

**MICROSOFT PLAYS HARDBALL:**

**The Use of Exclusionary Pricing and Technical Incompatibility to  
Maintain Monopoly Power in Markets for Operating System Software<sup>†</sup>**

by

KENNETH C. BASEMAN\*

FREDERICK R. WARREN-BOULTON\*

and

GLENN A. WOROCH\*\*

May 1995

---

\* Principals, MICRA: Microeconomic Consulting and Research Associates, Inc., Washington, DC.

\*\* University of California, Berkeley.

† Forthcoming, Antitrust Bulletin, June 1995. We would like to express our appreciation for helpful comments and other assistance to Sturge Sobin, Linnet Harlan, Paul Dennis and the participants at the Columbia Business School's Institute for Tele-Information's Seminar on Sustaining Competition in Network Industries through Regulating and Pricing Access, especially Janusz Ordoover and Bobby Willig.

## TABLE OF CONTENTS

<b>I.</b>	<b>INTRODUCTION AND SUMMARY</b> .....	1
<b>II.</b>	<b>BACKGROUND</b> .....	3
	A. THE MARKET FOR PERSONAL COMPUTER OPERATING SYSTEMS .....	3
	<b>TABLE:</b> NEW SHIPMENTS OF PERSONAL COMPUTER OPERATING SYSTEMS .....	8
	B. MICROSOFT'S PRACTICES .....	9
<b>III.</b>	<b>FIRST-DEGREE PRICE DISCRIMINATION vs. INEFFICIENT SUBSTITUTION</b> .....	15
	A. FIRST-DEGREE PRICE DISCRIMINATION .....	16
	B. INEFFICIENT SUBSTITUTION .....	20
<b>IV.</b>	<b>ANTIFRAUD AND ANTIPIRACY RATIONALES FOR IMPOSING CPU ROYALTIES RATHER THAN MS-DOS UNIT ROYALTIES</b> .....	20
	A. REDUCING MANUFACTURER FRAUD .....	21
	B. REDUCING THE NUMBER OF NAKED MACHINES IN ORDER TO REDUCE PIRACY BY THE OEM'S CUSTOMERS .....	24
<b>V.</b>	<b>MARKET-POWER RATIONALES FOR CPU LICENSES RATHER THAN PER-UNIT ROYALTIES</b> .....	27
	A. WORKABLE COMPETITION IN TECHNOLOGY MARKETS WITH RAPID TECHNOLOGICAL CHANGE .....	27
	B. MICROSOFT'S PRICING AND MARKETING STRATEGIES .....	31
<b>VI.</b>	<b>EPILOGUE: THE DOJ CONSENT DECREE AND BEYOND</b> .....	33

## **I. INTRODUCTION AND SUMMARY**

This article examines Microsoft's licensing practices for its MS-DOS and Microsoft Windows operating system software. Our main focus is on Microsoft's use of CPU (central processing unit, or per-processor) licenses, under which an original equipment manufacturer (OEM) of personal computers pays a royalty for each machine it ships instead of for each unit of MS-DOS installed. We also examine Microsoft's practice of requiring in these licenses a minimum number of personal computers (PCs) on which MS-DOS can be installed, Microsoft's tying of Microsoft Windows and technical support information to the sale of MS-DOS, and Microsoft's attempts to induce technical incompatibility between MS-DOS and its main competitor, DR-DOS. Finally, we turn to the proposed consent decree between Microsoft and the Department of Justice.

We begin in section II with a brief description of the market in the early 1990s for personal computer operating systems, and a history of Microsoft's licensing practices and technical design tactics. In addition to CPU licensing, the minimum requirements contract, and the Microsoft Windows tie to MS-DOS, we discuss "cliff-pricing" quantity discounts for MS-DOS and attempted or threatened design incompatibilities between MS-DOS and DR-DOS.

We then turn to two potential efficiency rationales for the CPU license. The first, presented in section III, is based on the similarity between a CPU license and a two-part tariff, which can result in "efficient" first-degree price discrimination. Upon closer examination, however, we find that the CPU license could operate as a two-part tariff only toward customers with time horizons of less than 1 year. Moreover, even if a CPU license were a two-part tariff, in this specific factual context a CPU license would be neither welfare enhancing nor—absent an exclusionary effect—would it even be profit-maximizing.

Section IV examines a second potential efficiency rationale for the CPU: reducing OEM fraud and/or software piracy. By reducing the number of "naked" machines shipped by OEMs, a CPU

license could deter OEMs from engaging in fraud, or it could deter OEMs, retailers and/or customers from piracy. An examination of the historical record leads us to conclude, however, that the prevention of piracy and fraud is not a plausible explanation for why CPU licensing was introduced. Even more telling, however, is that the CPU license is no more effective at deterring piracy or fraud than are other available but unused nonexclusionary alternatives such as a "credited-CPU" license.

Section V turns to potential anticompetitive rationales for Microsoft's practices in the DOS market. We begin by observing that markets for many high technology products are characterized by a competitive process where a new product appears with a significantly superior technology or design and sweeps the field. By rapidly displacing the old product and its old technology, it achieves a very high market share in a very short time and earns very large profits. This situation persists only until the dominant firm's product is itself displaced by a new superior product. This cycle of a new product with a new technology displacing an existing product with an old technology is a process of "creative destruction" in the race to be best. Firms achieve a dominant position, but hold that position only transitorily because, without artificial barriers to entry, today's dominant or monopoly firm and product can readily be displaced by a new product developed by a competitor or a new entrant.

When the monopolist's position is protected by strategically erected barriers to entry, however, this displacement process can come to a halt. We examine the possibility that Microsoft has used a variety of exclusionary practices, notably nonlinear pricing and technical incompatibility, not to achieve its initial position but rather to retain that position against new competition. We conclude that, under the conditions present in the operating systems market, such practices can be, and in this instance have been, effective in limiting the growth and threatening the existence of entrants and rivals with very small market shares. We also conclude that Microsoft's anticompetitive behavior has reduced social welfare.

In section VI we turn to an examination of the Department of Justice's recent settlement with Microsoft. While we do not quarrel with the Department's focus on the horizontal aspects of the case, we are concerned that the remedies prescribed in the consent decree are likely to be inadequate.

Specifically, the consent decree fails to prevent Microsoft from employing nonlinear pricing or quantity discounts to achieve the same exclusionary consequences as the offending practices. We offer several remedies—including a ban on sales or discounting of naked machines, “credited CPU licenses” and allowing arbitrage—that lack the exclusionary aspects of CPU licenses. Furthermore, these alternatives preserve any antipiracy and antifraud properties that CPU licenses may possess.

## II. BACKGROUND

### A. THE MARKET FOR PERSONAL COMPUTER OPERATING SYSTEMS

**1. Personal Computer Platforms.** Our focus is on the market for packaged software that operates personal computers, and to a lesser extent, the software applications that run using those operating systems. To better understand the market for these products, we must delve into the economics and technology of the personal computer.

Several key features distinguish this product. PCs can be decomposed into hardware and software components. Some of these components are essential: every computer system requires a microelectronic chip called the central processing unit (CPU) plus operating system (OS) software. The OS directs the stream of instructions requested by the applications software, while the CPU performs the numerical computations. Importantly, the CPU and the OS are almost always combined in fixed proportions: one of each is needed per system.

Once an OS is installed, a user can run many kinds of applications software.<sup>1</sup> The most popular packages do word processing, spreadsheet analysis, and database management. Increasingly popular is the use of a graphical user interface (GUI) that simplifies the management of the various applications. Both applications and GUIs are optional components of a personal computer system.

---

<sup>1</sup> A PC also requires a layer of software that stands between the CPU and the OS. Called the BIOS, or basic instruction operating system, this code is burned into the machine's ROM (read only memory) chip.

Personal computers are available in several "platforms" that differ in their hardware specifications. The predominant PC "platform" is the so-called "IBM-compatible" PC, which has evolved from the hardware and software specifications of the machine introduced by IBM in 1981.

**2. Industry Structure.** The supply of many components is highly concentrated. First of all, an overwhelming proportion of IBM-compatible PCs in use today are equipped with CPUs manufactured by the Intel Corporation. Secondly, the majority of existing PCs run on one version or another of the operating system sold by Microsoft Corporation. Sales of applications software and peripheral hardware components are far less concentrated.<sup>2</sup>

Hundreds of OEMs assemble hardware components in various configurations called "models," distribute the machines through retail stores or mail order, and provide technical and repair service. In addition to a few large OEMs such as Compaq, Dell and AST Research in the U.S., and NEC, Toshiba and Hitachi in Asia, there is a host of small resellers. We can safely assume this segment of the market to be competitive.

The bulk of new PCs shipped in the U.S. (see the table) arrive loaded with some operating system, usually Microsoft's MS-DOS, and often with their Microsoft Windows interface as well. IBM ships its PCs with one of its own operating systems: PC-DOS or OS/2.<sup>3</sup> The only independent DOS (i.e., compatible with, but not a clone or derivative of MS-DOS) was Digital Research Incorporated (DRI's) DR-DOS which, with Novell's acquisition of DRI in 1991, is now referred to as Novell DOS and IBM's PC-DOS. Users could purchase OSs at retail stores (e.g., Egghead Software) or direct from the software publisher.

**3. Demand for PCs.** Personal computers are purchased by businesses, individuals, schools, government, and other organizations. Users select a hardware platform and a specific

---

<sup>2</sup> As to the ROM-BIOS, there are many providers including Phoenix, AMI, Quadtel and Award in addition to IBM's original version.

<sup>3</sup> OS/2 combines OS software and a GUI in one program.

hardware-software bundle based on the overall system price. Accordingly, demand for an operating system as well as for the microprocessor is derived from demand for the entire package. In 1992, it was estimated that the worldwide installed base of personal computers of all platforms totaled over 138 million.<sup>4</sup> Of those, 72% were IBM-compatible. Less than a quarter of those machines were equipped with Microsoft Windows.

Potential purchasers of an operating system can be divided into two groups. First, there are existing PC owners seeking to upgrade their OS or switch to a new one. Then there are individuals who need an OS for a new machine, whether it is their first PC, a replacement, or an additional one. Either way, current OS users will bear some costs when switching from one OS to another. Certainly this would be true if the new OS demands a more powerful machine (as with the move from DOS to either Microsoft Windows<sup>5</sup> or OS/2). At a minimum, the user must learn some new command or menu structure and may have to replace outdated or incompatible applications.

**4. Supply Conditions.** Operating system software is very costly to develop and market. For instance, it has been estimated that IBM has spent over \$2 billion developing OS/2. In comparison, operating system software is relatively cheap to produce and maintain. As a result, fixed costs are enormous and marginal costs are negligible. These fixed costs are also largely sunk. The code itself is rarely of little value in other uses.<sup>6</sup> Development teams accumulate expertise and reputation, only a portion of which can be redeployed into other projects.

Entry into the operating systems software market is not easy. There are sunk costs of development and marketing, as mentioned above. Besides the irreversible investment in computer code, incumbents acquire sunk, or partially sunk, assets such as customer lists and brand name

---

<sup>4</sup> BERNSTEIN RESEARCH, FTC INVESTIGATION OF MICROSOFT (Sanford C. Bernstein & Co.: New York, January 1993).

<sup>5</sup> Strictly speaking, Windows is not an OS, in that it must run in conjunction with DOS.

<sup>6</sup> This may change as operating systems adopt the object-oriented approach in which the program is composed of "objects" that can be re-used in other programs in a modular fashion. NeXT Computer's operating system, NextStep, has pursued this strategy.

recognition. Furthermore, any new OS must be compatible with all the applications that were written to that "standard." User switching costs also limit the ability of new entrants to gain a toehold. Of course, these costs erect barriers only when the incumbent firm has a first-mover advantage. However, sunk costs ordinarily imply a first-mover advantage, at least for the current vintage of technology.<sup>7</sup> In addition, as we will see, IBM bestowed a somewhat unique first-mover advantage on Microsoft when it selected MS-DOS to be the operating system for its PC.

**5. History of PC Operating Systems.** Dating back to 1976, Digital Research Incorporated sold a popular operating system, called CP/M, for use on machines based on Intel's 8-bit 8080 chip. In 1980, in what may become the deal of the century, Microsoft paid a mere \$100,000 for the rights to a CP/M derivative or clone software package called "Disk Operating System," which, with minor modifications, became the initial MS-DOS. In 1981, when IBM launched its entry into the personal computer market, it selected Intel's new 16-bit 8088 chip as the CPU. It also chose to endorse Microsoft's MS-DOS as the operating system.

IBM's partnership with Microsoft later fell apart. But in the meantime, neither IBM nor DRI stopped developing their own operating systems.<sup>8</sup> Under the terms of the dissolution, IBM continued to develop MS-DOS, and eventually its own variant, PC-DOS, which it loaded on PCs bearing the IBM nameplate. In exchange, IBM agreed to pay Microsoft a royalty for a predetermined number of units.

Having been passed over by IBM, DRI went on to modify CP/M for the Intel 8086 chip, leading to its CP/M-86. Later it developed DOS PLUS and then DR-DOS. In April 1990, DRI introduced DR-DOS 5.0 to critical acclaim. Instantly, it began to make inroads into MS-DOS 4.0's

---

<sup>7</sup> If there are no cost complementarities across vintages of technology, then the requirement to sink substantial investment in software development will not convey an advantage to the successful first generation firms in the competition to develop subsequent generations of technology.

<sup>8</sup> There were two other significant MS-DOS derivatives. For a while, Compaq Computer had shipped its machines with its own Compaq DOS, and NEC developed NEC-DOS, a proprietary operating system that, until recently, dominated the Japanese market.



market share. By year-end 1990, DR-DOS's share had increased to 10% of new OS shipments, leaving MS-DOS with 70% and IBM with 18%.<sup>9</sup>

Within a month of DR-DOS 5.0's inauguration, Microsoft reported development of MS-DOS 5.0. Curiously, it boasted nearly all of the innovative features of the DRI product. Yet MS-DOS 5.0 was not commercially available until July 1991, more than a year after DR-DOS 5.0's release. Anticipation of the new Microsoft product, prolonged by continuous Microsoft statements indicating imminent availability, however, reined in growth of DR-DOS 5.0 sales.<sup>10</sup>

The emergence of the graphical interface played an important role in the events that followed. After repairing bugs in Microsoft Windows 3.0, Microsoft shipped Microsoft Windows 3.1 in April 1991. In that year, 18.5% of new PC shipments included Microsoft Windows along with MS-DOS. By 1992, that fraction jumped to 59.7%. Over that period, sales of MS-DOS (both with and without Microsoft Windows 3.1) rose 28.9% while sales of PC-DOS and DR-DOS fell 15.4%. (See table ) By 1993, the market shares for operating systems on x86 PCs were 79% for MS-DOS, 13% for PC-DOS, 4% for OS/2, 3% for DR-DOS and 1% for UNIX.<sup>11</sup>

---

<sup>9</sup> See BERNSTEIN RESEARCH *supra* note 4, at exhibit 2, at 10.

<sup>10</sup> Sherer, *Microsoft Outlines DOS 5.0 to Ward Off DR-DOS*, PC WEEK, October 22, 1990.

<sup>11</sup> See note 28 *infra*.

**TABLE: NEW SHIPMENTS OF PERSONAL COMPUTER OPERATING SYSTEMS**

<b>COMPANY</b>	<b>OPERATING SYSTEM</b>	<b>1990</b>	<b>1991</b>	<b>1992</b>
Microsoft	MS-DOS	11,648	13,178	18,525
	w/ Windows	490	2,440	11,056
	w/o Windows	11,158	10,738	7,469
IBM	PC-DOS	3,031	3,003	2,315
DRI/Novell	DR-DOS	1,737	1,819	1,617
DOS Subtotal		16,603	18,288	22,847
Apple	Macintosh	1,411	2,204	2,570
UNIX	UNIX	357	582	797
IBM	OS/2	0	0	409
Other	NEC, etc.	5,079	4,628	4,458
<b>TOTALS</b>		23,450	25,702	31,080
Source: Bernstein Research, International Data Corporation				

## B. MICROSOFT'S PRACTICES

**1. The CPU License.** When first available, MS-DOS was sold to OEMs for a flat fee. Microsoft offered an unlimited number of copies for \$95,000, and for a limited time, reduced the price by half.<sup>12</sup> Around 1983, Microsoft began to gear its license fees to the level of OEM sales. Then and now, each OEM contract was individually negotiated; an external price list never existed.

Over time, Microsoft phased in a new type of royalty contract. By 1992, the "CPU license" became the dominant sales arrangement, with 60% of Microsoft's operating system sales made under CPU licenses.<sup>13</sup> Under its terms, affiliated OEMs were required to pay a royalty for every CPU they shipped. Since each machine had a single CPU, the OEM paid for a copy regardless of whether the machine was preloaded with MS-DOS. Microsoft would sell DOS licenses to OEMs who refused the CPU license, but only at significantly higher prices.

Under the CPU license, an OEM usually had to also commit to a minimum "requirement" ( $X$ ) that approximates its annual shipments. The one-time charge for this requirement is computed using a negotiated per-unit price ( $f$ ) multiplied by  $X$ .<sup>14</sup> If an OEM shipped a machine with a competing operating system, say PC-DOS or DR-DOS, *it would receive no reduction in its payment to Microsoft*. Consequently, an OEM who accepts a CPU license faces a zero marginal price for units of MS-DOS up to the minimum requirement. In the event an OEM exceeded its projected volume during the contract period, the per-unit fee ( $f$ ) used to calculate the lump sum payment for the first  $X$  units would apply to each unit above  $X$ . Thus, once the contract is in place, the marginal price is 0 up to  $X$  units and  $f$  for additional units.

---

<sup>12</sup> MANES & ANDREWS, GATES: HOW MICROSOFT'S MOGUL REINVENTED AN INDUSTRY—AND MADE HIMSELF THE RICHEST MAN IN AMERICA, (1993); cites are to edited and condensed version in *Microsoft Monopoly*, UPSIDE, March 1993, at 10–18.

<sup>13</sup> The percentage of Microsoft's operating system sales made under CPU agreements rose from 20% in FY 1989 to 22% in 1990, 27% in FY 1991 and 50% in FY 1992. By FY 1993, 60% of MS-DOS sales to OEMs and 43% of Windows sales to OEMs were covered under CPU agreements. See note 28; *infra*.

<sup>14</sup> It is paid to Microsoft over the course of the year with an initial payment at the beginning of the year.

Regardless of whether an OEM ends up shipping more or less than  $X$  PCs during the contract, the terms of the CPU license commit the OEM to pay for one unit of MS-DOS for each PC it ships. As a result, customers view themselves as paying double if they use other OSs. If an OS competitor offers to sell at a per-unit price  $m$ , the OEM will only buy if the second OS has a quality advantage over MS-DOS valued at  $m$  or more.<sup>15</sup>

In 1992, the average license fee per copy of MS-DOS to a hardware OEM under these CPU licenses has been estimated at \$15, far below the average retail price of an upgrade of \$49.<sup>16</sup> All together in that year, Microsoft grossed \$399 million on worldwide sales of 18,525,000 units of MS-DOS to OEMs and as upgrades.<sup>17</sup> From every indication, the implicit per-unit charges and requirement levels vary across the contracts signed by different OEMs.

Typically, these agreements ran for a period of 2 years. It was quite likely an OEM will finish any contract with unused licenses—if only because Microsoft, in an attempt to lock-in customers, would offer a lower per-unit fee to OEMs who agreed to minimum volumes exceeding expected shipments. The customer has no right under the contract to receive a credit for its unused units at the end of a contract. Nevertheless, Microsoft may allow the OEM to carry forward its unused licenses from the prior year  $Y$ .<sup>18</sup> When Microsoft allows carry forward of unused copies, then the marginal price of MS-DOS in the current year is effectively reduced by its implicit rebate value.

In addition to the price incentives for exclusivity that are provided by the CPU license,

---

<sup>15</sup> For a competing OS supplier to make a sale to an OEM who has signed the CPU license, the quality differential must be worth at least  $m$  regardless of whether the OEM is shipping more or less than  $X$  PCs. When the OEM ships less than  $X$  units, her marginal cost of using MS-DOS on the next PC is zero, compared with a marginal cost of  $m$  if she chooses another OS. After  $X$  PCs have been shipped, the marginal OS cost is  $f$  if the OEM uses MS-DOS, and it is  $f + m$  if the OEM uses the other OS. In each case, the additional marginal cost of using the alternative DOS is  $m$ . If the machine is shipped "naked," then  $m$  is zero.

<sup>16</sup> See BERNSTEIN RESEARCH, *supra* note 4.

<sup>17</sup> See *id.* at exhibit 3. In that year, Microsoft's sales of Windows through OEM and upgrades totaled \$599 million.

<sup>18</sup> Whether the unit is marginal or inframarginal, its value is the reduction in next year's CPU license fee from displacing one—unit, after discounting for time and likelihood that the additional unit will be used.

Microsoft has been reported to have responded with a variety of direct penalties if an OEM shipped some of its machines with a competing operating system. First, the OEM may be prohibited from carrying forward unused MS-DOS licenses. At the extreme, Microsoft has on occasion required an OEM to renew the CPU license at equal or higher volumes to retain the carry-forward option. In this way, Microsoft's policy on carry forwards establishes a "tie" between sales from one year to the next.

Second, Microsoft's technical service and support may be withheld from the rebellious OEM. This practice can disadvantage an OEM who needs this information to match the hardware configuration with the demands of the operating software (especially the choice of the microprocessor, the amount of RAM, and the graphics card).

Third, the price of Microsoft Windows has been increased to rebellious OEMs. As far back as the days when Microsoft Windows was called Interface Manager, Microsoft established a connection between the terms of sale of MS-DOS and its graphical interfaces.<sup>19</sup> Microsoft cautioned OEMs against bundling competing multitasking interfaces (such as Quarterdeck's DESQview, VisiCorp's VisiOn and DRI's GEM) with PC hardware components such as hard disks.

Discounts on Microsoft Windows were extended to OEMs who agreed to accept a CPU license for MS-DOS. Those who refused the CPU license or who did not use MS-DOS exclusively, could still purchase Microsoft Windows. Again, Microsoft extended the nearly valueless option of purchasing it on an unbundled basis for a much higher per-unit price.

What options are open to an OEM who does not wish to exclusively ship its machines with MS-DOS? The OEM can negotiate a per-unit contract with Microsoft. However, Microsoft charges a price differential that is so high relative to CPU rates as to make the per-unit "option" economically infeasible. Alternatively, the OEM can choose not to deal at all with Microsoft. In that case, it can

---

<sup>19</sup> See *supra* note 12.

purchase OS/2 on a per-unit basis<sup>20</sup> (assuming the OEM manufactures machines that fit OS/2's higher memory requirements). Or it could send out machines with no operating system at all. A user who buys a "naked" machine must obtain an OS from another source. The owner can transfer the operating system from an old machine, buy a new copy from a retail outlet, or "pirate" one from another user or an electronic bulletin board.

**2. Technical Incompatibilities.** Coordination on technical standards is crucial between the OS developer and applications developers. In several instances, Microsoft made it difficult for competitors, especially DRI/Novell's DR-DOS, to achieve compatibility with Microsoft Windows. Nowhere is this coordination more important than with the publication of the APIs. Microsoft has left undocumented some of these interfaces. In principle, access to these APIs would allow Microsoft to write applications (such as for its Word word processor or its Excel spreadsheet) that work faster and with greater functionality. Furthermore, should an applications developer discover and choose to use these undocumented interfaces, as long as they remain "unofficial," Microsoft can remove or alter them in later versions of the operating software, rendering parts of the applications useless.

One way for applications programmers to insure compatibility with an operating system is to receive copies of the preliminary version of the software. Known as "beta testing," this gives applications developers an opportunity to fine tune the interaction between the two programs.

In a well-publicized episode, DRI was excluded from the beta testing of Microsoft Windows 3.1 and later Microsoft's Windows for Workgroups product. The importance of compatibility testing with the Microsoft Windows beta version became evident when applications developers using DR-DOS received error messages warning them of a potential incompatibility with Microsoft Windows. As it turned out, upon installation, Microsoft Windows 3.1 checked whether the source of the underlying system and the extended memory manager was a Microsoft product. If they were

---

<sup>20</sup> The CPU license appears to be unique to Microsoft. Besides DRI's per-unit license, UNIX is sold to OEMs such as Sun Microsystems using right-to-use "site" licenses. Like most site licenses, they provide for volume discounts.

not, the user was informed that a problem was detected, and was asked to contact Microsoft's beta support for Microsoft Windows 3.1. This message appeared on the screen even though no actual compatibility problem was detected. Indeed, if the user continued past the alleged error message, he or she would discover that Microsoft Windows 3.1 would run in conjunction with DR-DOS. "The only error was that the customer was running Microsoft Windows on a competitor's version of DOS."<sup>21</sup> The error messages raised fears of incompatibility among developers and users who contemplated running Microsoft Windows with non-Microsoft versions of DOS. Concerns over possible incompatibility between DR-DOS and Microsoft Windows resulted in significant declines in DR-DOS retail sales. In addition, Microsoft Windows disks included a "Readme" text file that cautioned users that "running Microsoft Windows 3.1 with an operating system other than MS-DOS could cause unexpected results or poor performance."<sup>22</sup> Microsoft refused to address compatibility problems with DRI.<sup>23</sup> Microsoft boldly defended its action claiming it had no responsibility to assist an operating systems competitor.<sup>24</sup> Microsoft's actions went beyond refusal to assist a competitor, however, as it had engaged in commercial sabotage.

**3. Antitrust Action.** Microsoft's practices first came to the attention of antitrust authorities in Korea. The Korean Fair Trading Commission launched an investigation that centered on use of the CPU license in Asia. In May 1992, the Korean FTC banned the use of CPU licenses in that country.<sup>25</sup> That action was not very effective, however, because Microsoft then began offering customer-specific price schedules with steep "cliffs" (sharp price reductions) at volumes close to the customer's requirements.

---

<sup>21</sup> See *supra* note 12.

<sup>22</sup> Goldman Rohm, Will the FTC Come to Its Senses About Microsoft's Mischief?, *UPSIDE*, August 1993, at 11-27.

<sup>23</sup> John Dodge "It's Not an Uplifting Sight When Microsoft Bares It's Claws," *P.C. Week* Dec 9, 1991.

<sup>24</sup> Microsoft's decision was clearly related to market power. It provided Windows beta versions to many of its competitors in applications software where, at the time, it was not a dominant firm.

<sup>25</sup> Phang, *Microsoft Deals Not Fair: Korea*, *ASIA COMPUTER WEEKLY*, May 11-17, 1992.

In June 1990, the U.S. Federal Trade Commission initiated a nonpublic (sic) investigation of Microsoft's practices. At first the focus of its inquiry was the relationship between Microsoft and IBM and the statements being made by these companies about their future OS product development. Later the investigation turned to marketing practices of DOS and Microsoft Windows.<sup>26</sup> Without ever acknowledging the investigation, the Commission met in February 1993 to decide whether to issue a unprecedented preliminary injunction requiring Microsoft to cease and desist from its marketing practices. The vote was a 2-2 tie. Six months later, the FTC deadlocked again, apparently dooming any chance of antitrust action by the U.S. government .

But then, with victory almost within Microsoft's grasp, in an unprecedented move, the Antitrust Division of the Department of Justice (the Department) took up the case and, after extensive further investigation,<sup>27</sup> negotiated a consent decree with Microsoft. On July 15, 1994 the Department filed a civil antitrust complaint along with a proposed Final Judgment to which Microsoft had consented (the Consent Decree),<sup>28</sup> followed, as required under the Tunney Act, by a Competitive Impact Statement (CIS).<sup>29</sup> The case then took an even more startling twist when Judge Sporkin of the DC District Court refused to play the role of a mushroom<sup>30</sup> and rejected the decree as inadequate under the Tunney Act. The U.S. government and Microsoft jointly (again, an unusual event) appealed Judge Sporkin's decision, and that appeal is currently pending before the U.S. Court of Appeals for the District of Columbia.

The proposed consent decree is described and evaluated below in section VI. Before doing

---

<sup>26</sup> At one time, the FTC staff was also investigating whether the relationship between Microsoft's operating systems and applications divisions created remediable competitive problems in markets for applications software.

<sup>27</sup> AAG Bingaman revealed that the investigation had consumed thousands of hours of attorney and economist time.

<sup>28</sup> *United States v. Microsoft Corp.*, No. 94-1564 (D.D.C. filed July 15, 1995). Amended versions of the Proposed Final Judgment and the Competitive Impact Statement were filed with the court on July 27, 1994.

<sup>29</sup> Proposed Final Judgment and Competitive Impact Statement, 59 Fed. Reg. 42845 (1994) (proposed August 19, 1994).

<sup>30</sup> The court noted that "Tunney Act courts are not mushrooms to be placed in a dark corner and sprinkled with fertilizer." *Microsoft*, 1995 U.S. Dist. LEXIS 1654, at 42.



so, however, we first examine two potential efficiency rationales for the CPU licenses—the apparent similarity between the CPU license and an efficient two-part tariff, discussed in section III, and the argument that the CPU license may be an effective way to combat fraud and piracy, discussed in section IV—we discuss the potential anticompetitive rationales for Microsoft’s practices in section V.

### **III. FIRST-DEGREE PRICE DISCRIMINATION vs. INEFFICIENT SUBSTITUTION**

At first glance it may appear that the CPU license is just a means to provide volume discounts to large OEMs. This is not the case: it is possible that an OEM that purchases more MS-DOS pays a higher per-unit price than one that purchases fewer units. This would happen if an OEM purchased more units of MS-DOS than some another OEM, but proceeded to ship many more machines (loaded with an alternative DOS or none at all). It is possible that its per-unit cost of MS-DOS could be higher because its royalty charge is based on the number of machines shipped.<sup>31</sup>

In fact, CPU licenses may imply a quantity premium if units beyond the requirements are sold at a per-unit charge. At the minimum requirements quantity, the marginal price jumps from zero to a positive level. So based on marginal prices, purchases beyond the requirements level incur a quantity premium.<sup>32</sup>

The CPU license could be characterized as first-degree price discrimination only in a very limited sense. An OEM who signs under the CPU license (or a take-or-pay license with  $X > \text{output}$ ) has agreed to a lump-sum payment, with an (expected) zero marginal price for 1 year. However, since the size of the lump-sum payment is based on expected sales times a per-unit royalty, the OEM

---

<sup>31</sup> The actual price paid per unit could be higher even if the royalty fee itself incorporated volume discounts.

<sup>32</sup> Average price is the more typical yardstick for measuring nonlinearity of prices. In the case of a CPU license, they fall through the range up to the minimum requirements and thereafter may rise or fall depending on whether the average price at the requirements level is lower or higher, respectively, than the per-unit charge for additional sales.

knows that if its sales increase, the (apparent) lump-sum payment next year will also increase proportionately (based on the per-unit royalty Microsoft will be charging in the next year). Thus, for any time horizon longer than 1 year, the CPU license is a tax on output; it is not first-degree price discrimination.

#### A. FIRST-DEGREE PRICE DISCRIMINATION

But even if—perhaps within the very limited time horizon of a 1 year window, OEMs regarded the CPU license as imposing a lump-sum fee unrelated to their MS-DOS use or to their output, such a royalty structure would be neither profitable to Microsoft nor would it be welfare-enhancing when compared to a per-unit royalty.

Efficient first-degree price discrimination occurs when a seller charges a two-part fee, consisting of a lump-sum payment for the right to purchase the product and a price for each unit equal to marginal cost. Where, as here, marginal cost is essentially zero, first-degree price discrimination requires a per-unit price of zero.

Economists have long recognized the strong efficiency advantages of first-degree price discrimination when customers are final consumers so that their demands are independent. But these results do not hold when intermediate inputs are sold to competing downstream firms. In that case the demands of such customers (the firms in the downstream industry) are clearly not independent (i.e., if my rivals pay less for an input than I do, the price of the final product falls, reducing my demand for the input). Ordover and Panzar state the issue quite clearly.

*...we recast the welfare analysis of the simple two-part tariff using the classical model of perfect competition in which all firms are identical and free entry and exit ensures that the equilibrium output price is equal to minimum average cost. In this context we discover that two-part tariffs are not generally desirable from a welfare standpoint...This is due to the fact that the entry fee, instead of acting as a "lump*

*sum levy," affects both the equilibrium number of firms and their output level. This new distortion must be balanced against the losses due to a unit price in excess of marginal cost.*<sup>33</sup>

However, where, as here, the input (OS) is used in fixed proportions with the output (PCs) and the downstream industry is a classic competitive industry with U-shaped average cost curves, Ordover and Panzar find that a very strong theoretical result obtains: a monopoly seller of the input would find any two-part tariff, including an all-or-nothing arrangement where marginal cost to the buyer is zero, less profitable than a uniform per-unit fee. In addition, the uniform per-unit fee results in higher economic welfare than any two part-tariff. As Ordover and Panzar put it,

*Most surprisingly, for the empirically relevant class of production processes in which the purchased input is required in fixed proportion to output, we discover that a two-part tariff is never optimal from either a profit or welfare maximizing standpoint. (p. 660.)*

*The intuition behind this result is rather straightforward. It is well known that under fixed proportions an upstream uniform pricing monopolist can extract all the profits which an integrated uniform pricing monopolist could reap. Since competition downstream ensures that a uniform price prevails in the final product market, there can be nothing to gain from introducing a two-part tariff; optimal choice of [the per-unit price] allows the monopolist to earn the maximum possible under such circumstances. There is something to lose, however, since an entry fee  $e > 0$  causes the downstream firms to operate at an inefficiently large scale. Total (upstream plus downstream) costs are not minimized and a portion of this dead-weight burden falls on the monopolist. Viewed another way, this result reveals the futility of attempting to impose a seemingly nondistortionary lump-sum levy  $e$  on a perfectly competitive industry with free entry and exit. (pp. 666-667.)*

---

<sup>33</sup> See Ordover & Panzar, *On the Nonlinear Pricing of Inputs*, INTL. ECON. REV., October 1982, at 659–60.

In short, even if Microsoft's CPU license (or equivalent volume discounts) did impose a true lump-sum payment, there would be no efficiency or welfare gain that could provide a defense for such a pricing system. Nor would such a licensing system be profitable for Microsoft to impose on OEMs even if those OEMs somehow did not recognize the link between their sales and the lump-sum royalties they paid. Both theory and the available evidence would indicate, therefore, that Microsoft's CPU license (or its equivalent in the form of a volume discount) is not a form of first-degree price discrimination.<sup>34</sup>

One might ask if, in the context of this case, the fixed-proportions assumption made by Ordoover and Panzar refers to fixed proportions between the OS and the PC, or does the result require fixed proportions between MS-DOS and the PC?<sup>35</sup> It does seem safe to assume that every PC requires one (and, as a practical matter, only one) OS. Every PC may not, however, require one MS-DOS although again, as a practical matter, given the pricing and tying arrangements imposed by Microsoft, most OEMs appear to have no practical alternative to MS-DOS over any relevant price range.

Recall, however, how the fixed-proportions assumption affects the results of the model. Absent fixed-proportions, the lump-sum fee is still inefficient, it is just that the per-unit-MS-DOS royalty alternative becomes less desirable. The analysis of the effect of the lump-sum royalty is only

---

<sup>34</sup> It could be argued that the Ordoover and Panzar analysis is too long run, and that what Microsoft is really attempting to do is expropriate some of the fixed, sunk costs OEMs have committed. There is no obvious gain in economic efficiency from such behavior. More importantly, for Microsoft to do this, it would have to (1) estimate the fixed sunk costs of every manufacturer at the time DOS was first offered, and set a different lump-sum fee for every manufacturer that was less than that manufacturer's sunk costs, (2) convince the manufacturer that the lump-sum fee would not change if that manufacturer produced fewer or more PCs; (3) set a zero license fee for DOS to any manufacturer who entered the PC market after DOS came on the OS market; and (4) set an average price for MS-DOS to the more established, larger OEMs that have expended significant sunk costs in differentiating their product that is significantly higher than the average price to smaller "generic" OEMs, such as, notably, many of the Taiwanese and Korean OEMs. Conditions (1) and (2) would appear to be difficult to achieve. Condition (3) does not hold since Microsoft has not waived the CPU requirement for new OEM entrants. Finally, Microsoft appears to be charging the larger, more successful OEMs a lower — rather than higher — average price for MS-DOS in contradiction with Condition (4). Thus, this possible argument for Microsoft appears to have no merit, either on policy or factual grounds.

<sup>35</sup> Note that fixed proportions implies that the input is essential, but an input can be essential without fixed proportions: an input is not essential if the unit cost of output approaches a finite limit as the price of the input approaches infinity.

affected by alternatives to MS-DOS if those alternatives were such close substitutes that an increase in the lump-sum fee would not impose any cost on the OEM. That is, a lump-sum fee of any size would cause all OEMs to switch over to the alternative OS.

With fixed-proportions of MS-DOS per PC, a per-unit-MS-DOS royalty would not affect the MS-DOS to PC ratio. Thus a positive fee per unit of MS-DOS would not result in inefficient input proportions, making a per-unit-MS-DOS royalty as socially efficient (or inefficient) as a per-unit-PC royalty. This is in contrast to a lump-sum fee that would lead to, in the final market equilibrium, a distorted ratio of fixed to variable inputs, with too few firms, each producing too much output.

Suppose, instead, that there are fixed proportions between having some OS and a PC, but not having MS-DOS and a PC. In that case, a per-unit-MS-DOS royalty could result in the OEM shifting to some other OS. Would this be inefficient? Only if the social cost of the OS alternative (for example, DR-DOS) were higher than the social marginal cost of MS-DOS. But since the social marginal cost of both DR-DOS and MS-DOS (and indeed of all OSs) are equal (and nearly zero), this change in the ratio of MS-DOS per PC does not introduce an inefficiency.

We thus conclude that sufficient conditions for the Ordoover and Panzar result are that either (a) the particular input—in this case MS-DOS—is used in fixed proportions with the final product, or (b) the social marginal cost of the alternative DOS chosen in response to an increase in the per-unit price of MS-DOS is less than the social marginal cost of MS-DOS.

This implies a natural extension of the Panzar-Ordoover result. Suppose that the quality-adjusted social marginal cost of the input(s) B, C,...toward which a manufacturer would substitute if the price of input A were increased is less than the quality-adjusted social marginal cost of input A. This appears to be true in the case of MS-DOS and DR-DOS, since the production cost of both MS-DOS and DR-DOS are the same, while DR-DOS is of arguably higher quality than MS-DOS. Production efficiency will then actually increase as a result of the higher per-unit-price for MS-DOS. It follows that, under these circumstances, a per-unit-MS-DOS royalty would be socially even

more efficient than a per-unit-PC royalty.

## B. INEFFICIENT SUBSTITUTION

While the CPU license does not produce a positive output effect (i.e., encourage efficient utilization of a zero-marginal-cost input), it does have a significant substitution effect. The CPU license induces substitution of MS-DOS for OS alternatives. While this may be privately profitable, the social gain is zero, even if it did not induce the exit of rival operating systems such as DR-DOS with its attendant expected effects on raising the MS-DOS license fees. Both MS-DOS and any other OS have a near zero social marginal cost in use. Thus, to the extent that the CPU license induces substitution of MS-DOS for DR-DOS, no cost saving results.<sup>36</sup> Indeed, if, as appears to be the case, the value of DR-DOS is greater than that of MS-DOS (at least on those PCs where DR-DOS would be incorporated, absent the CPU license for MS-DOS), the substitution of MS-DOS for DR-DOS actually reduces efficiency and total welfare.

## IV. ANTIFRAUD AND ANTIPIRACY RATIONALES FOR IMPOSING CPU ROYALTIES RATHER THAN MS-DOS UNIT ROYALTIES

In this section we compare CPU royalties and per-unit royalties in terms of their effects on fraud (under reporting of volume by OEMs) and piracy (unauthorized copying by end-users).

### A. REDUCING MANUFACTURER FRAUD

As a factual matter, we are not aware of any evidence that underreporting of MS-DOS usage by PC manufacturers is or has ever been a serious problem. This is not to say however that in principle a CPU license could not reduce fraud. OS systems are duplicated and incorporated by the manufacturer, not the licensor, and only the manufacturer knows how many units have been

---

<sup>36</sup> This is, of course, just another example of the theory of the second-best.

duplicated. If the licensor could readily determine the total PC production of the manufacturer, a CPU license could effectively prevent such fraud. Several considerations, however, point to manufacturer fraud as not being the rationale for CPU licensing by Microsoft.

1. First and most important, we should observe CPU licenses where fraud is likely, but where market power or exclusion could not plausibly provide a rationale. If CPU licenses are not observed in those circumstances, then the ability of CPU licenses to minimize fraud is highly suspect.

Microsoft has historically chosen not to license many smaller and/or "high-risk" OEMs, i.e., OEMs (mostly in Asia-Pacific) that are viewed as particularly prone to engage in fraud or whose demand levels might not justify the fixed costs of licensing. By contrast, DRI did license many of these producers, employing a variety of means to control potential fraudulent underreporting. These methods include the use of serial numbers cross-referenced to end-user requests for technical support, the use of holograms, and audits of the OEMs. If CPU licenses were an effective and inexpensive means of controlling fraud, DRI might well have used CPU licenses for these OEMs.<sup>37</sup> Beyond this, fraud is not a problem limited to operating system vendors, yet to our knowledge other software vendors similarly situated have not used such licensing terms. Thus, this market test indicates that CPU licenses are not part of the optimal antifraud strategy for a licensor of operating systems where market power and exclusionary potential are not present.

2. Fraudulent underreporting cannot credibly be asserted for every OEM. Especially at the currently low royalty rates that would continue with competition from DR-DOS, few, if any, of the major OEMs would have any incentive to defraud MS. Even if detection by Microsoft were unlikely, an OEM can be deterred<sup>38</sup> from fraud by penalties that are a correspondingly large multiple of the gains from fraud; Microsoft could clearly impose a penalty on a major OEM that would dwarf

---

<sup>37</sup> DRI did not believe that the expense of an audit was affected, one way or the other, by whether one is auditing for violation of a CPU license or a per OS-unit license. Its business behavior confirms this belief.

<sup>38</sup> For example, the contract could specify treble damages (a three-fold royalty) for all proven cases of underreporting.

that OEM's potential gain from fraud. This implies that Microsoft imposes CPU licenses on many OEMs that could not credibly be expected to attempt to defraud Microsoft.

3. To our knowledge, Microsoft does not regularly "audit" the number of PCs produced. Rather, Microsoft relies on that manufacturer's representations of the number of PCs, just as they might have to rely on that manufacturer's representations of the number of PCs produced that incorporated MS-DOS.

One might argue that if an individual OEM's shipments of PCs can be accurately estimated, the use of CPU licenses reduces the need to engage in audits even if, given the decision to audit, there is no difference in auditing costs between CPU licenses and per-unit licenses. Given that public information on OEM shipments shows considerable variation in estimated shipments for many OEMs, however, there is reason to question the empirical significance of such an argument.

There is, however, a plausible way to test this assertion, using information that, while not privately available, would be available to an enforcement agency such as the FTC or DOJ. What has happened to Microsoft's auditing expenses (per MS-DOS unit) since it introduced CPU licenses? If auditing expenses did not fall, this is inconsistent with CPU licenses being an inherently superior method for dealing with OEM fraud.<sup>39</sup>

4. The timing of any shift between MS-DOS unit licenses and CPU licenses should parallel shifts in the seriousness of OEM fraud. To our knowledge, however, the introduction of CPU licenses did not coincide with any notable increase in the incidence or the potential for OEM fraud.

In particular, since an OEM's incentive to underreport is proportional to the size of the

---

<sup>39</sup> The test is only a one-way test. If auditing expenses fell, this could be due to the reduction in the incentive for fraud (and, therefore, the reduced need to spend money to control it) after competition drove down the price of MS-DOS. This is discussed in points 5 and 6 below.



royalty, the extent of CPU licensing should have risen or fallen with the Microsoft royalty. This implies that, since the Microsoft royalty rate rose steadily until the availability of DR-DOS induced a sharp decline, the prevalence of CPU licensing should have increased over time until DR-DOS appeared, and then declined. In contrast, it is our understanding that widespread CPU licensing did not appear until early 1990, after the introduction of DR-DOS and the ensuing decline in prices for PC operating systems.

5. OEM fraud could be handled by a credited CPU license, with the royalty based on the number of PCS minus the number of documented machines that were sent out either naked or loaded with some alternative OS system. Yet Microsoft's CPU licenses do not work in this fashion. Instead they require the OEM to pay a royalty on all machines produced, without a credit for the use of an alternative DOS.

6. Finally since, as noted above, an OEM's incentive to underreport is proportional to the size of the royalty, and since the availability of DR-DOS has resulted in a sharp decline in Microsoft's royalty, it would appear that maintaining effective competition in the OS market has a desirable by-product—it reduces the extent of OEM fraud.

## **B. REDUCING THE NUMBER OF NAKED MACHINES IN ORDER TO REDUCE PIRACY BY THE OEM'S CUSTOMERS**

Piracy of software by computer users has long been a concern of software developers. It has been alleged that CPU licenses may discourage piracy by reducing the relative benefits of installing an unlicensed copy of MS-DOS. By not installing any operating system on an outgoing machine, an OEM could pass along the saving to its customers. The OEM would sell more machines because at least some customers will prefer to install a pirated OS (and comparatively higher cost) rather than pay the additional cost to the OEM. This option is no longer attractive when the OEM faces a zero price for installing MS-DOS on a machine as is true under a CPU license.

There are, however, several difficulties with this proposition.<sup>40</sup>

1. Even before the advent of the CPU license, virtually no computers from companies licensed by Microsoft were shipped naked (i.e., without an OS).<sup>41</sup> Simply put, if the incidence of naked machines shipped by OEMs licensed by Microsoft was very low before CPU licenses, then it is not plausible that CPU licensing was implemented to reduce the shipping of naked machines.

2. Another major factor is that the OEM license fee is far lower than the retail price of MS-DOS. It might seem reasonable that individual users would pirate copies themselves (or buy commercially pirated copies of MS-DOS) if their alternative were a retail MS-DOS at a price of \$79. But it seems inherently unlikely that many buyers of a new computer, no matter how much they may dislike paying for software, would go to such lengths to avoid paying less than \$15 more on a \$1000 computer system.

3. A CPU license could only deter piracy if, absent the CPU license, the OEM would provide a discount for machines without an OS. If the customer pays the same price for a naked machine as for one with an OS installed, purchasing a naked machine cannot facilitate piracy. It is our understanding, however, that OEMs did not generally offer a discount for naked machines prior to the introduction of the CPU license. If correct, then the CPU license could not have been a response to piracy. Moreover, even if prior to the CPU license, Microsoft's OEMs had been offering naked machines at a discount to end-users, Microsoft could easily have handled the problem by forbidding its OEMs from offering a discount for naked machines. While this might conceivably have raised some antitrust risk for Microsoft (under some private plaintiff's theory that the vertical restraint was unlawful), that antitrust risk would surely be far less than that associated with the CPU license.

---

<sup>40</sup> Note that the only form of piracy relevant here is an end-user's substitution of pirated MS-DOS for the MS-DOS incorporated by an OEM. In what follows, therefore, "piracy" refers to only this substitution, and not to the copying of upgraded versions of MS-DOS by customers whose machines incorporated earlier version of MS-DOS. Such "retail upgrade" thievery could not be affected by a CPU license.

<sup>41</sup> This is not surprising, since there are good reasons to believe that it would be more expensive for most end-users to install an OS themselves.

Thus, fear of antitrust exposure could not explain Microsoft's failure to adopt this simpler remedy, which would eliminate any incentive for end-user piracy while not foreclosing OS competition.

4. Microsoft could prevent the problem, if it exists, by charging a royalty based on the number of PCS that were sent out either with MS-DOS or without any OS or, if OEM fraud is also a problem, imposing a royalty based on the number of total PCs minus the documented number of machines that were sent out incorporating some alternative OS.

5. Since the customer's incentive to pirate will be proportionate to the amount of the OEM royalty that is passed on to him, it also follows that, as in the case of OEM fraud, a customer's incentive to pirate an OS will be proportional to the size of the OEM royalty. It would thus appear, again, that maintaining effective competition in the OEM market for operating systems has the desirable by-product of reducing the incentive for piracy.

6. If Microsoft is earning supracompetitive returns (i.e., risk-adjusted returns above what would be necessary for the product to have been developed), piracy may be socially beneficial if it results in greater use of MS-DOS than would otherwise be the case. Output increases to some extent because some users of pirated MS-DOS might not otherwise have bought MS-DOS. A more important effect, however, is on the demand for MS-DOS becoming more elastic if piracy is possible since piracy is an increasing function of the price charged the OEM for MS-DOS. Thus even "deserving" customers—those who would not or could not pirate an OS system—gain from the existence of the pirates.<sup>42</sup>

Microsoft may object that tolerating piracy would inefficiently interfere with its ability to recover its investment in developing intellectual property. However, it is simply not the case that efficiency is greatest if property rights in intellectual property, at least as those rights are currently established, are perfectly secure. Most inventors are free-riding on a common pool of prior

---

<sup>42</sup> The situation is reversed, of course, in a competitive market, where pirating would only increase costs to non-pirating customers or even make some products unavailable.

knowledge. In such circumstances, it can be shown that it is optimal for the inventor to face the same degree of free-riding on her invention. Perfect appropriability, in such circumstances, would lead to over-investment in inventive activity.<sup>43</sup> This observation seems particularly relevant here. Microsoft's original MS-DOS was based on its acquisition of technology from a company that had cloned CP/M, a pioneering PC operating system developed by DRI.

Thus we have an interesting policy paradox. The claim that CPU licenses help to control piracy is highly questionable when Microsoft earns monopoly returns on MS-DOS and there appears to be no efficiency rationale for the supranormal returns. Were Microsoft earning competitive returns to MS-DOS, controlling piracy would clearly be defensible on efficiency grounds. Under the CPU license, however, the act that (allegedly) controls piracy also forecloses competition, thus also undermining the policy rationale for controlling the (alleged) piracy.

7. A similar debate over copying in other industries has made it clear that the effects of copying on profits and on social welfare are complex and ambiguous. The existence of "unauthorized" copying may actually increase the profits to the seller, and may be socially desirable, depending on the nature of infringing users and the heterogeneity of purchasers.<sup>44</sup> It is simply not

---

<sup>43</sup> See Barzel's qualification (Yoram Barzel, *Optimum Timing of Inventions*, Review of Economics and Statistics, August 1968) of Arrow's argument (Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, National Bureau of Economic Research, THE RATE AND DIRECTION OF INVENTIVE ACTIVITY, Princeton, NJ: Princeton University Press, 1962) argument that imperfect appropriability leads to underinvestment in inventive activity. For the proposition that the problems raised by imperfect appropriability may be significantly reduced if the existence of the product results in pecuniary and/or technological effects, see Jack Hirshleifer, *The Private and Social Value of Information and the Return to Inventive Activity*, American Economic Review 61, September 1971, 561–574. See also (A. Michael Spence *The Economics of Internal Organization: An Introduction*, The Bell Journal of Economics 6, Spring 1975, 163–172 at 168) for a critique of Arrow.

<sup>44</sup> To illustrate the point, assume 1000 homogeneous buyers, each with a reservation price for DOS of \$100 for her main machine. Each buyer also has a second PC, onto which she can copy her purchased copy of DOS, for which the reservation price for DOS is \$40 (alternatively, she has a younger brother, partner in her office, etc., to whom a pirated version of DOS would be worth \$40). The marginal cost of DOS to Microsoft is \$10, and the marginal cost to a "pirate" of unauthorized copying DOS is \$15. If Microsoft effectively prevented copying (perhaps by inserting a secret virus that would destroy the disk if copied) it would set a price of \$100, selling 1000 units, with revenue of \$100,000 and profits of \$90,000. (If preventing copying did not cost less, profits would be less than \$90,000.) If Microsoft made no effort to prevent copying/piracy, it would set a price of \$125 (= \$100 + \$40 - \$15), selling 1000 units for a revenue of \$125,000 and profits of \$115,000. Note that, in this example, anything that increases the cost to the "pirate" of unauthorized copying reduces the profits to the licensee. The point of this example is not that all copying/piracy benefits the licensee, but

clear that the CPU license would be in Microsoft's interest, absent its exclusionary effect on competition.

## **V. MARKET-POWER RATIONALES FOR CPU LICENSES RATHER THAN PER-UNIT ROYALTIES**

### **A. WORKABLE COMPETITION IN TECHNOLOGY MARKETS WITH RAPID TECHNOLOGICAL CHANGE**

Economic theory would predict highly volatile market shares under a set of conditions that have often characterized, to varying degrees, PC software markets. Consider a market where numerous potential entrants face no *ex ante* (Stiglerian) barriers to entry into the development of a new technology: entrepreneurs, usually scientists or engineers themselves, put together teams of scientists and engineers, financed internally from their past successes or from venture capital, with access to a common pool of basic technology and to learning acquired at their previous firm. These new firms incur significant sunk costs to develop a higher-quality technology that (we shall assume) is protected by laws that cover intellectual property to the optimal extent.<sup>45</sup> The new technology may be simply licensed to users (as to OEMs in the case of software) or embodied in a new product using manufacturing facilities available from a number of competitive firms (software duplicators and packagers for shrink-wrapped sales of software at retail). The products embodying these alternative technologies are mutually exclusive in the sense that a customer will almost always use only one operating system on any PC.

---

rather than even the private, much less the social, effects of copyright violation are complex and often ambiguous. For a thorough analysis of these issues, *see* (Timothy J. Brennan "Taxing Home Audio Taping," Economics Analysis Group Discussion Paper, EAG 86-5, April 15, 1986, AntiTrust Division, U.S. Department of Justice) and the articles cited therein.

<sup>45</sup> The optimal degree of protection for intellectual property—in particular, the optimal scope for patent or copyright protection in the computer hardware and software industries—is a matter of considerable debate that we cannot, unfortunately, enter into here. *See* note 51 *infra*.

When two other conditions also hold, we would expect to observe a "competitive" or "socially optimal" performance. The first of these conditions is that firms in this market take their competitors' prices as given and unaffected by their own actions, and will thus continue to try to undercut their rivals' prices as long as that price exceeds their own marginal cost. The second condition is that homogeneous customers can costlessly switch among the products of rival suppliers.

Given these two conditions, we would expect to observe that (1) a new technology or product will be developed if (and only if) the expected value of the costs of development is less than the expected value of the increase in the value to consumers of this technology over the prior technology, (2) the price of the old technology (e.g. the license or royalty fee) will fall to zero upon introduction of the new technology; (3) the price of the new technology will equal the difference in value between the old and the new technology, and (4) market share will rapidly shift from 100% for the old technology to 100% for the new technology.

While such competition may seem tough on the players, it (1) can still generate very large rewards to the winners, (2) results in even greater benefits to consumers: as each new generation appears, the value added by the prior generation is passed on directly to consumers,<sup>46</sup> and (3) is efficient in terms of production and distribution: a technology is developed if and only if it adds more value than it costs to develop, and that technology is priced, like all products in a competitive market, just below the marginal cost of its next best substitute (the prior technology) plus the value of the quality differential. The results under "perfect" competition thus provide a benchmark for evaluating performance in any particular case.

To the extent that these two conditions do not hold (e.g., because it is costly for consumers to switch), the old technology will retain some share at some positive price, and the new technology will sell at a higher price than the quality differential. If the new and the old technology are owned by the same firm, the implicit price of the old technology will not fall all the way to zero, although

---

<sup>46</sup> In effect, firms earn a normal (i.e., competitive) return (adjusted for risk) on their investment, while the value of the underlying opportunity is passed on to consumers.

it may still be profitable for the firm to set relative prices so as to encourage migration to the new technology.

The resulting deviation from the pure model is not necessarily inefficient to the extent it reflects real costs of learning and equipment. But if owners of the current technology are allowed to create artificial barriers to the entry of a new technology, those suppliers will earn too much, opportunities for technical change will suffer, and consumers will be harmed.

One might expect something close to the result of the competitive model in operating systems because the industry appears characterized by *ex ante* (Stiglerian) barriers to entry that are low enough for these industries to be workably competitive (absent exclusionary practices).<sup>47</sup> As a result, the incumbent would ordinarily expect only a limited time before a functionally similar or superior product becomes available. Given the combination of high fixed development costs and low marginal production and distribution costs, the resulting competition can have a dramatic effect on the profits of the first mover. Not surprisingly, therefore, there is a strong incentive for the incumbent to try to make life difficult for any entrants, either by directly increasing their costs or by reducing the attractiveness of their product to consumers, and to do so as soon as possible.

Under certain conditions, it may be possible for a first mover to maintain or even extend its dominant position through certain price and nonprice strategies that seek to exclude or handicap its smaller rivals in dealing with its immediate customers. The goal of such a strategy, rather than to assist in achieving the original high market share which requires having, at least for a while, the first-best technology), would be to artificially preserve that status. The four conditions described below appear to hold in the market for operating systems, where Microsoft successfully preserved an overwhelming market share against competition from a technically superior product. The

---

<sup>47</sup> Entering a market with no Stiglerian barriers to entry may still be very difficult because Stiglerian barriers are not the only barriers to entry. Very large sunk costs of the magnitude observed for operating systems do usually imply a significant first-mover advantage, at least for the current vintage of technology. In addition, IBM bestowed somewhat unique first-mover advantages on Microsoft and Intel when it selected MS-DOS as the operating system and Intel's 8088 as the microprocessor for its PC.

conditions are:

1. Immediate buyers, i.e., firms at the next level downstream (e.g., OEMs), can be posed with an all-or-nothing choice by the dominant firm that compels them to deal either exclusively or not at all with the dominant firm;
2. While buyers would be interested in purchasing rivals' products for some of their requirements, they are unwilling to rely exclusively on those rivals' products: at least some of the dominant firm's product is very important or even essential to many or even all the downstream firms;
3. The substitute product requires significant fixed sunk costs to develop, maintain or expand, so that some significant minimum market share is essential for entry or expansion; and
4. The costs to the dominant firm of forcing exclusivity on the downstream firms are relatively low.

#### B. MICROSOFT'S PRICING AND MARKETING STRATEGIES

Let us now turn to each of the four conditions for exclusivity to be an effective strategy against smaller rivals. The first condition was that immediate buyers, i.e., firms at the next level downstream, can be posed with an all-or-nothing choice by the dominant firm that compels them either to deal exclusively with the dominant firm or not at all. Here, Microsoft can effectively force OEMs that wish to incorporate MS-DOS in any of their PCs to use MS-DOS exclusively through either of two policies, both of which Microsoft has been accused of:

1. Microsoft can set per-unit MS-DOS prices that are so high relative to CPU rates as to make selecting the per-unit "option" economically infeasible: the OEM that wishes to use any



MS-DOS will in effect be required to sign a CPU contract.<sup>48</sup> The CPU license (or a policy of inducing large carry forwards) then provides a strong economic incentive (a zero cost to the OEM for using MS-DOS at the margin) for the OEMs to use MS-DOS exclusively;

2. Microsoft can also refuse to sell Microsoft Windows to an OEM that purchases any alternatives to MS-DOS, and can cut off the OEM from technical information and other services provided to "favored" OEMs. This imposes a direct penalty on the OEM for using an alternative DOS in addition to the pricing incentive created by the CPU contract.

Our second condition was that, while buyers would be interested in purchasing rivals' products for some of their requirements, they are unwilling to rely exclusively on rivals' products: at least some of the dominant firm's product is very important or even essential to many or even all the downstream firms. In this case, OEMs are very reluctant to purchase DOS exclusively from sources other than Microsoft, at least in the short run, because:

1. Requiring a sudden and complete switch from one OS to another imposes real costs that could be avoided under a more gradual transition;
2. Actual or threatened technical incompatibility between other Microsoft products, such as Microsoft Windows, and competing versions of DOS results in at least some of the OEM's customers insisting on MS-DOS;
3. Withdrawal of Microsoft support services to any OEM that does not enter into a CPU contract (or that purchases DOS from a source other than Microsoft) would impose what is in effect a lump-sum penalty for switching;
4. Microsoft can refuse to sell Microsoft Windows to an OEM unless that OEM also purchases

---

<sup>48</sup> Microsoft can also structure its Windows pricing to an OEM in such a fashion as to make it very difficult for OEMs to avoid a Windows CPU contract.

MS-DOS through a CPU contract.

Our third condition was that the substitute product requires significant fixed sunk costs to develop, maintain or expand, so that some significant minimum market share is essential for entry or expansion. In this case, given the large non sunk fixed costs of remaining in the DOS market, any alternative to MS-DOS must either achieve a critical minimum market share, exit the market, or be subsidized indefinitely through other operations of the rival firm.

Our fourth condition was that the costs to the dominant firm of forcing exclusivity on the downstream firms are relatively low. Here, the cost to Microsoft of excluding rivals from the DOS market is very low as long as the share of those rivals remains very small, since:

1. The cost to Microsoft of requiring a CPU contract is that Microsoft may lose an entire OEM to a competitor. As long as MS-DOS remains essential, however, no OEMs will refuse the CPU contract, and the cost to Microsoft is minimal;
2. Similarly, the cost to Microsoft of tying Microsoft Windows to MS-DOS is low. Microsoft sacrifices some sales of Microsoft Windows to customers for whom the value of Microsoft Windows is very low, but who would buy it to use with a rival's DOS but not with MS-DOS. But until a rival achieves a significant share of the DOS market, tying (or simply making Microsoft Windows and any rival DOS incompatible) will again impose minimal costs on Microsoft.

Our analysis thus concludes that, as compared with other strategies for maintaining market share, such as cutting prices or merging with entrants, implementing exclusionary practices can be a relatively cost-effective strategy to use against an entrant who has a superior technology but whose market share is very small. This approach can thus be characterized as a "fight them on the beaches" strategy, or less kindly, as "economic infanticide." The lower the market share of the rival, the lower the costs and the greater the benefits of this strategy to the established firm. Once—or if—the entrant

reaches a critical market share, however, the incumbent can be expected to switch to the alternative defensive strategies or, if the entrant's technology is strictly superior and user switching costs are not significant, to simply abandon the field.

## **VI. EPILOGUE: THE DOJ CONSENT DECREE AND BEYOND**

As discussed above at the end of section II, much has happened since the analysis of the preceding sections was first developed and, in a much more extensive version, presented to the FTC in 1992 and 1993. As of this writing the proposed consent decree between Microsoft and the DOJ is before the U.S. Court of Appeals for the District of Columbia. Given the controversy generated by the decree it would seem useful to apply our analysis to the consent decree. It is important to note from the start that we have been concerned exclusively with horizontal aspects of this case. The Department's Complaint and Proposed Final Judgment concentrate on horizontal aspects as well. We believe that this demonstrates the proper priorities since, as with all antitrust matters, the consequences of anticompetitive horizontal practices are the most serious, and also the least ambiguous in terms of their efficiency implications.

But while we concur with the Department's focus on the horizontal aspects of the case, we are concerned that the remedies prescribed in the consent decree are likely to be inadequate. Specifically, the consent decree fails to prevent Microsoft from employing quantity discounts or other form of nonlinear pricing to achieve the same exclusionary consequences as the offending practices. We offer several remedies—including a ban on sales or discounting of naked machines, "credited CPU" licenses and allowing arbitrage—that lack the exclusionary aspects of CPU licenses. Furthermore, these alternatives preserve any antipiracy and antifraud properties that CPU licenses may possess.

### **A. WHAT THE COMPLAINT ALLEGED AND WHAT THE PROPOSED FINAL JUDGMENT WOULD PROSCRIBE**

The Department alleged that Microsoft used the following anticompetitive practices:

(1) Exclusionary Per Processor Licenses. Microsoft's use of CPU licenses for MS-DOS and Windows gives it an advantage unrelated to efficiency because this arrangement forces the OEM to pay a royalty to Microsoft on the sale of a PC that has a non-Microsoft operating system. Microsoft, in effect, has been able to levy a "tax" on alternative operating systems.

(2) Unreasonably Long Licenses. By entering into long-term contracts with major OEMs, and by requiring minimum commitments and then crediting unused balances to future contracts, Microsoft locks in OEMs to the purchase of Microsoft products for an excessive period, beyond the lifetime of most operating system products, further impeding the access of PC operating system competitors to the OEM channel, and preventing new entrants from gaining and maintaining a sufficient toehold in the market.

(3) Restrictive Non-Disclosure Agreements. Microsoft sought agreements from companies participating in trial testing of the new versions of Windows that precluded applications developers from working with Microsoft's competitors for an unreasonably long period of time.

What is notable is that all these allegations relate to the "horizontal" effect of Microsoft's practices, i.e., the effects on competitors and customers in the market for operating systems, as opposed to the "vertical" effects of Microsoft's practices, such as the "leveraging" of market power from operating systems into applications software or other products.

The proposed Final Judgment agreed to by the Department and Microsoft would prohibit Microsoft from:

- Entering into "Per-Processor Licenses" (what we have called "CPU licenses"),
- Requiring OEMs to pay Microsoft on a flat amount for a license (lump-sum pricing),

- Obligating OEMs to pay Microsoft a minimum amount under the license (minimum commitments),
- Entering into any licenses with terms longer than 1 year (although licensees may renew for another year on the same terms),
- Requiring licensees to purchase any other Microsoft product as a condition for licensing a particular Microsoft operating system (a tying arrangement), and
- Requiring developers of applications software to sign unlawfully restrictive nondisclosure agreements.

These restrictions apply to the sale of current Microsoft operating systems (DOS 6.22 and Windows 3.11) as well as to operating system software under development (i.e., Windows 95) and to future products that will replace these operating systems.

## B. COMPETITIVE CONSEQUENCES OF THE CONSENT DECREE

The consent decree has been extensively criticized on the grounds that it would do little or nothing to address the "vertical" aspects of Microsoft's actions, notably the "leveraging" of market power in the operating system market into other existing and evolving markets. Judge Sporkin, the Wilson, Sonsini brief<sup>49</sup> and other amici briefs—with the exception of the Williams brief,<sup>50</sup>—focused on these vertical aspects. Both the Department and Microsoft have argued that any judicial review under the Tunney Act should concern itself exclusively with whether the remedies in the proposed Final Judgment could be expected to solve the problems specifically described in the complaint.

---

<sup>49</sup> Memorandum of Amici Curiae in Opposition to Proposed Final Judgment, January 10, 1995.

<sup>50</sup> Brief for Amicus Curiae Richard H. Williams. This brief was filed with the Appellate Court but the Court ultimately denied Williams' motion to participate.

Whatever the merits of this argument by the Department and by Microsoft, however, it is not a relevant criticism of our analysis of the consent decree, since we focus exclusively on the PC operating system software market and on the decree's ability to remedy the exclusionary practices identified in the complaint.<sup>51</sup>

As we shall explain, we conclude that the proposed consent decree would be unlikely to have a significant impact on competition in the market for operating systems. As such, it fails to address even the concerns expressly stated in the complaint.

Microsoft's goal has always been to impose contracts on OEMs that would not allow an OEM to reduce its total payments to Microsoft if it installed a competing operating system on some of its machines. The Department's complaint and CIS clearly state that such contracts are illegal and explains the exclusionary and anticompetitive nature of such a contract.

The consent decree does define and ban three types of contracts—per-processor licenses, lump-sum pricing, and minimum commitments—under which there is no reduction whatsoever in an OEM's total payments to Microsoft when the OEM installs a competing operating system on some of its machines. Nevertheless, the consent decree explicitly permits schemes that amount to *near* per-processor pricing, i.e., extreme quantity discounts that can have the same effect, or as much of an effect as is necessary to exclude a competitor.

The core provisions are found in sections IV(H) and II(F) of the Proposed Final Judgment. section IV(H) states that "Microsoft may not use any form of Lump Sum Pricing..." section II(F), however, defines lump-sum pricing as "any royalty payment ... that does not vary with the number of copies that are licensed, sold or distributed...." Thus, if Microsoft sets a royalty of \$2.5 million

---

<sup>51</sup> Since the analysis in this article has focused exclusively on the horizontal effects of Microsoft's practices, we will not discuss here our reaction to the absence of vertical provisions in the complaint or in the consent decree. While not expressing an opinion here as to the merits of the vertical aspects of the antitrust case against Microsoft, the authors have dealt with very similar issues (i.e., network externalities, sunk investments by users, de facto standards and interface specifications) in an analysis of the proper role for copyright in software. See Warren-Boulton, Baseman & Woroch, *Copyright Protection of Software Can Make Economic Sense*, 12 Computer Law. 10, 18–28 (1995), and *The Economics of Intellectual Property Protection for Software: The Proper Role for Copyright* STANDARD VIEW, forthcoming 1995.

to an OEM with a projected output of 100,000 machines, this would be lump-sum pricing. But if Microsoft sets a royalty of \$2.499 million plus \$0.01 for each unit of MS-DOS installed, this is not lump-sum pricing and would not be banned by the decree.

To eliminate any possible confusion on this issue, section IV(F) affirmatively authorizes Microsoft to obtain "non-binding estimates of projected sales of Microsoft's Covered Products for use in calculating royalty payments," and section IV(H) then goes on to state that:

*It is not a violation of this Final Judgment for Microsoft to use royalty rates, including rates embodying volume discounts, agreed upon in advance with respect to each individual OEM, each specific version or language of a covered product, and each designated Personal Computer System model subject to the License Agreement.*

Thus, our hypothetical sales contract (\$2.499 million for the first unit of MS-DOS, one cent for each additional unit) is explicitly legal.

The Department was certainly not unaware of the potential for anticompetitive uses of quantity discounts. In the "Alternatives to the Proposed Final Judgment" section in the CIS, the Department stated that it "...considered whether to require limitations on the manner in which Microsoft could structure volume discount pricing arrangements for covered products," but then went on to explain that:

*While the Department recognizes that volume discount pricing can be and normally is pro-competitive, volume discounts can also be structured by a seller with market power (such as Microsoft) in such a way that buyers, who must purchase some substantial quantity from the monopolist, effectively are coerced by the structure of the discount schedule (as opposed to the level of the price) to buy all or substantially all of the suppliers they need from the monopolist. Where such a result occurs, the*

*department believes that the volume discounts structure would unlawfully foreclose competing suppliers from the marketplace—in this case, competing operating systems—and thus may be challenged. (CIS)*

Why then did the Department not impose limits on the use of volume discounts by Microsoft? The explanation offered was that:

*The Department ultimately concluded that it would not require provisions in the Final Judgement to attempt to proscribe in advance the various means by which Microsoft could attempt to structure volume discounts as a means to thwart competition rather than as a means of promoting competition. The Department reached this conclusion because it does not have evidence that Microsoft has, to date, in fact structured its volume discounts to achieve anticompetitive ends. (CIS)*

The problem with this explanation, however, is that, as long as CPU licenses are available to Microsoft, using quantity discounts to achieve exclusion would be redundant and unnecessary, so one should hardly expect to see them used. Only when CPU licenses are prohibited would we expect to see Microsoft turn to an equally exclusionary sales practice. As the Department was well aware, this is just what had occurred in Korea in 1992, after the Korean FTC investigated and banned the use of CPU licensing by Microsoft.<sup>52</sup> And, even if the Department did not believe when it entered into the consent decree that Microsoft would turn to exclusionary volume discounts, they must soon have been disabused with the first report of Microsoft turning to such discounts.<sup>53</sup>

---

<sup>52</sup> The resulting pricing schedule not only left the Korean OEMs with essentially no option but to deal exclusively with Microsoft, Microsoft even increased the per unit price for essentially the same volumes that were previously covered by the CPU licenses.

<sup>53</sup> The Wall Street Journal of December 12, 1994 reported that in August, just after the consent decree was signed, Microsoft proposed a contract to Vobis, the German PC maker, that estimated its annual shipments of 88 models at about 475,000 and quoted a Windows price of \$28 a copy based on that total. When the chairman of Vobis tried to negotiate a discount based on lower estimated sales, in order to accommodate customers that might ask for OS/2, Microsoft's response was that Vobis would have to pay \$83 for each machine under a per-copy license.



A more substantive reason why the Department might have hesitated to address volume discounting is that it might have believed that volume discounting by Microsoft could be efficient and procompetitive in some circumstances.<sup>54</sup> If it believed that no remedy could be crafted that would prevent anticompetitive licensing practices while preserving Microsoft's ability to offer socially efficient quantity discounts, the Department might have concluded that any available remedy would do more harm than good.

We do not believe this is the case and we would urge the Department to reconsider its remedy options. The next section therefore examines alternative relief provisions that could have been implemented to address the exclusionary effects of nonlinear pricing by Microsoft, including quantity discounts. In doing so, we assume that the Department would be searching for a set of provisions that would (1) prevent anticompetitive exclusionary behavior by Microsoft; (2) not hinder desirable actions by Microsoft; (3) minimize monitoring and enforcement cost to the DOJ; and (4) minimize implementation cost to Microsoft as well as any monitoring or enforcement costs to Microsoft's customers and/or competitors.

### C. ALTERNATIVE REMEDIES FOR ANTICOMPETITIVE PRACTICES ALLEGED IN THE COMPLAINT

Our relief discussion is divided according to which of two conditions holds true.<sup>55</sup> First, the problems of piracy and fraud may not be solved in a cost—efficient way by CPU licensing or equivalent quantity discounts—which we believe to be the case given the factual evidence. Absent strong countervailing efficiencies of the practice, DOJ does not face a significant policy tradeoff in

---

<sup>54</sup> AAG Bingaman's explanation in front of Judge Sporkin for why the Department did not address volume discounting was that "everything is offered on volume discounts. So for the Antitrust Division to take a position Microsoft cannot offer volume discounts is weird on the face of it." *U.S. v. Microsoft*, Case No. 95-5037 (D.C. Cir.) Joint Appendix at 845.

<sup>55</sup> These are relief alternatives for the "medium term." As discussed below, relief in the very short term (i.e., until existing contracts expire) will require an additional provision of allowing conversion of existing CPU contracts. On the other hand, our underlying theory of the case implies that any intervention need be only temporary since these anticompetitive practices are most effective against recent entrants or when the total market share of rivals is small. Since intervention in the long run will not be necessary, sunset provisions should be considered for all the relief measures discussed in this section.

this case: relief should ban CPU licenses, and its variants including quantity discounts.

Alternatively, the CPU license or equivalent volume discounts<sup>56</sup> may be effective in reducing the level of piracy or fraud, while still having serious anticompetitive exclusionary effects. In that case, it is natural to ask what alternative additional measures or modifications to CPU licensing might be introduced that would reduce or even eliminate the anticompetitive effects while preserving its antipiracy and antifraud benefits.

## 1. RELIEF IN ABSENCE OF ANTIPIRACY AND ANTIFRAUD RATIONALES

In this section, we begin with a set of relief provisions that would eliminate both the anticompetitive effects of CPU licensing and the possibility that Microsoft can retaliate against OEMs who deal with other suppliers of operating systems. We then discuss the potential efficiency benefits, competitive risks, and costs of allowing Microsoft greater pricing flexibility. We conclude that under any DOJ consent decree that allows Microsoft pricing flexibility, the Department would need to collect and monitor various data needed to statistically test whether Microsoft has attempted to circumvent the relief.

Underlying the discussion here and elsewhere in this article is our belief that the facts reasonably approximate the conditions required under the Panzar-Ordover theorems for uniform, per-unit prices to strictly dominate nonuniform pricing structures from a welfare perspective. If uniform, per-unit fees are welfare optimal, then the Department could safely require that Microsoft charge the same price per unit for all sales to all OEMs. Nevertheless, sound economic reasons for prices to vary across OEMs and across systems and models are possible. Weighing the relative merits leads us to make three recommendations:

First, Microsoft could be allowed to charge different and confidential prices to different

---

<sup>56</sup> To avoid repetition, in the following discussion we use the term “CPU license” to refer to both CPU licenses and quantity discounts.

OEMs, provided that the Department implemented effective procedures to prevent Microsoft from charging higher prices for MS-DOS or other products to OEMs that also purchase alternative operating systems. Banning nonpredatory price differentials could harm consumers if unsystematic, selective and secret price cutting facilitates price competition among rivals. Systematic price differentials may also be nondiscriminatory: lower prices to larger OEMs, for example, could reflect differential externalities (e.g., a major or "flagship" OEMs use of the product may encourage other OEMs to buy the product).

Second, Microsoft should be required to charge the same per-unit price for all sales to any one OEM. Microsoft's costs do not appear to be related in any way to its share of an OEM's OS purchases. To the extent that smaller OEMs systematically impose higher average costs on Microsoft for support or other services, Microsoft should be free to charge a higher license fee to such OEMs. Alternatively, if Microsoft's service or support costs are both significant and not directly proportional to license volume, Microsoft could unbundle support from licensing, price its support services separately, and allow the OEM to accept or reject those support services on the basis of their unbundled price.

Third, we agree with the Department that Microsoft should not be allowed to set OEM-specific minimum license requirements. As noted above, requiring minimum quantities reduces price to zero for units up to the required amount, having the effect of excluding rivals as in the case of the CPU license. We can see no other reason for Microsoft imposing such minimums. When an OEM increases its use of MS-DOS, Microsoft incurs no incremental production or inventory costs that might otherwise justify contractual minimums. Nor are contractual minimums necessary to provide Microsoft with accurate usage forecasts since Microsoft is free to request that its licensees report their anticipated MS-DOS purchases and even to reward them for doing so accurately. Finally, OEM-specific minimums are not necessary to allow recovery of Microsoft's OEM-specific fixed costs. Microsoft can either set a low minimum quantity that applies to all OEMs, charge higher unit prices to small OEMs, and/or unbundle such services.

## 2. PROCOMPETITIVE REMEDIES THAT ARE EFFECTIVE AGAINST FRAUD AND PIRACY<sup>57</sup>

If one assumes that a CPU license is a cost-effective component of a software developer's portfolio of measures to reduce fraud or piracy, then it is natural to explore alternatives or modifications to the CPU license that would preserve these benefits while eliminating its anticompetitive effects. With this objective in mind, we consider a provision that would prohibit OEMs from either shipping naked machines or offering a discount for naked machines, plus three ways in which the CPU license could be modified to mitigate its anticompetitive effects.

### (a) A Ban on Naked Machines or on Discounting Naked Machines.

Suppose that Microsoft were allowed (but not required) to put a clause in its contracts that either (1) forbids their OEMs from offering a discount to their customers for naked machines or (2) simply forbids licensed OEMs from selling naked machines. Then Microsoft could offer per-unit licenses knowing that the world was safe from OEM-induced end-user piracy. The reason is simple. Absent a discount for naked machines, the OEM's terms of sale provide no financial incentive for the end-user to pirate an operating system for that machine, and absent a naked machine there is no need for piracy.

This relief requires that someone (the DOJ, Microsoft, or a trade group?) decide which competing operating systems are "legitimate." Otherwise OEMs bent on facilitating end-user piracy would have an incentive to claim, for example, that a 10 year old version of an operating system that it licensed for a penny—and that no one in their right mind would actually use—entitled it to sell what is in effect a naked machine at a discount. Microsoft would have the opposite incentive; it would like to claim that genuinely competitive operating systems—which some customers would actually use at the right price—should not count as legitimate operating systems.

---

<sup>57</sup> The CPU license is discussed in terms of MS-DOS, but the same analysis applies to CPU contracts for Windows.

These provisions have an attractive truth-revealing feature: if Microsoft really adopted the CPU license solely to deter piracy, it now should be willing to abandon CPU licensing and quantity discounts and offer each OEM a (possibly different) per-unit price. On the other hand, if the antipiracy and antifraud properties of the CPU license were not motivating its use, then Microsoft may simply never exercise its newly acquired right to prevent its licensees from shipping or discounting naked machines.

The discussion so far has implicitly assumed that there is no legitimate demand for a naked machine. Under some circumstances, however, a PC user may have a particular preference for an operating system that is not installed or offered by the OEM. We do not know the quantitative significance of this effect. But should the DOJ decide that it wishes to address this issue, it could modify the ban to allow discounts on naked machines that are no greater than the OEMs' incremental costs for the operating system.

(b) Credited CPU Licenses

Under this remedy, an OEM would receive a credit (or a cash refund) for each unit of a competitor's operating system that it purchased. Microsoft would be permitted to continue to use a CPU license (or other licenses with quantity discounts). The per-unit refund would equal the average price under the CPU license, i.e., the average MS-DOS license fee divided by the number of machines per CPU actually shipped.<sup>58</sup> This would allow competition from alternative OS suppliers to sell to OEMs that are unwilling to do without MS-DOS entirely. It does so without raising the

---

<sup>58</sup> For example, if an OEM that produced 100,000 PCS had a Microsoft license that allowed it to use 200,000 units of MS-DOS for \$1,000,000, the credit would be \$10 (the license fee divided by actual production), rather than \$5 (the total fee divided by the contract volume) per alternative OS used. If Microsoft were allowed to base the refund on the agreed contract volume, it could easily evade the relief by basing the license fee (\$1,000,000 in this example) on unrealistically high volume and low prices per contracted unit. For example, it could require the OEM to commit to 1 million units at a \$1 price, and then claim the OEM was entitled only to a \$1 refund if it used an alternative OS. Of course, this problem would only arise if Microsoft were allowed to set minimum requirements. As discussed above, we strongly urge that Microsoft not be allowed to set contract minimums. This recommendation applies to all the alternatives remedies discussed in this article.

possibility of piracy since Microsoft would continue to tax naked machines.

Such a proposal, however, would raise at least two problems. The main problem with a credited CPU license, as compared to a per-unit license, is that it allows the dominant firm to know just how much of each alternative operating system each of its OEMs is buying, thereby exposing the OEM and/or the operating system rival to retaliation or strategic pricing. Credited CPU licenses also suffer from the same problem as the previous remedy: someone will have to determine which competing operating systems are legitimate enough to qualify for the credit.<sup>59</sup>

(c) CPU Licenses with Carry Forward

A third relief possibility has the OEM retaining the right to carry forward into future years<sup>60</sup> any MS-DOS displaced by an alternative operating system.<sup>61</sup> Again, Microsoft could continue to

---

<sup>59</sup> One question that has been raised, however, is whether Microsoft's competitors would be free-riding on Microsoft's antipiracy efforts under a credited CPU license if indeed a credited CPU license were the most effective way to reduce piracy. The concern appears to be that Microsoft would receive less revenue under a credited CPU license than under a per-unit license because the OEM would "prefer" to sell some naked machines rather than load an operating system on all its machines. This implies that stamping out piracy imposes some burden on the software producer that opts for the credited CPU license (presumably Microsoft), whereas rival software producers that use a per-unit pricing schedule can "free ride" on the reduction in piracy. The analysis of this issue is complex, but it can be shown that if adoption of credited CPU licenses by any operating system seller would in fact efficiently reduce piracy, then (a) the operating system industry will benefit if any operating system supplier adopts the credited CPU license, and (b) it will be unilaterally profitable for at least one operating system supplier to adopt the license. Thus, there would be no need for side payments or industry coordination in order to insure that a credited CPU license would be adopted if, in fact, such a license would reduce piracy.

<sup>60</sup> Under this proposal, the OEM's Microsoft license would not have to be renewed until the contract volumes had been exhausted, even if the exercise of the carry forward resulted in the OEM taking longer to use up its licenses than was originally contemplated and stipulated in the contract.

<sup>61</sup> Note that the OEM would not retain the right to carry forward all of its unused MS-DOS. An OEM can have unused MS-DOS for two reasons. First, the contract quantity of MS-DOS (say, 120,000) may exceed the number of PCS produced (say, 100,000) by some amount (e.g., 20,000). Second, the OEM may use some alternative operating system (say, 10,000 units of OS/2), so that MS-DOS use (i.e., 90,000) may be less than the number of PCs. Assuming that Microsoft's ability to use other practices to ensure future exclusive dealing was effectively restrained, we would propose only that the OEM retain the right to carry forward the 10,000 units displaced by a competing operating system.

There are three reasons for so limiting the scope of this right. The first is that we are searching for a minimalist relief, and the goal of preventing exclusion does not necessarily require that MS-DOS licenses in excess of PC production be carried forward. Second, Microsoft has argued that one goal of its pricing policies is to reduce the number of naked machines (and hence incentives for piracy). This can be achieved by Microsoft specifying a contract amount equal to or above the number of PCS (or using a CPU license) and refusing to allow any carry forward of such excess licenses, so that the marginal cost to the OEM of putting MS-DOS onto what otherwise would have been a naked machine is zero (in

use CPU licenses. This relief may not, however, be fully effective in eliminating the exclusionary effect of the license. Because of the rapid pace of new product introduction in the software industry, carrying forward the right to use what may soon be obsolete or less valuable technology at the old price may not significantly reduce the OEM's financial disincentive to offer an alternative operating system. In short, the carry-forward right at this year's price (which is really intertemporal arbitrage) may not adequately open up the operating system market if OEMs expect the version of MS-DOS they are currently buying to be obsolete or available at lower prices next year.

Nonetheless, the carry-forward relief has some legitimate value. Absent rapid technical and price changes, and as long as the OEM was sure that it could renew its contract on terms no less favorable than if it had not exercised the carry-forward option, each OEM would be able to convert its CPU license into a per-unit price schedule.

(d) Arbitrage

In this case, OEMs licensed by Microsoft could be allowed to buy and sell MS-DOS licenses, with Microsoft retaining a "right of first refusal" for all sales and a right to be informed of the identity of any customer who is not a current or recent licensee of Microsoft.

The problem with the carry-forward relief is that the allowable range of arbitrage (OEM-specific intertemporal arbitrage) may be too limited to give OEMs much flexibility to deal with alternative operating system suppliers. One solution is to increase the allowable range of arbitrage. For example, any Microsoft licensee could be allowed to resell its excess MS-DOS entitlements<sup>62</sup> to

---

contrast, since MS-DOS units displaced by OS/2 can be carried forward, the marginal cost to the OEM of putting MS-DOS onto what otherwise would have been a machine with OS/2 is the average price of MS-DOS). Third, as a practical matter, we expect that, if OEMs have adequate credit rights, carry-forward rights and arbitrage rights (discussed below) to MS-DOS units displaced by OS/2, Microsoft will no longer find it in its interest to systematically require contract amounts in excess of estimated PC production. The only caveat would be if routinely generating excess license amounts facilitated threats or bribes to OEMs to induce exclusive reliance on MS-DOS. Since a number of other vehicles for such threats or bribes would be available to Microsoft, however, such actions could only be prevented by general monitoring and penalties by the DOJ.

<sup>62</sup> Again, as in the carry-forward provision, we would restrict the OEM's right to arbitrage MS-DOS licenses to MS-DOS displaced by a competitor's OS only, rather than all excess MS-DOS licenses: *see* note 61 *supra*.

other current or former licensees or even to brokers who could resell those rights.<sup>63</sup> Such arbitrage will sharply limit Microsoft's ability to price discriminate, and will tend to result in per-unit license fees that are uniform across all OEMs. Microsoft retains the right not to deal with OEMs it regards as too untrustworthy, however, assuming that arbitrage is allowed only among current and former licensees.<sup>64</sup>

Microsoft may object that allowing such extensive arbitrage is overkill since it will have the tendency to limit all forms of price discrimination, not just the all-or-nothing discrimination of the CPU license. There is a simple fix for this problem. Microsoft can be allowed to retain a right of first refusal at the average price in each OEM's contract (a right that is similar to its obligation under a credited CPU license). Microsoft would also be entitled to know the identity of the proposed buyer before the OEM can resell its MS-DOS entitlements if the buyer is not a current licensee.

A right of first refusal does two things for Microsoft. First, it would allow Microsoft to continue to price discriminate among OEMs, since Microsoft could always exercise its right of first refusal toward OEMs that had received a lower average price for MS-DOS. Second, it would assure Microsoft of complete control over which OEMs could install MS-DOS, since Microsoft could always prevent any sale to an "undesirable" OEM by buying back all of the OEM's extra licenses at the same average price at which Microsoft had originally sold them.<sup>65</sup>

The DOJ will still want to collect and analyze licensing terms to check for retaliation. However, retaliation by Microsoft may be less likely than under the other relief proposals because the arbitrage market may provide potential targets with an alternative source of MS-DOS licenses.

---

<sup>63</sup> Microsoft will become aware of these transactions after the fact, since the OEM will still be obligated to provide evidence that it had a valid license for the MS-DOS that it shipped. However, with arbitrage, it can obtain the license from either Microsoft or another licensee.

<sup>64</sup> Microsoft could also be allowed to forbid resale to a former licensee who was dropped for piracy or fraud, but only after a finding by an independent arbiter, selected by the DOJ and paid by Microsoft, that the OEM was in fact more prone to piracy or fraud than the average of the remaining Microsoft licensees.

<sup>65</sup> In addition, given a right of first refusal, arbitrage no longer would need to be limited to current or former licensees.



In different ways, each of the relief provisions discussed above grants property rights to the OEM that effectively moves the contract closer to a constant per-unit price schedule while retaining the OEM's disincentives under a CPU contract to ship naked machines. A credited CPU contract gives the OEM the right to a refund for displaced units; a carry-forward provision gives the OEM the right to use those units internally in the future; and an arbitrage provision gives the OEM the right to sell those units to other authorized OEMs.

\* \* \* \* \*

We conclude that there are a number of options available to the Department that would allow them to preserve any desirable effects from CPU licenses, volume discounts or other forms of nonlinear pricing while containing its potential for anticompetitive effects. The critical question in choosing between these alternatives is whether one believes that the antipiracy and antifraud rationales for the CPU license are justified. If those explanations are rejected, then since unit pricing is efficient where an intermediate good is used (absent piracy) in fixed proportions by a competitive downstream industry, a ban on all variants of CPU licensing—combined with a requirement that Microsoft license MS-DOS and its other products on a constant per-unit price basis—is warranted. Assuming effective means of detecting and preventing retaliation, there appears to be no reason, however, except possibly in the very short run, not to allow Microsoft to charge different prices to different OEMs.<sup>66</sup> Relief that allows Microsoft pricing flexibility, however, must also contain oversight by the DOJ to determine whether Microsoft is discriminating against those who do not deal exclusively with Microsoft by charging them higher prices or raising their prices more rapidly.

The second possible factual assumption is that the CPU license, although anticompetitive, may be an efficient method of deterring piracy and fraud. In that case, the DOJ could first consider simply

---

<sup>66</sup> Microsoft could be required to charge the same per-unit price to all OEMs, subject to being able to discount its established price in order to meet competition. If indeed, by the time that remedies are imposed, the survival of any competing operating system is sufficiently tenuous that such a requirement could be expected to significantly increase the probability of the survival of any remaining effective competitor, then such a provision might be justified as a temporary measure. If such a relief provision were adopted, however, a sunset provision should be adopted with a term fixed at the beginning of the decree and not subject to reconsideration based on competitive circumstances at a later time.

banning CPU licenses (as well as, of course, quantity discounts) but allowing Microsoft to add a provision to its OEM licenses that forbids either the sale or discounting of naked machines.

Our analysis indicates that, on the benefit side of the calculation, other contract provisions dominate CPU contracts. On the cost side of the calculation, banning naked machines or banning discounts on naked machines impose lower costs than credited CPU licenses. The regulatory burden of identifying "legitimate" operating systems is identical, but banning discounts for naked machines or banning the sale of naked machines would not require that Microsoft receive competitively sensitive information about its rivals' sales and customers.

Arbitrage and carry forward have lower enforcement costs for the DOJ than credited CPU licenses or contractual bans on the sale or discounting of naked machines, since these proposals do not require the DOJ to determine which operating systems are "legitimate." These costs, however, appear likely to be small. Arbitrage has trivially higher private costs to Microsoft, since it now has to track the information for a newly created market; however, it is difficult to believe that Microsoft could not quickly create the software for such tracking. As noted, the problem with carry forward is that it may be insufficient as a competitive remedy.

Thus, for piracy concerns, any form of CPU licensing appears to be dominated (from a social perspective) by allowing OS suppliers to ban its licensees either from the sale or the discounting of naked machines.

CPU licenses cannot, however, be dismissed a priori as a potentially useful incremental tool against OEM fraud. Bans on the sale or discounting of naked machines may be as effective as modified CPU licenses at deterring OEM fraud, and legal and contractual penalties may not be effective against financially unreachable OEMs.<sup>67</sup> If, in the final analysis, the DOJ decides that bans on either the sale or discounting of naked machines provide insufficient deterrence to fraud-prone

---

<sup>67</sup> An OEM would be financially unreachable if the maximum penalty that could be imposed upon it if the fraud were detected is less than the license fees that the OEM could avoid by fraud, divided by its probability of detection.

OEMs, it should consider allowing either a credited CPU, a carry forward, or an arbitrage provision for OEMs that either have a history of fraud or that do not respond to *ex post* penalties. As noted, however, whatever merit such relief may have when applied to fraud-prone OEMs, there is no reason to allow Microsoft to require all OEMs, whether fraud-prone or not, to sign a modified CPU contract.