced to lower its prices, both to attract new customers and to retain the customers that it had. However, Apple's prices are still not fully competitive with IBM compatible PCs, partially because Apple has a large customer base which has invested time and money in its Macintosh line, and partly because of price discrimination, since the Macintosh is seen by some buyers as the "Mercedes" of personal computers.

The popular press has been recently been reporting on the voracious price competition between makers of PC clones and between makers of Unix workstations, and between the two sub-sectors (e.g. Economist, 1991a).There is no doubt that this is going on, and this will lead to a shakeout that will leave only a half dozen or so companies in each sub-sector. However, this competition only obscures the fact that both operating systems (dominated by Novell and Microsoft) and microprocessors (dominated by Intel) are highly monopolistic. Thus the computer industry, if thought of in terms of computer manufacturers

(who simply put components together) is highly competitive, but if it is thought of in terms of chip and software manufacturers (who are more important) it is quite monopolistic.

Thus the industry, like many American industries, the computer industry somewhere in the gray area between monopolistic and competitive. It is not nearly as monopolistic as it was ten years ago, when IBM was truly dominant in mainframes, and Digital in minicomputers. Now there is much more competition, both within sub-sectors and between them where they overlap.

KILL THE KING

There are many stories in the computer industry wherein many firms gang up on a single dominant firm in order to break its monopoly power and establish a new standard. There are many monopolists in computer sub-sectors, some of which may be listed as follows:

· Intel, microprocessors

· Microsoft, operating systems for PCs

· IBM, mainframe computers

· Sun, Unix-based workstations

· Adobe, page-description software (Postscript) in laser printers

· Novell, the Unix operating system

· WordPerfect Corp., word processing software

· Lotus Corp., spreadsheet software

· Hewlett-Packard, non-Postscript laser printers

· Novell, IBM PC compatible networking

All of the above monopolists have created de-facto standards in their own sub-sectors of the computer industry by virtue of their market dominance. This de-facto standard has in turn ensured their continued market dominance. In some cases, such as that of Lotus in its lawsuit against Paperback Software, the maker of a standard product uses intellectual property law in order to protect its monopoly position from clones. Usually, however, the prestige, name recognition, and standard associated with the monopoly product is enough to ensure consumer loyalty and preserve market share, at least until the next major technological alignment. Recent decisions, such as the Apple vs. Microsoft lawsuit and the Computer Associates International vs. Altai suit, have taken a more strict interpretation of the copyright law. These decisions, in contrast to the Lotus vs. Paperback case, held that the program listing of a computer program is protected, not the behavior or user interface of the program. This precedent, if it is upheld, will create an opportunity for clones in the software industry, as we have seen in the hardware industry. This may make the software industry more competitive, if competitors create programs that are compatible with the popular ones, such as WordPerfect and Lotus. This is an area of the law that is still being explored.

In the following sections, we examine how other alliances have been formed to dislodge monopolists from other sub-sectors. These alliances have met with variable success. These attempts to dislodge monopolists usually fail, because users are unwilling to pay the price to switch from the monopoly standard.

In the trade press, these attempts to dislodge a monopolist, or what we call "ganging up on the big guy," are usually referred to as "wars," because they involve relatively few participants. For instance, the wars against Microsoft are referred to as "OS Wars," the wars against AT&T and Sun are referred to as the "Unix Wars," and the wars against Adobe over

typesetting standards are referred to as "Font Wars". The prevalence of such governance struggles in the computer industry are one indication of its monopolistic nature; if the computer industry was truly a commodity market, such governance battles would not be so important. These governance shifts may be understood in terms of a continual search that firms make to find a governance regime that serves their interests in the face of changing markets and industry structure (Williamson, 1985).

Litigation is properly viewed as part of an overall structure of governance relations between firms. Since, as I shall document, struggles of alliances versus monopolists characterize the computer industry, these struggles, and the governance of the alliances of themselves, are important to understanding why litigation is going on the computer industry. Often substantial legal work and negotiation is required to shape the initial contractual terms of the alliance, whether this is in setting out the corporate structure of the entity created by the alliance, in delineating joint and separate rights and responsibilities, etc. Often when an alliance breaks down, disputing ensues, as the former alliance partners attempt to carve up the joint pie that they have created. If one party is injured or there is a breach of contract over the course of the alliance, this may lead to a lawsuit.

One good example of an alliance breaking down is the case of the IBM/Microsoft alliance over OS/2. IBM and Microsoft agreed to collaborate on OS/2, which was supposed to be the next generation operating system for Intel-based machines. IBM was not pleased with the progress it making with the alliance, and pulled OS/2 out of the alliance. Microsoft decided to switch to Windows as its next generation operating system instead of OS/2, and eventually achieved spectacular success with this product. At this point, most observers agree that the version (2.1) of OS/2 that IBM is currently selling is superior to the current

version (3.1) of Windows, but IBM, having entered too late, is in the position of trying to take market share away from Windows with $49 "competitive upgrades" and aggressive marketing. Applications software vendors advertise their software as Windows-compatible, not OS/2 compatible. Microsoft's Windows NT is an attempt to compete with OS/2 on the high end.

Of course, broken alliances are not the only place in the computer industry where litigation can ensue. Three other important relations are between hardware and software vendors, between hardware vendors and their resellers or retailers, and between hardware vendors and semiconductor or microprocessor manufacturers. These relations will be discussed in a later version of this thesis.

Sun and the Open Systems Strategy

Sun, in the mid-1980s, realized that the proprietary lock, promoted by IBM and adopted by Digital, bothered many computer purchasers, and started promoting "open systems", that is, systems that allowed customers to quickly move software from one manufacturer’s computer to another’s, and allowed customers to set up networks consisting of machines from different manufacturers.

To do this, Sun used two technologies. First, the new RISC (reduced instruction-set computing) microprocessors were faster than PCs and more economical than minicomputers and mainframes. Second, Sun's new computers relied on Unix, which many universities and other research centers had been using for about 10 years, and many scientists and engineers were familiar with it and liked it. Unix was developed from the beginning to be portable,

that is, it could run on a variety of different computer architectures.[2] Also, software that was developed under Unix could be made to run on many different computers, so that Sun could claim (fairly accurately) that people who bought their computers would not be locked into Sun when it came time to upgrade, since they could easily port all of their software to another workstation (such as one made by HP or DEC). This became a marketing advantage for Sun, and made it into a large company quickly. Other, more established computer vendors, first HP and DEC, then IBM, moved into the Unix workstation market. Sun also had competition from other new companies, the most prominent of which was Apollo, which was later acquired by HP.

If Sun's strategy for the computer industry holds sway, it could radically change the monopoly structure of the industry with respect to hardware. Right now, Intel has a strong monopoly position. The conversion to Unix, or another portable operating system, could make the need to standardize on a single computer architecture less strong, since software could much more easily be ported to different architectures. Sun created a large new market sub-sector which has largely supplanted the older minicomputer sector, severely wounding DEC, which regrouped and moved into workstations itself, while attempting to merge its new workstation line and its older VAX minicomputer line, supporting its old customers while capturing a chunk of the workstation market. Now it is planning to build a new computer, based on its Alpha chip, that will run all of its old VAX software and Unix software as well.

In computer industry parlance, the term "architecture" refers to the design on which a line of chips such as Intel's 286, 386, and 486, or Sun's Sparc chips, is based. Generally, software will run on only a single architecture. Portable software will run, and function identically, on different architectures.

Many industry pundits argue that the computer industry will become even more competitive with time. If Sun, Unix, and open systems hold sway, this will be the case. Hardware will become an almost totally fungible commodity, since the same software will run on all hardware platforms. The only true monopoly will be in Unix itself, which will continue to be proprietary to Novell. Since the IBM/Apple alliance, and well as Sun, AT&T, HP, and DEC, are all primarily relying on an open systems strategy, Unix dominance may come to pass. The main avenue of competition will then be in software. Sun is already positioning itself as both a software company and a hardware manufacturer, with its software subsidiary SunSoft marketing its flavor of Unix for Intel-based architectures.

Recently, the two leading market research firms in the computer industry, Dataquest and International Data Group (IDG) projected market share for various next generation operating systems such as Windows NT (the upcoming new version of Windows), OS/2 from IBM, Unix, and Taligent. Dataquest had Windows NT with a majority share, whereas IDG had Unix with a majority share. Microsoft has current market control, and it remains to see if everyone else, betting on Unix, can dislodge them. This will be difficult to do. The only thing that is not in dispute is that there will continue to be a strong monopoly standard in the area of operating systems, the only question is who it will be.

The incentive to migrate to Unix may not be there for the majority of computer users, who use Windows applications on Intel-compatible PCs. As long as they can continue to use these applications and get comparable performance to fast RISC chips, they have no reason to move over to Unix and leave the Intel x86 line of chips. The success of Unix is based on the availability of new technologies, such as speech recognition, on Unix-based RISC platforms, and the non-availability of these same technologies on the x86

Windows platform. Only this will give Unix and RISC the technological edge that it needs in order to become the new standard.

As Sun became quite successful in promoting Unix and "open systems," and after AT&T bought a chunk of Sun and started making some money from Sun's success and increased Unix royalties, other vendors, such as Digital, HP, and IBM, became concerned that AT&T's proprietary hold over Unix would make them all dependent on AT&T, much as most of the microcomputer industry is currently dependent on Microsoft. IBM, DEC, and HP, along with several other companies, formed the Open Software Foundation (OSF), co-funding it to develop its own version of Unix, which could then be returned to its users royalty-free, releasing them from paying royalties to AT&T. The first version of this operating system, OSF/1, was based on Carnegie-Mellon's Mach version of Unix.

Since each computer vendor wants to sell as many systems as possible, from the beginning it was unclear to what extent OSF's members were committed to OSF's products, since they all had AT&T Unix System V versions running on their workstations when OSF was started. System V had 20 years of debugging and development behind it when OSF began. OSF was formed in 1988, and in 1992, despite the availability (immanent or actual) of OSF/1-based systems on some OSF member machines, notably DEC and IBM, it was unclear to what extent OSF/1, as opposed to Unix System V, would become the standard. Given the much larger installed base of System V, most bets were on AT&T. At some point, however, if the promise of "open systems" came true, it would make little difference whether a computer ran OSF/1 or System V, or one of their successors, because all applications software that ran on one would run on the other. Eventually, if competition in the system software area heated up, and the standard for systems was truly open, then the

market for system software would become competitive, much as the market for computer hardware is becoming competitive, as workstations start to compete with PCs and Intel's dominance is challenged.

Meanwhile, AT&T was hardly sitting on its hands. AT&T spun off its Unix software operation into a subsidiary -Unix Systems Laboratories (USL) - and sold off some of the subsidiary's stock to other computer companies, in what seemed to be a deliberate attempt to counter the influence of the OSF and to assauage the fears of other companies that AT&T would have undue control over the emerging standard. It kept license fees for Unix relatively low, to help third party value-added vendors, such as the Santa Cruz Operation (SCO) and Interactive (which was acquired by Sun), keep prices low. As a result, the number of PC-compatibles running Unix rose significantly, although it was still insignificant compared to those running Windows or DOS. Sun started a software subsidiary, SunSoft, to market its own value-added version of Unix, SunOS (renamed to Solaris), to Intel architectures, and acquired Interactive. And finally USL itself entered the fray, with a product code-named Destiny, that brought Unix to the PC desktop for a price below $500. Many observers felt that Destiny, with USL's (and AT&T's) name backing it up, would pose a formidable threat to Windows. Like IBM did with OS/2, USL designed Destiny so that it could run Windows software on PCs, to provide a nice migration path for windows users.

In 1993, Novell acquired USL from AT&T. It did this after working closely with USL in co-developing products. Novell hopes to use the marketing power that comes with a dominant position in PC networking to promote Unix as an alternative to MS/DOS, Windows, Windows NT, and OS/2. Before it acquired Unix, Novell had been marketing an

MS/DOS clone, DR/DOS, which it had obtained when it acquired Digital Research, one of Microsoft's early competitors. DR/DOS did not succeed in getting much market share away from Microsoft, so Novell decided to shift to a Unix-based strategy, implicitly allaying itself with Sun, IBM, Apple and other workstation vendors against Microsoft.

OSF stayed largely out of the fray, concentrating its efforts primarily on networking and other "interoperability" issues. Since PCs have a much larger installed base than workstations, if Unix becomes a popular operating system on PCs (perhaps supplanting DOS, Windows, and OS/2), then whatever version of Unix is most popular on PCs - whether it is Destiny, SCO Unix, or Solaris - is likely to become the favorite flavor of Unix in general. SInce OSF has no PC-based Unix, it is not even in the running right now. However, the IBM/Apple PowerPC, which is not due until 1994, is supposed to be OSF/2-based, and if this impressive configuration of corporate power manages to successfully market the PowerPC with an OSF/2-based OS, the entire situation will change. All the companies are likely to want to retain a proprietary element to their flavor of Unix that they can market as an additional value (such as Sun with it's OpenWindows user interface), so that there is unlikely to emerge a flavor of Unix that is completely free (although Richard Stallman's GNU project is attempting to do just that, with its free GNU Unix clone, which is under development.)

Thus the impact, and ultimate success, of the OSF remains to be seen. One area that it has had a major impact has been in the graphical user interface (GUI). The OSF's user interface, OSF/Motif, which, like all Unix user interfaces, is based on MIT's X Window software, has already become the most popular Unix user interface. This is because its only major competitor was Sun and AT&T's OpenLook user interface, and SCO, IBM, and HP

all promoted Motif. It is now the closest thing there is to a standard Unix user interface. However, Destiny uses yet another user interface, which may actually hurt Destiny's adoption by people who are used to the Motif interface. The largest number of Unix GUI-based applications are on Motif. Thus, although a particular initiative, such as the OSF, may not break a monopoly, it may expand into as yet fully explored product markets, such as GUIs.

The state has a role in promoting Unix as a standard in the computer industry. The IEEE Posix standard, which is based on Unix, has been selected by the federal government for its computer purchases. One of the reasons Microsoft developed Windows NT, which is Posix compliant, is because it was required for computer purchasing. The federal government, and in particular the Department of Defense, has been active in promoting standards over the years, particularly in the areas of computer languages, networks, and computer security and encryption. For instance, the federal government encouraged the development of common programming languages between manufacturers in the 1950s by only purchasing equipment from manufacturers that participated in the development of the common programming languages. In the 1970s, DOD supported the development of the TCP/IP networking standard that has become one of the two most important networking standards (the other is Novell's IPX). State participation has been motivated less by a desire to assure the health of the computer industry than by the need for standards for military purchasing and continued use of computers. Of course, the military has been involved in the development of computers from the beginning, and much computer engineering and software research continues to be funded by the military.

Along with the federal government, IBM and Apple have decided to join together and jump on the Unix bandwagon. They are basing their forthcoming PowerOpen operating system for their forthcoming PowerPC architecture on OSF/1. The PowerPC architecture, co-developed by Apple, IBM, and Motorola, is based on IBM's RS/6000 workstation architecture and Motorola's 88000 RISC chip. Machines based on PowerPC chips became available in late 1993.

If the PowerPC is a success (as it likely will be if it can run Mac, DOS, Windows, and Unix applications at the same time, as promised), then OSF/1 will be a success by association, and IBM's investment in the OSF effort will have paid off. IBM and Apple have promised to license PowerOpen and PowerPC to other manufacturers, and to promote PowerOpen as an OS standard. So even if the PowerPC fails to be a success, PowerOpen may be a success on its own. IBM and Apple have a dual purpose here; they want to wrest the domination of the chip business away from Intel, and they want to be on the cutting edge of the emerging Unix standard. Even if Unix fails to dislodge MS/DOS and Windows from their dominant position, it is still likely to be important on the high end, as many large companies are basing their strategies on it.

Both IBM and Apple spent several years promoting their own proprietary operating system strategies, the Macintosh OS in the case of Apple, and OS/2 in the case of IBM. Apple was particularly rigid about not licensing its operating system for use with non-Apple machines. While not abandoning these strategies, Apple and IBM, in embarking on an open, standards-based strategy and a consortium approach, have brought about a shift in the governance of the sector, and have mounted a challenge to both Microsoft and Intel.

Intel and Microsoft are not sitting on their laurels. Microsoft has promised to port Windows NT to a variety of architectures, including the PowerPC, Sun's SPARC, and Digital's Alpha. Intel is aggressively pursuing the next two generations of its x86 architecture, the Pentium (the successor to the 486), and the Pentium's successor, which is so far simply referred to as the P6.[3] The Pentium is only slightly slower than the first generation PowerPC, but it is much larger and consumes more power. Intel, because of the standard it has established, is wedded to ten year old design choices made in its earliest chips (the 8086 and the 80286.)

Microsoft and the PC Operating System Wars

In 1995, Microsoft had almost complete dominance of the PC-compatible operating system market, both with MS-DOS (now in version 6) and with Microsoft Windows. It was also coming under attack from many of its competitors, both large and small, as well as the Federal Trade Commission and the Justice department for its business practices.

Microsoft, like many other large companies, aggressively protects its intellectual property. It may do so even more than other large companies, because, as a software company, intellectual property is virtually the only thing that it sells (or more properly, licenses.) (Microsoft also sells some computer accessories, notably mice and keyboards, but this represents a small fraction of its business.)

Many of Microsoft's competitors alleged that Microsoft used its dominant position in operating system software to garner an unfair advantage in application software. They alleged that the sections of Microsoft responsible for operating system software got

---

The name Pentium was chosen instead of 586 because Intel had difficulty in copyrighting the name "486"; AMD has been able to sell chips with the names "386" and "486."

information about updates to the operating system before competitors outside Microsoft. Since, in order to write operating system software, one must access the operating system often, this, if it were true, would give Microsoft a major advantage. The competitors alleged that this constituted illegal "tying" of products prohibited under the Sherman and Clayton antitrust acts.

In addition, the competitors alleged that Microsoft sometimes actually intentionally misled application developers outside of Microsoft on the direction of operating system products. And they alleged that Microsoft developed features of its operating systems that were known only to internal application programming (so called "undocumented calls" or "hooks".)

Microsoft's competitors also complained about Microsoft's licensing agreements for MS-DOS. Often, Microsoft would agree to license MS-DOS to a manufacturer only if they agreed to pay a license per machine sold, whether or not it included MS-DOS. Rivals complained that this policy made it more difficult to get manufacturers to license a rival system, such as IBM's OS/2, since they have to pay for MS-DOS for a given machine in any case. This amounts to, the rivals would argue, illegal "exclusive dealing" prohibited by the antitrust acts.

In addition, the competitors would argue, in the field of operating systems, one requires a certain minimum market share in order to recover sunk costs and have sufficient revenue for continued development. Microsoft, by its practices, made it impossible for a rival system (such as IBM's OS/2) to gain sufficient market share to become a viable competitor.

Also, Microsoft's competitors complained that Microsoft would announce forthcoming products well in advance of their actual appearance and with unrealistic shipping dates; so-called "vaporware". This, the competitors claimed, was a way of misleading customers and taking them away from existing products.(Of course, Microsoft could easily find examples of competitors doing the same thing.) For instance, Microsoft had announced Windows 1.0 in November 1983 for delivery in June 1984. The delivery date was then delayed until June 1985, and it was shipped in November 1985. Windows 95 was announced in February 1994 for delivery in the first quarter of 1995; it was shipped in August 1995. (Flynn 1985)

In 1994, after years of inaction, the Justice Department finally threatened Microsoft with a lawsuit. The FTC's investigation of Microsoft had begun in 1991., but, because of deadlock between the commissioners (one of whom had recused himself) had never taken action against the company. The lawsuit may have reflected a new activist attitude to antitrust by the Clinton administration, which determined to distinguish itself from twelve years of Republican rule. It may also be that the sustained complaining by Microsoft's competitors finally had effect.

As a result of the Antitrust division's experience in the AT&T and IBM cases, where it sought, in each case, the breakup of the company (and which cases dragged on for year, in the case of IBM from 1969 to 1981), Justice in this case sought other remedies.

Justice department lawyers took statements and documents from Microsoft's competitors, which basically listed the issues raised above. In addition, they complained of predatory pricing and predatory disparagement of competitors (Goldman, 1995) Novell complained that Microsoft dumped its "Windows for Workgroups" product, which

competed with Novell's Netware, on the market at sharply reduced royalties in order to take market share away from Novell.

The complaint filed in federal court listed most of the anticompetitive practices name above. In addition, it not only complained about the nature of the operating system licenses (per processor licensing) but also the fact that Microsoft required licensees to take long-term contracts, often for three years or more, exceeding the PC product cycle time in most cases. Also, it accused Microsoft of requiring of application developers overly restrictive nondisclosure agreements, which prevented them from working with Microsoft's competitors. The relief requested was that Microsoft cease these uncompetitive practices, and that the court consider other actions "appropriate to restore competitive conditions."

Microsoft lobbied the Commerce department, arguing that a successful suit against it would harm the U.S. economy. They also lobbied the significant political constituency that does not believe in antitrust enforcement, believing that the government should not interfere with the workings of the market in any way. Anne Bingaman, the assistant Attorney General for antitrust, successfully lobbied Congress for more funds to beef up the Antitrust division and hire more lawyers and economists, many of whom were slated to work on the Microsoft case.

In June of 1994, Justice and Microsoft sat down in settlement negotiations, and about a month later reached agreement on a consent decree. The decree banned, for 78 months, the licensing practices and non-disclosure agreements that were listed in the Justice complaint. As required by the (1974) Tunney Act, the parties had to submit the proposed degree to a court to determine whether the proposed degree was in the public interest. Judge Stanley Sporkin, who considered the decree, took the rather unusual step of rejecting it. He

rejected it on four grounds: 1) that the Government did not provide him with sufficient information on how the decree was arrived at for him to make a public interest determination; for instance, he wasn't informed on what had been negotiated out of the decree 2) that it was too narrow, in that it covered only x86 PCs and versions of DOS and Windows, and not other products that Microsoft may produce (Microsoft will most likely argue that Windows NT is a separate product from Windows) 3) that it would not succeed in transforming the monopolistic structure of the operating systems market back into a competitive one and 4) that the enforcement mechanisms seemed inadequate.

Specifically, Judge Sporkin was dissatisfied that the decree did not deal with the issue of "vaporware" and the allegation that Microsoft had used its monopoly status to gain unfair advantage in application software. The Justice department had initially considered requiring that Microsoft construct a "Chinese Wall" between applications and systems software by requiring that any information that it discloses to its internal applications developers must also be simultaneously released to all other application developers. But, for whatever reason, Justice had agreed with Microsoft to drop this provision. Other firms are concerned that Microsoft will use its market power to gain a prominent position in emerging markets for set-top boxes for interactive television and video-on-demand, in on-line services, and in electronic banking.

Nobel prize-winning economist Kenneth Arrow submitted an a affidavit at the Government's behest stating that the operating systems market was a "increasing returns market." This means that a firm gets more returns the more market share it garners, and once a firm garner a monopoly position, it is very difficult to dislodge Sporkin used this to buttress his third concern (above), although Arrow and the government had used this

analysis to argue that now that Microsoft will be prohibited from certain licensing procedures, it will not be as easy for it to block other entrants. Sporkin felt that the damage had already been done, and the consent decree was "too little, too late." One analyst felt that Sporkin's reasoning here was similar to that of advocates of affirmative action; in fact, this logic is similar to that of compensatory damages in the common law; the remedy is to "make whole." Most analysts agreed that requiring Microsoft to change its licensing practices at this late juncture would make little difference.

In an unusual twist, Silicon Valley lawyer Gary Reback filed an amicus curiae brief to Sporkin, representing several anonymous persons who did not want their identities revealed to Microsoft or the Justice department. His firm represents many prominent computer firms, such as Novell, Sun, and Borland. These persons may not have wanted their identities known because they may not have wanted to compromise current or future business dealings with Microsoft. In addition, amicus briefs were filed by the Computer and Communications Industry Association and the I.D.E. Corporation. All these briefs opposed the consent degree, stating that it was too weak.

The Tunney Act had been passed in the wake of Watergate. Democrats were concerned that Nixon's antitrust division had been too lenient against ITT and other companies that were close to Nixon. By requiring judicial review that a decree was in the public interest, Democrats were hoping that the Justice department would not be allowed to bow to the will of powerful monopolists. In this case, however, Sporkin was not to prevail, and the intent of the Tunney Act was not carried out. Ironically, Sporkin had been appointed by a Republican, but he had formerly been head of enforcement for the Securities and Exchange Commission and perhaps had no fear of going up against large companies. One

legal expert, Phillip Areeda, felt that the Tunney Act was attempting a difficult balancing act, in that it tries to make the judge more than a rubber stamp, but does not allow him to use Government resources in making his case (Andrew, 1995).

Both Microsoft and the Government appealed Sporkin's decision. In June 1995, the appeals court stated that Sporkin did not have the power under the Tunney Act to go beyond what had been alleged by the government in the complaint. It is true that the complaint did not mention either "vaporware" or Microsoft's unfair advantage in applications, which in itself is strange, since the Justice department was clearly aware of these issues. The appeals court ordered the consent decree remanded to a lower court other than Sporkin's, and on August 22, 1995 (three days before the release of Windows 95), that court ordered the consent decree implemented. They also objected to the Reback briefs, saying that they were a violation of due process. This represented the second major legal victory for Microsoft, the first being its victory in the lawsuit brought against it by Apple for copyright infringement. Ironically, Windows 95 looked even more like the Macintosh than did Windows 3.1.

Microsoft spent $200 million to promote Windows 95, the successor to Windows 3.1, which premiered in August 1995, putting on such stunts as buying out the daily press run of the Times of London, and distributing it free with an insert promoting Windows 95, and lighting up the Empire State Building with three of four of the colors from the Windows logo (the fourth color could not be done in time due to technical problems.) It was easily the most ballyhooed software release in history, with many front-page articles in newspapers and quite a bit of television coverage. The marketing of Microsoft Office for Windows 95, which was closely tied to the marketing for Windows 95 itself (the new version of Office was released simultaneously) most likely caused competitors to cry foul as it appeared that

Microsoft was again engaging in product tying, although there was no bundling of the two together at a reduced price.

Windows 95 raised yet another concern on the part of the Justice department and Microsoft's competitors. This was caused by Microsoft's decision to bundle Microsoft Network, its own on-line service, into Windows 95. In June of 1995, the Justice department said that it was investigating Microsoft's plans to do so, but Justice took no action to stop Microsoft on this, so Windows 95 was released with Microsoft Network included.

Home Finance Software Wars

Microsoft had, by 1994, managed to gain sizable market shares in a variety of areas of software, including computer languages, databases, word processors, and spreadsheets, but one area remained resistant to Microsoft's dominance. This was the area of personal finance software, which was dominated by the program Quicken developed by the independent software house Intuit. Microsoft had attempted to take market share away from Intuit with its product Microsoft Money, but had failed to do so. In 1995, 81 percent of PC computer users who use financial software used Intuit's Quicken or its Quickbooks, its small-business bookkeeping software (Dickenson, 1995) Dickenson suggests that Microsoft may be able to use its market power to wrest a domination away from Intuit. He points out that Lotus 1-2-3 was once the dominant spreadsheet, but now Microsoft's Excel is dominant. Microsoft may be able to use its new (as of 1995) on-line service, Microsoft Network, to interface to Money and gain an edge in electronic banking, although Intuit also has plans along these lines and is lining up prominent banks as partners.

In 1994, Microsoft announced plans to buy Intuit, in a stock swap, but in 1995, the Justice department filed suit to block the acquisition, saying that it would lead to an

uncompetitive situation. As a result, Microsoft decided not to go ahead with the acquisition, over the protests of Intuit. This made Intuit and Microsoft competitors again, and Microsoft promised to proceed with the development of Money. Banks were generally pleased with the outcome, because they feared that Microsoft-sponsored on-line banking would crowd others out of the market.

Networking Wars

A closely related area to operating systems is computer networking. In fact, these two areas increasingly are blurring into one another, as vendors hustle to build networking features into their systems. For instance, Microsoft has built networking features into Windows for Workgroups and Windows NT. Novell is very concerned that Microsoft will dislodge it from the primary position in PC networking, using its dominant position in desktop operating systems to leverage itself into the network file server market.

The two dominant companies in networking are Novell and Sun. Novell grew out of the need for DOS-based computers to be connected together and share files. Novell brought out a product, called Netware, which made this possible. Over time, Novell became the dominant company in DOS networking, as people settled on Netware as a standard. A similar need was addressed by Sun, with its Network File System (NFS) for Unix workstations, which allowed heterogeneous Unix workstations, and later computers running other operating systems, to share files. This rapidly became a standard in Unix networking.

Today, a popular model for computing is the "client-server" model. In this model, computing, file, and display services are distributed across a network. A program could run on machine A, its input and output could appear on machine B's display, and it could be

using files located on machine C. All three machines could be in the same room or on different continents. Unix-based machines already largely support this kind of networking, and all operating system and network software vendors are trying to build such networking into their systems. In doing this, they must conform to existing standards.

Windows NT, OS/2, Netware, and Unix all conform to the client/server model. Novell's strategy with Unix is to fuse it with Netware to fuse the market shares of the two products and make it a more powerful player in the market. In fact, they have brought out a version of Unix, Unixware, which incorporates Netware features. This has led to a strange situation of a single company being committed to promoting two networking protocols, Netware's IPX and the TCP/IP protocol traditionally associated with Unix.

Novell is collaborating with Sun in supporting Unix, and at the same time has an interest in seeing a version of Netware become more popular than Sun's NFS in file sharing over networks. This is in fact a typical situation, with firms competing in one area and cooperating in another. We will see in the next section another example involving Apple and Microsoft.

Font Wars

When Apple brought out the Apple Laserwriter, this represented a revolution in the usage of computers. For the first time, it was economical for the personal computer user to obtain high-quality output on the desktop. This spawned a whole industry, desktop publishing, which allowed end-users, using sophisticated software programs such as Aldus Pagemaker and Quark Xpress, to produce publication-quality documents that would previously have required the services of professional typesetters.

The Laserwriter had a built-in software interpreter, called Postscript, from Adobe, which interpreted commands sent to the printer. Postscript is a page-description language. The early entry of Apple and Adobe into this field created a temporary monopoly for them and established Postscript as a standard for page description in desktop publishing.

Apple's success with the Macintosh was based on expertise hired away from Xerox's Palo Alto Research Center (PARC). Adobe, as well, was formed by PARC alumni. Xerox and HP, as two of the older companies in the Silicon Valley area, have played a major role in providing talent for new companies in the area and creating the San Jose area's famous regional economy (Saxenian 1990).

Soon, other firms besides Adobe were producing Postscript and non-Postscript printers. The biggest success in the area of non-Postscript printers was HP, with its Laserjet series for PC compatibles. Postscript printers are now manufactured by many manufacturers, including Apple, IBM, HP, Texas Instruments, and many others. However, Adobe receives a royalty for every genuine (licensed) Postscript printer.

There are also clones of Postscript available; Adobe does not receive a royalty for printers that use Postscript clones. For instance, Stallman's GNU project has a Postscript clone called Ghostscript, that they distribute free of charge. Microsoft also has a Postscript clone. These clones may be vulnerable to legal challenge, although most common computer languages are standardized by IEEE and are not copyrighted. Adobe would have to make the case that it could copyright Postscript.

As well as being a page-description language, Postscript is a typeface-description language. It describes fonts so that they can be printed out at any size and resolution.

Postscript fonts have become some of the leading fonts in publishing, and Adobe has become a major distributor of fonts, which it sells as software.

After it became evident that desktop publishing was a big business that was here to stay, Apple and Microsoft, as the two leading manufacturers of operating systems for personal computers (the Macintosh operating system in the case of Apple, and MS/DOS and Windows in the case of Microsoft), became concerned that Adobe was exercising too much control over the desktop publishing business, and that they would be beholden to Adobe both over the future direction of software and font design. Apple would have to continue to pay Adobe for every Laserwriter that it sold.

Initially, Adobe kept the specifications for its Type 1 Postscript fonts, the most common fonts in use, secret. This made it difficult for other vendors to develop their own Type 1 fonts. As a result of pressure and of the dangers of another font standard emerging, Adobe published the specification of Type 1 fonts. Now a large variety of Postscript fonts are available from vendors other than Adobe. The decision to publish a standard is a common one in the computer industry: since adoption by other vendors can promote a standard. For instance, Sun made a similar decision when it decided to set up a company (SPARC International) to license its SPARC chip set to other vendors.

In order to compete with and to decrease its reliance on Adobe, Apple developed its own type specification in-house, which it called TrueType. The original design of the Macintosh did not allow for fully scaleable fonts on screen, so Adobe created a program (Adobe Type Manager) which supported scaleable fonts using Postscript fonts. This became a popular program for Macintosh users who wanted to see exactly what they were going to get on their Postscript printer on screen. As a result, Apple began to think about how to

build the same feature into the operating system, and a scaleable font technology based on Truetype fonts (which are not compatible with Postscript) was incorporated into the system software.

Meanwhile, Microsoft was developing its clone of Postscript, hoping to gobble up some of Adobe's market share in built-in printer software. Apple and Microsoft realized that they could help one another if Microsoft used Truetype fonts in its Postscript clone. The result was that Microsoft's Postscript clone was named "Trueimage," and was made to support Truetype fonts. Also, Truetype was incorporated into Microsoft's Windows software. With scaleable fonts built into both Windows and the Macintosh, both companies' reliance on Postscript was somewhat diminished. However, many more fonts are available in Postscript format than in Truetype, and Postscript remains the industry standard, not Truetype or Trueimage.

Adobe was not sitting on its heels. It got IBM to agree to incorporate Adobe fonts in its Systems Applications Architecture (SAA), which is IBM's ambitious attempt to get computers of various sizes (micros, workstations, minis, and mainframes) to run the same software. (IBM also promised to support Truetype fonts) It published the Type 1 font specification, as noted above. And, not least of all, it announced a new version of Postscript, Postscript Level 2, with added speed and functionality. The point of this was to stay a step ahead of the Postscript clone makers. Now printers with Postscript Level 2 are marketed, and clones of Level 2 are busily being prepared. Since Adobe controls the direction of Postscript (much as Novell controls the direction of Unix, or Microsoft, the direction of DOS), it can stay ahead of the competition by expanding and enhancing the language.

It is a bit surprising and inconsistent on the face of it when you see large companies making alliances in one sub-sector while they are competing and joining alliances against one another in another sub-sector. For instance, in the case of fonts and desktop publishing, Apple and Microsoft formed an alliance against Adobe, and IBM largely threw its support to Adobe. In another area, operating systems, IBM and Apple formed an alliance against Microsoft. Of course, the desktop publishing alliance occurred first, so to some extent this represents shifting strategies and loyalties. However, this also reflects the willingness of companies to adopt different strategies, and different partners, in varied market sub-sectors.

Such multiple alliances must obviously be navigated with great caution. It doesn't make a great deal of sense to hurt a partner in one market sector when you are dependent on them in another market sector. Such bargains trade market efficiency for economies of scale and use of comparative advantage in bargaining between firms. Alliances work best when each firm brings something to the transaction that the other needs. In fact, the economies of scale can be partly understood in these terms.

In a not unexpected denouement to all these machinations, Apple announced that future versions of the Macintosh Operating System would support Adobe fonts fully (as well as Truetype.) IBM included support for Truetype fonts in OS/2 version 2. Many observers saw these events as the beginning of the end for Truetype, yet another victim of an attempt to dislodge a monopoly standard.

INCREASING CONCENTRATION

In 1994 and 1995, several of the largest firms in the computer industry merged. The two most significant mergers were of IBM and Lotus, and of Novell and WordPerfect. In addition, Novell bought Borland’s database product Quattro Pro. Borland had formerly

acquired Ashton-Tate, the developer of dBase. Also, Adobe acquired Aldus in a stock swap, in an attempt to become the Microsoft of desktop publishing. And there were rumors that Novell would buy Borland.

The IBM/Lotus and Novell/Wordperfect mergers can be understood as a response by some of the largest players in the industry to the increasing market power of Microsoft. Microsoft was finding it increasingly easy to leverage its application software business off of its operating system software business, being able to exploit the increasing prestige of its brand name that it received from the enormous success of Windows. This was cutting into the market share of WordPerfect and Lotus 1-2-3, among other popular applications. In addition, a segment of the computer business-- the PC or desktop business-- was becoming increasingly a mass-market business, and in all mass markets, brand names are critical.

This goes against the conventional wisdom that the software industry is an innovation-driven industry. It is, but only in the long-term, not the short-or-medium terms. New varieties of software-- such as groupware, epitomized by Lotus Notes-- incubate for a while, usually in small firms. When they become popular, they change gradually, typically with the addition of features. Most software that people use is of this latter variety-- slow-changing, and dominated by large firms.

Since there are few economies of scale in software production; all you need is 20 or so people to develop a product and seldom more than a few hundred to support it, how can we explain the increasing concentration in the industry. The answer is in market power and brand reputation. Microsoft has developed a recognizable brand, and others wanted to do the same. Firms gain an advantage with the customer if they can provide for all of his or her needs, and thus garnering a large stable of applications under one firm's aegis.

There is a lot of propaganda in the software industry about how this is an industry in which the small firm or the individual can make a large impact, and certainly there are many examples of this. But the major thrust of the industry is increasingly being carried forward by large companies. Partially this is due to the drift to "fatware;" software that is so complex that it requires a small army of technical people to carry forward (although usually not more than 100) and a slightly larger army to support. But mainly, it is due to the market power and branding issues discussed above.

Novell maintained a strong monopoly position in PC networking, but was worried about its position given that Microsoft was putting more and more networking features into versions of Windows. For instance, Microsoft, in 1994, developed a version of Windows, Windows NT, that basically emulated a Novell file and print server, as well as emulating many features of Unix (also now a Novell product.) In response, Novell developed Unixware, which combined the features of Unix and Netware. This is described in more detail in the section on "networking wars", above.

In addition to this strategy to maintain market share in networking and "enterprise computing", Novell wanted to emulate Microsoft's strategy of using market power in one area to promote products in another area, and to provide "one-stop stopping" to customers. To do this, Novell needed application software, which was the motivation behind the acquisition of WordPerfect. The acquisition was good for both parties, theoretically, since each could benefit from the name recognition of the other. WordPerfect was a year behind Microsoft in the development of a "suite" product, which is a product which includes all the most popular types of desktop productivity packages, including a word processor, spreadsheet, presentation graphics package, electronic mail package, and (optionally) a

database package. Some of this lag was probably due to Microsoft's advantage in developing applications for Windows, an advantage which was one of the major reasons for the Justice's department's antitrust action against Microsoft. Similarly, Lotus's application suite was badly beaten in the market by Microsoft's, hurting 1-2-3 and making Lotus the target of a takeover.

In July of 1995, Microsoft had a 85 perfect market share in the suite market, with Lotus and Novell as also-rans, each with a single-digit market share. But with the release of Windows 95, it is likely, but by no means certain, that Microsoft will retain its dominance. For one thing, all three will have their suites ready much sooner after Windows 95's release than in the past, when suites did not appear until well after the introduction of Windows 3.1.

We have a situation which is oddly similar yet different from oligopoly situations of the past. Microsoft, IBM, and Novell are now the "big three" of the computer software industry, much as the big three dominated the auto industry for many years. But in the latter case, economists could argue that there were substantial returns to scale in the manufacture of cars. No such argument can be made in the case of software. 10 or 20 smart programmers, working together over the space of a year, can develop a suite of application programs. So, the only returns to scale are to be found in marketing, not production. The situation is much more like that of Coke and Pepsi than of Ford and GM.

In a twist, Microsoft is requiring all applications that run under Windows 95 to also run under Windows NT in order to earn the "runs with Windows 95" logo. This could hurt IBM and Novell in the enterprise server market, where they are promoting OS/2 and Unixware/Netware respectively, as competitors to NT. They are stuck between a rock and a hard place, in that if they want to promote their applications as Windows 95 compatible,

they need that logo, but the logo, at the same time, effectively promotes NT, since it increases the pool of applications that will run under NT. This strategy on the part of Microsoft has led some observers to think that Windows 95 may be a "decoy" leading customers to NT (Fisher 1995). Novell is saying that they will not use the Windows 95 logo on their application software.

Beyond the WordPerfect word processing software, Novell also acquired from a the WordPerfect merger a product called "Groupwise", which is a electronic mail, scheduling, and calendar application. This brings them into the groupware market dominated by Lotus Notes. Groupwise is less complex (and powerful) than Notes, and therefore can occupy a different market niche.

The Novell-WordPerfect merger was contested by Lantec, a company that makes messaging products for Novell networks. Groupwise competes directly with Lantec's products, and Lantec claimed that Novell had told it that it had no intention of entering the application software market. Lantec filed an antitrust claim against Novell, claiming unfair competition. Novell said that Lantec's claim was baseless and was related to a contract dispute, in which Novell claimed that Lantec owed Novell several million dollars under a co-marketing arrangement (Oberbeck 1995.) This is yet another example of how companies can use litigation strategically. Lantec may or may not believe in its claim, but may be using its suit as a bargaining chip to reduce or eliminate the money Novell claims it is owed. This is also a good example of the situation that a dependent company may find itself it in if the major company on which it is dependent changes its strategy. In such a situation, a company may have no alternative but to sue, alleging breach of contract, or unfair competition.

Lantec also filed an amicus brief in the Justice department's case against Microsoft, alleging that its case against Novell was similar to Justice's against Microsoft, and that both had merit.

Spreadsheet Wars

For several years, Lotus 1-2-3 was the most popular spreadsheet for personal computers. Its look and feel had become second nature for millions of computer users, many of whom had become used to programming 1-2-3 macros, which are keystroke combinations that perform complex operations that end-users can program themselves. In 1994, Lotus 1-2-3 still controlled 89 percent of the DOS market, with Borland's Quattro Pro a distant second with 11 percent. However, in the Windows market, Microsoft Excel had 49 percent of market share, 1-2-3 32 percent, and Quattro 18 percent. The DOS market is already much smaller than the Windows market, so 1-2-3 has already been eclipsed by Excel, which builds in a 1-2-3 compatibility mode to wean former 1-2-3 users.

Given these shifts in the spreadsheet market, it is somewhat ironic that Lotus has spent so much time on its lawsuit against Borland. The critical issue in the lawsuit was an emulation mode built into Quattro Pro that allowed it to execute 1-2-3 macros. Lotus alleged that this mode was a violation of its copyright in 1-2-3. At the district court level, Lotus won. The case is still in appeal and in 1995 the Supreme Court agreed to hear it.

Database Wars

The database market is divided into two major sub-sectors; desktop database and "enterprise" databases. The desktop database, such as dBase, is used by individual end-users and small businesses to manage data. The enterprise database, such as Oracle, is used by larger organizations to run servers that "serve" data to end-users. For instance, there may be

one large database used by a bank in a central server, and all the tellers have client PCs from which they do transactions that update the database.

Both of these markets are dominated by a few firms. For instance, the enterprise database market is dominated by Oracle, with 35 percent of the market. The second and third firms, Sybase and Informix, have 20 and 19 percent of the market . This totals 76 percent of the market, so the market is clearly oligopolistic. In 1995, Oracle was the second-largest software company in revenues, and was an early entrant into the relational database market, developing a product before IBM. Oracle was founded in 1977.

All three firms have recently partnered with firms that aim to develop "enterprise solutions"; Oracle with Novell, Sybase with Microsoft, and Informix with IBM. These are tricky partnerships that are bound to go awry, since both Microsoft and IBM have enterprise server products of their own that compete directly with the products of Oracle, Sybase, and Informix. This also makes for an interesting game-theoretical situation, since here you have two oligopolistic markets-- markets for database servers and for network operating systems-- interacting in a complex manner. The particular partnering that the parties choose constrains what happens in the software market. It is interesting that in this case the largest firm-- IBM-- is partnered with the smallest firm-- Informix. But this may be because IBM is perceived as perhaps one of the weaker players in the client-server market, although IBM's list of clients is truly formidable.

Sybase and Oracle have one of the most acrimonious relationships in the industry. They regularly refer to one other as liars. Sybase has taken out ads which portray Oracle as Pinnochio with a long nose. Both companies are interested in getting into the market for interactive television, and Oracle's CEO Larry Ellison has made this into his own personal

public relations obsession. But this market does not really exist yet, although both firms are establishing alliances with phone and cable companies to do trials.

Oracle also tried to develop a groupware package called Documents, but this didn't fly, so they started working with Lotus to make their databases work with Notes. The IBM acquisition of Lotus may change this, in that IBM is working with Informix. These alliances tend to form and dissolve quickly depending on how firms see their short- and medium-term interests. Rarely does an alliance last more than a couple of years, although firms may work together for much longer. For instance, Microsoft and Apple have worked together on various things for years, even while they are bitter enemies on the operating system front. But Microsoft is the leading developer of applications for the Macintosh, so they need to work together.

Modem Wars

The modem is a device used to connect computers across telephone lines. Hayes Microcomputer was a pioneer in the modem business. It was founded in 1977 and secured a dominant market share as modems became a popular adjunct to the personal computer. Hayes defined the command set that a computer attached to a modem used to control the modem, and this, due to Hayes's early entry into the market, became the defacto standard. By 1986, Hayes had a estimated fifty to seventy percent of the modem market. Much as in the case of the IBM PC, other manufacturers started to make Hayes-compatible modems. For Hayes, this posed a major problem, because many of the other manufacturers' modems were cheaper.

One important area of distinction between the case of the modem and the case of the PC is that in the latter case, the standard was controlled by two large firms, Intel and

Microsoft, whereas in the former case the standards were controlled by international telecommunications agencies and professional organizations such as the IEEE. All Hayes had invented was the command set for controlling a modem, not the actual mechanism for inter-modem communication. Hayes attempted to control other manufacturers by attempting to license the command set, based on a patent it had received for a part of the command set, but it was unable to do so. The actual mechanisms-- protocols-- for inter-modem communications, which go by names such as V.fast and V.32, are defined by governments, telephone companies and regulators, and professional societies.

As a standard solidifies, the market becomes more commodified. At first, the originator of the standard (IBM in the case of the PC, Hayes in the case of the modem) benefits from the fact that the clones are imperfect and that there is a certain amount of uncertainty on the part of buyers as to whether the clones are truly compatible. As the clones improve over time, and buyers learn that the clone is truly compatible, then the market becomes truly commodified, and the original versions lose market share. Usually, the original vendors try to maintain a higher price than the competitor to give the buyer the (possibly false) impression that they are getting something more by buying the original.

Hayes attempted to take control of the standard for data communication. For instance, in 1986, Hayes announced a technology it called Hayes Synchronous Interface (HSI). This was a standard for data communication at 2400 baud. It hoped that other modem manufacturers would adopt it, and it would become a defacto standard.

Unfortunately for Hayes, its standard did not take hold. Since it did not control the microprocessor chip set that is central to the operation of a modem, the chip set manufacturers sold their sets to all comers. By 1995, due to the almost total

commodification of the market, Hayes was bankrupt. The structure of the sub-sector had come full circle; Hayes had gone from a dominant position acquired by early entry to the status of just another player in a commodity market, from which they were squeezed out because they tried to maintain a high-price strategy, hoping that consumers would choose their brand name.

THE STRUCTURE OF DEPENDENT RELATIONS

One can define a dependent firm as a firm that is dependent on another firm for its survival. Examples of dependent firms include a Ford dealer, or a plumbing contractor that does all its work for a large chemical company. Another type of dependent firm is one whose business is dependent on selling products or services that only work with the products of a given firm. For instance, if there is a firm that makes only tape drives which only work with IBM mainframes, this firm is dependant on IBM, even if IBM would prefer that they not be in business at all. It is dependent because its research and development are based on what IBM does, and because its ability to attract customers is dependent on IBM's continuing ability to do so.

Often, when a given firm develops a certain amount of penetration of a particular market, other firms crop up to service aspects of this market. For instance, suppose that there is a company A that sells complete systems of hardware and software to auto repair shops. Company A may offer a service agreement that includes training, bug fixes, software upgrades, etc. Another company , B, may offer a similar service agreement at a lower price, siphoning off a part of the market (usually a small part, since Company A has an obvious advantage in marketing its agreement.)

Company A may want to drive Company B out of business. In some cases, companies in this position will attempt to expand their intellectual property rights. They may try to control who uses their software, for instance, attempting to license their systems, for instance, only for use by their customers, and no third party. If they succeed in expanding their rights by so doing, they will be able to change the structure of the industry, making it more monopolistic. Company B may try to counter by alleging antitrust claims such as illegal tying of the sale of the service agreement with the sale of the product. So far, the case law indicates that the original software vendor will have difficulty enforcing the license agreement, unless they get explicit assent. Shipping the license terms with the software will not be sufficient.

INTELLECTUAL PROPERTY RIGHTS OF VENDORS AS OPPOSED TO THOSE OF THE CONSUMER AND RIVAL FIRMS

In mass markets for software, software producers have certain rights. The consumer is entitled to make one copy if this copy is required to use the software, and one backup copy. The consumer is not entitled to make any additional copies.

Software producers attempt to expand these rights by the use of contract law. The typical way that they try to do this is by the use of so-called “shrink-wrap” agreements. These are licenses, the terms of which are inside the box, and to which the consumer supposedly assents by opening the disk package, using the software, etc. Most commentators find that these licenses are not enforceable, but the average consumer may not realize this and may abide by or be intimidated by their terms. Typically, these terms expand the scope of the vendor’s rights beyond those given in the copyright statute. For instance, the license agreement may prohibit reverse-engineering of the software (examining

it in order to clone it), which courts have held up as legal under the copyright law. They may attempt to govern the conditions under which the software is resold, attempting to impose the license on the second purchaser. They may attempt to disclaim warranties.

Insofar as a major software vendor (such as Microsoft) is able to enforce such terms, it may strengthen its monopoly position. The prohibition on reverse-engineering makes it more difficult for other firms to create clones. The limitations on warranties makes it easier for the firm to get software to the market that may not be totally de-bugged, and to avoid liabilities that may come with the multiple lawsuits that may be filed against it otherwise.

It is unclear whether or not the courts will enforce these licenses. They may not be enforceable since commercial law tends only to enforce whatever contract terms were stated and accepted at the time of the sale.

CONCLUSION AND DIRECTIONS FOR FUTURE STUDY

Rapidly changing technology and dominance by early entrants in technology-based sub-sectors leads to a great deal of dynamism in the computer industry. There is a constantly shifting terrain of governance, as firms search for the best strategies, whether they be competitive or cooperative, in an attempt to stabilize the conditions of competition and maximize each firm's advantage. Most commonly firms form alliances, either of a bi- or tri-lateral nature or many firms banding together to fight a monopoly firm by establishing an alternative standard. Occasionally these strategies include litigation; mainly contract litigation, intellectual property litigation, and antitrust litigation. Litigation is best understood in terms of continuing relations between firms.

In subsequent work I plan to pay more attention to this litigation side of the picture and attempt to measure whether there has been more or less litigation of the aforementioned

type over the years, and attempt to relate this to other parameters of the industry, such as firm profit rates and sales. One hypothesis would be that firms tend to resort to litigation more often when they are under more stress, that is when markets and profit rates decline. To test this hypothesis, we will look at firm profit data and litigation data from the Federal Courts litigation database.

REFERENCES

Andrew, Edmund L. 1995. “Information Technology: court hearing for Microsoft set for today.” *New York Times*, April 23rd, p. D1.

Blankenhorn, Dana. 1986. “Hayes Faces fight with IBM and AT&T”, *Data Communications*, February, p. 85

Brock, Gerald W. 1991. "The Computer Industry." In W. Adams, ed., *The Structure of American Industry*. New York: Macmillan.

Clapes, Anthony L, Lynch, Patrick, and Mark R. Steinberg. 1987. "Melville B. Nimmer Symposium: Silicon Epics and Binary Bards: Determining the Proper Scope of Copyright Protection for Computer Programs." *UCLA Law Review* 44:1493ff.

Corcoran, Elizabeth. 1990. "Likely Litigation: Companies wield lawsuits as a market development tool." *Scientific American*, March, p. 76ff.

DeLamater, Richard T. 1986. *Big Blue: IBM's Use and Abuse of Power*. New York: Dodd, Mead.

Dickenson, John . 1995. “Money-- That’s What I Want,” *Computer Shopper*, Sept., p. 65.

Economides, Nicholas. 1994. "The Economics of Networks," plenary address, EARIE conference, September 1994, Discussion Paper no. EC-94-24, Stern School of Business, New York University (available on-line at http://edgar.stern.nyu.edu/network/top.html)

Economist. 1991a. "Pile 'em High, Sell 'em Cheap," *The Economist*, Nov. 2, pp. 59-60.

Economist. 1991b. "Ace is High," *The Economist*, April 13th, pp. 65-67.

Fisher, Franklin M. 1983. *IBM and the U.S. Data Processing Industry: an economic history*. New York: Praeger.

Fisher, Lawrence M. 1995. “Windows 95’s Big Value May Be as Lure to Network System”, *New York Times*, August 7th, p. D5.

Flynn, Laurie. 1995. “Information Technology; the executive computer”, *New York Times*, April 24th, p. D4.

Friedman, Lawrence M. and Stewart Macaulay 1977. *Law and the Behavioral Sciences*. New York: Bobbs-Merrill.

Galanter, Marc and Joel Rogers 1991. *The Transformation of American Business Disputing? Some Preliminary Observations*. Working Paper 10-3, Disputes Processing Research Program, Institute for Legal Studies, University of Wisconsin Law School, January.

Goldman, Wendy 1995. “Oh No! Mr. Bill”, *Wired*, April.

Hall, Peter, Markusen, Ann, and Barbara Wachman. 1983. *The Computer Software Industry: Prospects and Policy Issues.* Working Paper No. 410, Institute of Urban and Regional Development, University of California at Berkeley.

Harvard Law Review. 1990. "Computer Intellectual Property and Conceptual Severance." *Harvard Law Review* 103:1046 ff.

Hollingsworth, J. Rogers, Schmitter, Phillippe C. and Wolfgang Streeck. 1994. “Capitalism, Sectors, Institutions and Performance” in Hollingsworth, Schmitter, and Streeck, eds., *Governing Capitalist Economies: performance and control of economic sectors.* New York: Oxford.

Hof, Robert D. 1992 "Inside Intel." *Business Week*, June 1, pp. 86-94.

Moeller, Mike and Mike Magee. 1993. "Microsoft Faces Restructure Following FTC Probe Results." *PC User*, Jan. 13, p. 18.

Markoff, John. 1992. "Toiling in Microsoft Shadow, Rivals Voice Awe and Anger." *New York Times,* Aug. 22, p. C1.

Oberbeck, Steven. 1995. “Suit Targets Novell-Wordperfect Merger.” *Salt Lake Tribune*, Feb. 3, p. C14.

Phillips, John C. 1992. "Sui Generis Intellectual Property Protection for Computer Software." *George Washington Law Review* 60:997ff.

Rebello, Kathy and Evan I. Schwartz. 1992. "Microsoft." *Business Week,* February 24, p. 60ff.

Rifkin, Glenn. 1988. *The Ultimate Entrepreneur: the story of Ken Olson and Digital Equipment Corporation*. Chicago: Contemporary Books.

Samuelson, Pamela. 1990. "Benson Revisited: The Case Against Patent Protection for Algorithms and other Computer Program-Related Inventions." *Emory Law Journal* 39:1025ff.

Saxenian, AnnaLee. 1990. "Regional Networks and the Resurgence of Silicon Valley." *California Management Review*, Fall, pp. 89-112.

Sheldon, Kenneth M., Linderholm, Owen, and Trevor Marshall. 1992. "The Future of Personal Computing?" *Byte*, February, pp. 96ff.

Spivak, Peter G. 1988. “Does Form Follow Function? The Idea/Expression Dichotomy in Copyright Protection of Computer Software." *UCLA Law Review* 35:723ff.

Wallace, James, and Jim Erickson. 1992. *Hard Drive: Bill Gates and the Making of the Microsoft Empire.* New York: Wiley.

Weber, Samuel. 1991. "Waging War on Intel: The RISC crowd moves in." *Electronics*, November, pp. 58-59.

Williamson, Oliver. 1985. *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*. New York: Free Press.