

Published in: OPENING NETWORKS TO COMPETITION: The Regulation and Pricing of Access, edited by David Gabel and David Weiman, Kluwer Academic Publishers: Boston, 1998.

**Exclusionary Behavior in the Market for  
Operating System Software: the Case of Microsoft<sup>†</sup>**

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December 1995

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† Forthcoming in Opening Networks to Competition: The Regulation and Pricing of Access, edited by David Gabel and David Weiman, Kluwer Publishers, 1997. We would like to express our appreciation for helpful comments and other assistance to Sturge Sobin, Linnet Harlan, Paul Dennis, David Gabel, Ben Klein (and participants of Western Economic Associates session in July 1995) 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.

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## 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 an operating system installed. We also examine Microsoft's practice of requiring in these licenses a minimum number of personal computers (PCS) on which an operating system can be installed, Microsoft's tying of Windows and technical support information to the sale of MS-DOS, and Microsoft's attempts in the early 1990s to induce technical incompatibility between MS-DOS and its main competitor, DR-DOS. Finally, we evaluate the proposed consent decree signed by 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 section III, we examine the superficial similarity between a CPU license and a two-part tariff, which can in many cases result in "efficient" first-degree price discrimination. Upon closer examination, however, we find that the CPU license is not a two-part tariff. This is not surprising, since in this specific factual context uniform linear prices would maximize simple monopoly profit, while a two-part tariff would be neither welfare enhancing nor—absent an exclusionary effect—profit maximizing.

Section IV 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 small market shares. We also conclude that Microsoft's anticompetitive behavior has reduced social welfare.

In section V 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.

## II. BACKGROUND

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

**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

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<sup>1</sup> A PC also requires a layer of software that stands between the CPU and the OS. Called the BIOS, or basic

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.

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.

**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.

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.

IN the early 1990s, the bulk of new PCS shipped in the U.S. (see the table) arrived 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>2</sup> The only independent DOS (i.e., compatible with, but not a clone or derivative of MS-DOS) were Digital Research Incorporated ( DRI's ) DR-DOS which, with Novell's acquisition of DRI in 1991, became known 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.

In 1992, it was estimated that the worldwide installed base of personal computers of all

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instruction operating system, this code is burned into the machine's ROM (read only memory) chip.

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

platforms totaled over 138 million.<sup>3</sup> Of those, 72% were IBM-compatible. Less than a quarter of those machines were equipped with Microsoft Windows.

**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 distribute. 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. Development teams accumulate expertise and reputation, only a portion of which can be redeployed into other projects.

Besides the irreversible investment in computer code, incumbents acquire sunk, or partially sunk, assets such as customer lists and brand name 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>4</sup>

**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 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

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<sup>3</sup> BERNSTEIN RESEARCH, FTC INVESTIGATION OF MICROSOFT (Sanford C. Bernstein & Co.: New York, January 1993).

<sup>4</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.

DRI stopped developing their own operating systems.<sup>5</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 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>6</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>7</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>8</sup>

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<sup>5</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.

<sup>6</sup> See BERNSTEIN RESEARCH *supra* note 4, at exhibit 2, at 10.

<sup>7</sup> Sherer, *Microsoft Outlines DOS 5.0 to Ward Off DR-DOS*, PC WEEK, October 22, 1990.

<sup>8</sup> See note 28 *infra*.

## B. MICROSOFT'S PRACTICES

**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>9</sup> Around 1983, Microsoft began to gear its license fees to the level of OEM sales. 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>10</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>11</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.<sup>12</sup> In the event an OEM

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<sup>9</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>10</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>11</sup> It is paid to Microsoft over the course of the year with an initial payment at the beginning of the year.

<sup>12</sup> From every indication, the implicit per-unit charges and requirement levels vary across the contracts signed by different OEMs.

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.

**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				

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>13</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>14</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>15</sup>

Typically, these agreements ran for a period of 2 years. It was quite likely an OEM will finish any contract with unused licenses under MS's CPU license. The customer does not receive a credit for its unused units at the end of the contract period. Nevertheless, Microsoft on occasion allowed the OEM to carry forward its unused licenses from the prior year.<sup>16</sup>

In addition to the price incentives for exclusivity embodied in the CPU license, Microsoft was alleged 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 have been prohibited from carrying forward unused MS-DOS licenses, required to renew the CPU license at equal or higher

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<sup>13</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>14</sup> See BERNSTEIN RESEARCH, *supra* note 4.

<sup>15</sup> See *id.* at exhibit 3. In that year, Microsoft's sales of Windows through OEM and upgrades totaled \$599 million.

<sup>16</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.

volumes to retain the carry-forward option. In this way, Microsoft's policy on carry forwards established a "tie" between sales from one year to the next.

Second, Microsoft's technical service and support may have been withheld from an OEM who installs a competing OS. 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 was allegedly increased to OEMs who purchase OAS from someone other than Microsoft. 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>17</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 at a much higher per-unit price.

**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 Applications Program Interfaces. These so-called "APIs" contain the technical specifications that permits applications programs to communicate with the operating system. 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 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

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<sup>17</sup> See *supra* note 12.

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 beta version became evident when applications developers using DR-DOS received error messages warning them of a potential incompatibility with Microsoft Windows. Upon installation, Microsoft Windows 3.1 checked whether the source of the underlying system and the extended memory manager were a Microsoft products. If they were 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>18</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>19</sup>

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<sup>18</sup> See *supra* note 12.

<sup>19</sup> Microsoft refused to address compatibility problems with DRI. Microsoft boldly defended its action claiming it had no responsibility to assist an operating systems competitor. Microsoft's actions went beyond refusal to assist a competitor, however, as it had engaged in commercial sabotage. See Wendy Goldman Rohm, *Will the FTC Come to*

*Its Senses About Microsoft's Mischief?*, UPSIDE, August 1993, at 11–27.

**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>20</sup> That action was not very effective, however, because Microsoft then began offering customer-specific price schedules with steep "cliffs" (sharp average price reductions) at volumes close to the customer's requirements.

In June 1990, the U.S. Federal Trade Commission initiated a nonpublic (sic) investigation of Microsoft's practices. The investigation eventually focused on Microsoft's marketing practices for DOS and Windows.<sup>21</sup> Without ever acknowledging the investigation, the Commission twice voted on whether to seek a preliminary injunction requiring Microsoft to cease and desist from its marketing practices. Both times the outcome was a 2-2 tie, resulting in no FTC action. .

But then, in an unprecedented move, the Antitrust Division of the Department of Justice (the Department) took up the case and, after extensive further investigation,<sup>22</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>23</sup> followed, as required under the Tunney Act, by a Competitive Impact Statement (CIS).<sup>24</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>25</sup> and rejected the decree as inadequate under the Tunney Act. The U.S. government and Microsoft jointly appealed Judge Sporkin's decision. The U.S. Court of Appeals for the District of Columbia has since upheld the consent decree.

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<sup>20</sup> Phang, *Microsoft Deals Not Fair: Korea*, ASIA COMPUTER WEEKLY, May 11-17, 1992.

<sup>21</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>22</sup> AAG Bingaman revealed that the investigation had consumed thousands of hours of attorney and economist time.

<sup>23</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>24</sup> Proposed Final Judgment and Competitive Impact Statement, 59 Fed. Reg. 42845 (1994) (proposed August 19,

### III. THE CPU LICENSE, FIRST DEGREE PRICE DISCRIMINATION, AND QUANTITY DISCOUNTS

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>26</sup>

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1994).

<sup>25</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.

<sup>26</sup> The actual price paid per unit could be higher even if the royalty fee itself incorporated volume discounts.

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.

Average price is the more typical yardstick for measuring nonlinearity of prices. In the case of a CPU license, average price 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.

The CPU license is not first-degree price discrimination in any meaningful 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 one year. However, since the size of the lump-sum payment is based on expected sales times a per-unit royalty, the OEM 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, the CPU license is a tax on output; it is not first-degree price discrimination. This is not surprising, since first degree price discrimination would not be 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. It also requires the lump-sum payment to approximate the incremental profit each OEM earns from using MS-DOS rather than the next-last alternative.

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>27</sup>*

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<sup>27</sup> See Janusz Ordover & John Panzar, *On the Nonlinear Pricing of Inputs*, INTL. ECON. REV., October 1982.

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.)*

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.

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 an alternative OS, no cost saving results. Indeed, if, as appears to be the case, other OSs offer greater value than that of MS-DOS, the substitution of MS-DOS for alternative OSs actually reduces efficiency and total welfare in the short run. The adverse effects on sound welfare are more pronounced in the long run, since the exclusionary nature of the CPU license will deter investments in competing OSs.

#### **IV. 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>28</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.

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<sup>28</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,

When two other conditions also hold, we would expect to observe a "competitive" or "socially optimal" performance. First, firms in this market take their competitors' prices as given and unaffected by their own actions, and try to undercut their rivals' (qualify adjusted) prices as long as that price exceeds their own marginal cost. Second, 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>29</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 it may still be profitable for the firm to set relative prices so as to encourage migration to the new technology.

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unfortunately, enter into here. *See* note 51 *infra*.

<sup>29</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.

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>30</sup> significant first-mover advantage, at least for the current vintage of technology. Given the combination of high fixed development costs and low marginal production and distribution costs, the competition resulting from entry 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 subsequent 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 product regarded by many software viewers as technically superior. The 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;<sup>31</sup>

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<sup>30</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

<sup>31</sup> For this condition to hold, arbitrage among OEMs must be uneconomic.

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 the market is not contestable (substantial sunk costs are lost in a failed entry attempt); 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 (induce) OEMs that wish to incorporate MS-DOS in any of their PCS to use MS-DOS exclusively through either of two policies:

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>32</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;

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<sup>32</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.

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 OSs 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 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 works best against potential competitors or rivals with a small market share. 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.

## **V. THE DOJ CONSENT DECREE**

Given the controversy generated by the consent decree it would seem useful to evaluate its competitive implications. 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 several year on the original 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 overly restrictive nondisclosure agreements.

These restrictions applied to the sale of current Microsoft operating systems (DOS 6.22 and Windows 3.11) as well as to operating system software then 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. 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. 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>33</sup>

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<sup>33</sup> Since the analysis in this article has focused exclusively on the horizontal effects of Microsoft's practices, we will

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 previous practices did 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 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.

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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.

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 aware 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 supplies 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 sales practices with an equally exclusionary. 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>34</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>35</sup>

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>36</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.

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<sup>34</sup> The resulting pricing schedule not only left the Korean OEMs with essentially no option but to deal exclusively with Microsoft.

<sup>35</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.

<sup>36</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

We do not believe this is the case. 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

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:

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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.

First, Microsoft could be allowed to charge different and confidential prices to different 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.<sup>37</sup>

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. 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.

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<sup>37</sup> In fact, Microsoft now requires OEMs to provide operating systems support for PCS they sell with a Microsoft operating system. And it often does charge end users for use of its own support services. Thus otherwise uncompensated service support costs do not appear to provide a rational for any concerns by Microsoft over its market share for operating systems at an OEM.

Fourth, Microsoft should not have been allowed to collect or negotiate over each OEM's estimated requirements. In this industry, such information can be used for exclusion (as in offering volume discounts with large price breaks at each OEM's expected volume). In other industries, where a seller's costs are affected by a variation in customers' purchases around forecast levels, sellers often collect such information, and reward customers in a variety of ways for more accurate predictions. But Microsoft has no cost (for which it is not directly compensated) which varies with an OEM's purchases, so no efficiency based explanation for allowing Microsoft to collect such information is plausible.

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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>38</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.

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<sup>38</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.