

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.⁴⁵ 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.

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

⁴⁵ 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*.

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;⁴⁶ 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.

⁴⁶ 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).⁴⁷ 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

⁴⁷ 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.

overwhelming market share against competition from a technically superior product. 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;
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.⁴⁸ 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;

⁴⁸ 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 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 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 nonsunk 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 mar-

ket 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 forms 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 brief⁴⁹ and other amici briefs—with the exception of the Williams brief⁵⁰—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. 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.⁵¹

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

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

⁵⁰ Brief for Amicus Curiae Richard H. Williams. This brief was filed with the appellate court but the court ultimately denied Williams' motion to participate.

⁵¹ 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*, STANDARDVIEW, forthcoming 1995.

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.

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 Judgement 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 (at § IV(H)).

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 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 Judgment 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.⁵² And, even if the Department did not believe when

⁵² The resulting pricing schedule not only left the Korean OEMs with essentially no option but to deal exclusively with Microsoft, Micro-

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.⁵³

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.⁵⁴ 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 Micro-

soft even increased the per-unit price for essentially the same volumes that were previously covered by the CPU licenses.

⁵³ 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.

⁵⁴ 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." *US v. Microsoft*, Case No. 95-5037 (D.C. Cir.) Joint Appendix at 845.

soft, (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.⁵⁵ 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 trade-off in this case: relief should ban CPU licenses, and its variants including quantity discounts.

Alternatively, the CPU license or equivalent volume discounts⁵⁶ 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

⁵⁵ 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.

⁵⁶ To avoid repetition, in the following discussion we use the term "CPU license" to refer to both CPU licenses and quantity discounts.

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 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 non-predatory price differentials could harm consumers if unsystematic, selective and secret price cutting facilitates price competition among rivals. Systematic price differentials may also be non-discriminatory: lower prices to larger OEMs, for example, could reflect differential externalities (e.g., a major or "flagship" OEM's 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 PIRACY⁵⁷ 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

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

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.

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.⁵⁸ 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 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.⁵⁹

⁵⁸ 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 alternative remedies discussed in this article.

⁵⁹ 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

(c) *CPU licenses with carry forward* A third relief possibility has the OEM retaining the right to carry forward into future years⁶⁰ any MS-DOS displaced by an alternative operating system.⁶¹ Again, Microsoft could continue to use CPU licenses. This

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.

⁶⁰ 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.

⁶¹ 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 (i.e., 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 insure 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

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

MS-DOS onto what otherwise would have been a naked machine is zero (in 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.

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 entitlements⁶² to other current or former licensees or even to brokers who could resell those rights.⁶³ 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.⁶⁴

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

⁶² 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*.

⁶³ 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.

⁶⁴ 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.

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.⁶⁵

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.

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

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

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.⁶⁶ 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 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

⁶⁶ 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.