

## ***Microsoft's "Applications Barrier to Entry" The Missing 70,000 Programs***

**by Richard McKenzie**

### **Executive Summary**

Judge Thomas Penfield Jackson bases his ruling against Microsoft on the claim that the company's monopoly in operating systems is protected by an "applications barrier to entry" made up of 70,000 Windows-based software programs.

Without an entry barrier, any dominant producer that seeks to restrict sales in order to raise prices above competitive levels will find its market share eroded as new entrants capture price-sensitive customers. But, according to Judge Jackson, to enter the operating-system market a newcomer would need a large and varied base of compatible applications like those available to consumers who might otherwise choose Windows. He concludes that "the amount it would cost an operating system vendor to create [70,000] applications is prohibitively large."

Judge Jackson seems unaware that the mere existence of a large number of Windows-based applications proves that Microsoft has stirred competition among software developers—leading to better products and falling prices and rais-

ing the value of both hardware and software to consumers. That said, there is a fatal flaw in the judge's argument: The overwhelming majority of the 70,000 Windows applications that make up the supposedly impregnable barrier to entry either never existed as unique products, no longer exist, or are totally out of date. When only unique Windows applications are counted—setting aside various versions of the same program—the number of applications is a small fraction of the judge's count.

Moreover, survey data indicate that the needs of active computer users are satisfied by a very small number of applications. That means the barrier to entry into the operating-system market is nowhere near as impregnable as the judge has claimed, which in turn helps explain many of Microsoft's aggressive business tactics to preserve its market position. Because the judge's most essential finding is clearly erroneous, it cannot support his conclusions of law.

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## **Introduction**

Judge Thomas Penfield Jackson, who presided over the Microsoft antitrust trial, understands that, in order for a monopoly to successfully restrict sales with the intent of raising prices and profits, there must be some barrier that keeps competitors out of the market. Without an entry barrier, higher-than-competitive prices and profits would attract rivals that could enter the market to cover sales not made by the would-be monopolist.

The judge recognizes that there are no legal barriers to entry into the operating-system business, such as those that protect the U.S. Postal Service from rivals who might want to deliver first-class mail. There are also no critically important resources in software markets—unlike, say, the diamond market—that could be cornered and denied to rivals. After all, the core resource of operating systems is a sequence of 1s and 0s, and such sequences can be produced ad infinitum to form alternative operating systems all over the world.

In lieu of standard barriers to entry, Judge Jackson has fashioned a totally new entry barrier that has never before been used in antitrust cases, dubbed the “applications barrier to entry.”<sup>1</sup> If for no other reason, that new entry barrier needs to be carefully scrutinized because it may not, on close examination, be what the judge says it is (i.e., the kind of monopoly protection that would warrant the breakup of the company and the binding behavioral restrictions the judge would like to see imposed on Microsoft).

## **The Existence of Commercially Viable Alternatives**

Any barrier to entry would be important in the operating-system market because Judge Jackson found that there is “no commercially viable alternative” to Windows,<sup>2</sup>

which implies that any potential competitor would have to surmount the entry barrier. The judge’s claim that there is “no” alternative to Windows ignores, however, the obvious fact that firms like Apple, Red Hat, Sun, and IBM (and several others) already have operating systems that can be used on personal computers. They might not be “commercially viable” in the sense that they have sizable market shares, but that could be because Microsoft is not acting like a monopolist. Firms like Apple, Sun, and Red Hat, which are already in the operating-system market, could quickly become “commercially viable” (or more commercially viable than they already are) *if* Microsoft did what monopolists are supposed to do: restrict sales in order to raise the company’s prices and profits. Few consumers would stay with a monopoly producer that could be expected to charge monopoly prices far into the future, imposing on consumers costs that they could avoid by going with one of the alternative producers already in the market.

Granted, the judge also found that there are “switching costs” for people who want to move from one operating system to another. Sometimes, consumers of a new operating system have to buy not only new software but also new computers (as would be required in any switch from a Windows/Intel-based personal computer to an Apple Mac). The consumers might also have to undertake training with the new software and hardware. But that does not mean consumers will refrain from switching. If a firm like Microsoft were to charge monopoly prices, there would be “staying costs” associated with paying monopoly prices far into the future. The “staying costs” would equal the present value of paying higher monopoly prices into the future. Hence, even if there are switching costs, those switching costs decline as the monopolist raises its price. Computer users can be expected to switch operating systems when the anticipated staying costs associated with an operating system are greater than the switching costs.<sup>3</sup>

## **Market Definition and the “Applications Barrier to Entry”**

How then was the judge able to declare that Microsoft is a monopolist in the operating-system market? Very easily. He declared Microsoft to be in a narrowly conceived market, covering only single-user personal computers that come equipped with Intel or Intel-compatible microprocessors. That definition excludes many sales of operating systems developed by Apple, Sun, Red Hat, and a number of other firms—either because their computers use non-Intel-compatible processors or because they are networked (i.e., linked to other users with whom they share resources).<sup>4</sup> Given his narrowly defined market, Judge Jackson then found that Microsoft’s operating systems—including DOS and all the dated versions of Windows, not just Windows 98—are installed on more than 90 percent of the personal computers in the world, implying that Microsoft has “monopoly power,” or the ability to restrict sales and raise prices.<sup>5</sup> Because there is “no” commercially viable alternative to Windows, according to the judge, no other producer could expand production to make up for Microsoft’s sales reduction, which means that the price hike could stick.

Moreover, Judge Jackson found that Microsoft’s substantial market dominance, as he defined the “market,” is protected by what he chose to call an “applications barrier to entry.”<sup>6</sup> He reasoned that the demand for an operating system is dependent on the number of applications written for that system. The greater the number of applications written for an operating system, the greater the value of the operating system to consumers. He also found that there are 70,000 applications written for Windows, a vastly greater count than for any other operating system.

As we shall see, Judge Jackson craftily rigged the outcome of the trial in favor of the government by making Microsoft a far more dominant force in the “personal computer”

industry than the company really is. He has also devised the required entry barrier behind which Microsoft, supposedly, exploited its market power.

The judge asserts that Microsoft need not worry about normal competitive market forces because existing or potential operating-system rivals “would need a large and varied enough base of compatible applications to reassure consumers that their interests in variety, choice, and currency would be met to more-or-less the same extent as if they chose Windows.”<sup>7</sup> That is really a sly way of turning consumer gains from using Windows against Microsoft. Microsoft has obviously done an outstanding job of encouraging and helping program developers to write for the “Wintel” platform, providing consumers with the “variety, choice, and currency” that they want. But the judge argues that Microsoft’s accomplishment is the source of the monopoly power that Microsoft can turn and has turned against consumers by its supposed illegal and anti-competitive practices.

Several thousand software applications would not be sufficient to enable a potential rival to erode Microsoft’s dominance, the judge argues, because buying the alternative operating system “would still look like a gamble from the consumer’s perspective next to Windows,” which, again, has 70,000 applications.<sup>8</sup> The proof of that statement, according to the judge, is evident in Apple’s market predicament. Apple has 12,000 applications written for its operating system, but “even an inventory of that magnitude is not sufficient to enable Apple to present a significant percentage of users with a viable substitute for Windows.”<sup>9</sup> Hence, the judge concludes that Microsoft’s market dominance is protected because “the amount it would cost an operating system vendor to create that many applications [70,000] is prohibitively large.”<sup>10</sup> That entry barrier would “prevent an aspiring entrant” from drawing away Microsoft’s customers even if Microsoft “priced its products substantially above competitive levels for a significant period of time.”<sup>11</sup>

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## Where Judge Jackson Went Wrong

Judge Jackson's first major mistake was to reason that Microsoft's market dominance gives it monopoly power worthy of antitrust scrutiny. In focusing on market share, as has been traditional in antitrust cases over the past century, the judge doesn't seem to realize that market share doesn't mean as much in "new-economy" markets like software as it does in "old-economy" markets like steel. In old-economy markets, the additional—or, more accurately, marginal—cost of expanding output is usually substantially above zero, because the production of more of a good like steel requires firms to incur labor and materials costs, if nothing else.

In addition, the marginal cost of production can be expected to rise (within the relevant range of production and in the short run). That means that, if the dominant producer restricts sales to raise its prices and profits, other firms in the market cannot easily expand production in the near term without incurring significant additional costs. The ability of other firms to expand output to make up for the restricted sales of the dominant producer is ultimately checked by the *rising* marginal cost. At some point as production expands, the cost of producing one more unit rises above the gains the rival firms can get from selling the additional unit, making further expansion no longer profitable. Hence, the dominant producer's restricted sales lead to a reduction in total market supply and a higher (monopoly) price.

New-economy markets are quite different. As the judge found, software production may require heavy fixed or up-front development costs, but the marginal costs of producing additional copies of a software product can be "very small," if not zero.<sup>12</sup> A product like Windows requires little in the way of additional resources for, say, Dell Computers to electronically copy Windows from the hard disk of its mainframe computer to the hard drive of each personal computer it builds.

Furthermore, the marginal cost of production can remain more or less constant at zero, or close to it, for as many copies as Dell chooses to produce.

Thus, mere dominance may mean little in the operating-system market. If Microsoft decides to restrict sales, some other existing operating-system vendor (Red Hat or IBM), whose up-front development costs are also "sunk," can make up for Microsoft's restricted sales at little or no additional cost, and the vendor can expand sales without confronting a rising cost constraint. Even though he mistakenly applied old-economy production economics to Microsoft and assumed that Microsoft's market dominance gave it market power, Judge Jackson realized that he also had to find a barrier to entry to make that market power durable.

Microsoft is clearly not as dominant in the operating-systems market as the judge finds. The judge's conclusion about Microsoft's protected market position can be disputed by the simple observation that Apple may not be a *dominant* force in personal computers like Microsoft, but it certainly has given "a significant percentage of users" not only "a viable alternative" to Windows but also a substitute most Apple users would swear by. Yet Apple's small market share in no way proves, or even affords credible evidence, that a potential rival would actually need more than 12,000 applications to compete with Windows. Apple's market-share problems might be a consequence, not of Apple's applications or lack thereof, but of some other more important factor—for example, Apple's prices (which have always been higher than the prices of comparable Wintel personal computers), product design, or marketing strategy.<sup>13</sup>

It's important to note that, in his findings of fact, the judge gives no indication that he knows anything specific about the supposed "applications barrier to entry" other than the count of applications, and surely the 70,000 Windows applications (as well as the 12,000 Apple applications) represent only a rough count, which could be off by several thousand. No one seems to know exactly how

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many applications there are overall or how many there are in various categories—for example, the number of business (or productivity) applications, games, or reference works. Many of the 70,000 applications may be nothing more than utility programs that are not likely to be sold as separate shrink-wrapped software packages. Indeed, it may be that the count includes various editions of games, most of which are out of date and no longer sold.<sup>14</sup> The point is that the judge gives no indication that he really knows what is in the barrier to entry on which he stakes his theory of Microsoft's monopoly power.

The 70,000 count of applications that supposedly form the barrier to entry appears to come from the trial testimony of John Rose, then head of Compaq Computers and a Microsoft witness. During the trial, he was pressed by Justice Department attorney David Boies to explain why Compaq used Windows. Rose noted that “approximately” 70,000 applications had been written for Windows, and he agreed with Boies that the existence of those applications was a “prime reason” (Boies' words) that Compaq shipped its computers with Windows on board. Lost in the judge's “findings of fact” based on Rose's testimony is that some of the 70,000 applications, according to Rose, were developed for the DOS environment. More important, he stressed that there had been 70,000 DOS/Windows applications developed during the entire 17-year life of the personal computer industry—not that there are actually 70,000 fully functioning, up-to-date Windows applications currently available.<sup>15</sup> Rose's assessment is far removed from what the judge suggests when he asserts that Windows “supports over 70,000 applications” and concludes, therefore, that “the amount it would cost an operating system vendor to create that many applications is prohibitively large.”<sup>16</sup>

Thus, the supposed applications barrier to entry is grounded in nothing more than speculation on the part of the judge concerning the role of the number of applications in determining market share. His position is

certainly not founded on any courtroom evidence about the determinants of market share for operating systems. As a consequence, the investment a potential rival might have to make in the development of applications is not necessarily “prohibitively large,” even though the judge stakes his case for a breakup of Microsoft solidly on that claim. Surely, no potential entrant into the operating-system market would need or want to develop (or encourage the development of) counterparts to DOS versions of applications, or even Windows 3.0 versions. Applications written for obsolescent operating-system technologies are not likely to have much of a market.

In fact, the investment a challenger would have to make in applications in order to take away at least a portion of the Windows market might actually be relatively modest, given that few computer users would ever be inclined to use hundreds, much less tens of thousands, of applications even over a long stretch of time. Most people simply don't have the time, need, or inclination to use more than a handful of applications.<sup>17</sup>

The number of applications that all computer consumers together might use is also a small fraction of 70,000. That fact is evident from a search of the available productivity applications sold on Amazon.com, which are listed by several subcategories in Table 1. Amazon lists only 8,301 “software programs” under its productivity software categories.<sup>18</sup> That is a large number, but it includes programs written for all available operating systems, including Red Hat Linux, IBM OS/2, and Apple Mac, as well as Microsoft Windows. Many of the software programs are also listed several times in the various subcategories. Still, the unadjusted count of productivity programs represents just 12 percent of Judge's Jackson's 70,000 applications.

Moreover, the software market is beset with “versioning,” the strategy of developing a basic product and then adding or subtracting features, often at little or no added development expense, to generate several versions of the same product. Those versions are designed to fit the needs and wants of differ-

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**Table 1**  
**Productivity Applications Listed on Amazon.com**

	Total Applications on Amazon	Total Unique Applications
<b>Business and Office Applications</b>		
Accounting	95	34
Career and management	97	58
Communication utilities	1,346	171
Database	93	32
Document management	219	45
Office suites	95	14 <sup>a</sup>
Personal finance	37	12
Presentation	138	43
Project manager	56	23
Reports and forms	156	30
Schedule and contact management	109	41
Spreadsheets	25	2
Training and tutorials	52	36
Word processing	35	14
Subtotal	2,553	555
Internet and Networking Applications	2,595	348
<b>Graphics and Multimedia Applications</b>		
3-D	73	32
Animation	67	7
CAD	103	31
CD burning	15	9
Clip art	148	73
Image capture	2	2
Desktop publishing	339	108
Multimedia editing	84	54
Illustrations	123	34
Professional design	103	12
Photo editing	155	51
Video editing	71	18
Subtotal	1,283	43
<b>Utilities Applications</b>		
Cross platform	28	5
File compression	25	7
File conversion	17	3
Hardware and memory management	63	23
Other	91	14
PC maintenance	100	33
Partition	14	2
Screen savers	14	11
Voice recognition	83	11
Backup	517	88
Virus protection	276	21
Subtotal	1,228	218
Programming Applications	642	125
<b>Total Productivity Applications</b>	<b>8,301</b>	<b>1,677</b>

Note: Counts are based on listings between June 30 and July 6, 2000.

ent consumers in distinguishable markets. With versioning in software markets (as in other markets), application developers can price discriminate by segmenting their markets according to the buyers' *willingness to pay* for different features, which can mean greater sales and profits.<sup>19</sup>

For example, a developer of office software can develop an array of productivity applications, including a word processor, spreadsheet, database, Internet browser, slide presentation, calendar, and Web page program. Then the developer can create more sophisticated or less sophisticated versions of those basic applications.<sup>20</sup> In addition, the developer can organize the basic applications into an array of "office suites"—identified, possibly, as "standard," "professional," and "premier" or "deluxe"—with each version containing different combinations of the firm's basic office applications, listed separately on Amazon and elsewhere.

To confuse the "count" of total applications still further, software firms can then provide "add-on" programs, which offer additional features (as in Windows Plus). Firms also can sell separate products for different numbers of users (for example, 10, 25, 50, or an unlimited number of users); each of those products may be counted, as they are in the Amazon listing. The different versions may add to the firm's packaging and marketing cost but not necessarily to the cost of software development.

No one seems to know how John Rose got his 70,000 count of software applications. He submitted no documentation for the figure in his court testimony. Neither was Rose challenged by either side to say where he got the number.<sup>21</sup> Interestingly, the presumption that there may be tens of thousands, if not 70,000 or even 100,000, Windows applications may have originated with Microsoft, which may have been overzealous in its public relations and marketing efforts to accentuate the value of Windows. Back in 1997, when it was heavily promoting the adoption of Windows NT for servers, Microsoft noted in a press release: "[H]undreds of leading applica-

tion vendors are writing rich and compelling 32-bit Windows NT Workstation-ready applications—with more than 100,000 32-bit Windows-based applications available today."<sup>22</sup> Apparently, Microsoft has no documentation to support the claim that there are "100,000 32-bit Windows-based applications available today."

Without supporting documentation, it appears that the 70,000 applications the judge elevates to the status of an "applications barrier to entry" include various versions of programs—for example, the standard and deluxe editions of Corel's WordPerfect Office Suite. Each version of Office Suite includes, of course, underlying productivity applications that can also be sold and counted separately. Through versioning, basic productivity applications can be double- and triple-counted, and then some. Moreover, the Amazon count of 8,301 programs includes upgrades of programs, as well as full programs, and even tutorials. Those multiple counts and overlapping coverage, along with programs not normally thought of as "applications," greatly exaggerate the cost that operating-system and application developers would have to incur in order to enter their respective software markets.

To understand the extent of the duplication involved in the Amazon count of business and office programs, consider that Amazon has 25 items for sale under its "spreadsheet" subcategory (which is itself under the "business and office" category), but there are only two distinct spreadsheet programs, Excel and Lotus 123, in the listing. There are 156 items listed under "reports and forms," but again many of the items are variations of the same basic 30 programs. There are 95 "office suites" listed on Amazon, but only 13 suites when properly counted.

When only unique programs are counted, Amazon sells just 555 Windows-based applications listed under the "business and office" subcategory in Table 1. When all other business subcategories ("internet and networking," "graphics and multimedia," "utilities," and "programming") are added,

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there are 1,677 unique Windows-based productivity applications listed on Amazon (many of which were, at the time of the survey, classified as “not in stock” or “not currently available”). That much more realistic count of available Windows applications represents just 2 percent of the judge’s “applications barrier to entry.”

Even then, that count exaggerates the barrier to entry in the desktop market. More than 400 of the included applications are designed exclusively for the back-office server market, which Microsoft does not dominate and was not an issue in the antitrust trial. Another 73 of the included applications are clip art programs that, with relative ease, could be adjusted to work with any new operating system. Furthermore, it is not at all clear why a new operating system actually needs 108 different desktop publishing programs or 88 backup programs in order to mount an effective challenge to Windows. All that’s needed is a few very good options.

In short, there may be a thousand or so Windows-based productivity applications listed on Amazon that can reasonably counted as a part of the “barrier to entry”—no more than 2 percent of the judge’s count.<sup>2 3</sup>

That means that there would have to be at least 68,000 nonproductivity applications for the total count to match the judge’s estimate of the “applications barrier to entry.” Yet there are only 3,644 combined applications listed on Amazon under the separate categories of “children’s programs” (1,458), “education and reference” (416), “games” (1,480), and “homes and hobbies” (290). That total count exaggerates the number of unique applications because many applications are listed several times under the subcategories, and versions and upgrades of games abound.<sup>24</sup> Also, an undetermined number of the programs in those categories (especially in “education and reference”) do not have to be fully recoded for a new operating system, which means that a promising new entrant into the operating-system market could expect to add those programs with relative ease.

Amazon, of course, does not sell all Windows-based applications. Also, many Windows applications are specific to industries and even firms. At the same time, Amazon must sell a sizable percentage of all available Windows applications, especially the widely used programs, and the Amazon list includes many programs that only computer technicians and experts might buy (for example, Tabworks, Faxrouter, Hostexplorer, and Cosession Remote). No doubt, the array of Windows programs makes entry less than easy, as should be expected. Building the Windows application base was not easy to begin with. Microsoft has invested billions in building its applications network by helping developers write for Windows.

The point is that Judge Jackson has staked his case against Microsoft on the explicit and very precise claim that there are 70,000 Windows-based applications, which, because it is a large number, necessarily forms a “prohibitive” barrier to entry. In staking out his position so firmly and precisely, he has grossly exaggerated the entry barrier, a point that he would surely have conceded had he known more about what was in the applications count that he accepted as legal “fact.” Because the array of Windows applications is far smaller than what he claimed, the required investment for entry must be far less than he indicated. Granted, the investment required to challenge Microsoft could still be substantial (given the complexity of a number of the applications in the final count), but that is a far cry from “prohibitive.” Besides, is it not reasonable to expect new firms to incur many of the same development costs that Microsoft had to incur?

It looks as though the up-front investment would be well within the means of a host of existing and potential software firms, *if* Microsoft were to act like a monopolist. That is especially true since operating-system challengers have to fund only the effort to encourage program development by others. That is, they would not have to fund the actual writing of the applications themselves. The applications firms would do that. Even

then, given the prevalence of “network effects”—which were at the foundation of the government’s case against Microsoft and which Judge Jackson adopted as “fact”—an “aspiring entrant” would have to spur the development of only a few applications at the start.<sup>25</sup> Those initial applications can be expected to cause an increase in sales of the challenger’s operating system, which can give rise to more applications written by outside developers, which can lead to even more operating-system sales and a greater number of applications. Again, encouraging the development of the “network” would be especially easy for an “aspiring entrant,” if Microsoft were to act like a monopolist.

## **Applications Used by MBA Students**

The fact that most computer users typically use few applications is obvious from a survey of 152 working managers enrolled in the part-time MBA programs at the University of California, Irvine.<sup>26</sup> All survey participants were computer literate and used computers on their jobs and in their graduate studies. If there is a group of people who should be expected to use a wide variety of programs, it is that one. Still, when asked how many different computer programs (games included) they had used over the five months before the survey, 19 percent of the respondents noted that they had not used programs other than the six that come with the Microsoft Office suite (which came preloaded on their university-issued laptops that were required for their classes). As indicated in Table 2, 42 percent used only one to three programs in addition to Office. Nearly 22 percent used four to six additional programs, and only 16 percent used more than six additional programs. That means 84 percent of the respondents used in total a dozen or fewer applications (including Office applications and games). No one reported using more than 18 programs—Office plus 12 other applications.

Of course, there was significant variation in the programs used. Respondents reported using 187 different productivity applications at work (ranging from 3-D CAD to Bacons Media to Lotus Notes, as well as other Windows-based programs developed exclusively for their firms). They also reported using 47 different games or entertainment programs (ranging from Delta Force to Sim City to Unreal Tournament). The survey respondents may not have accurately remembered all of the programs they had used. The count of programs used would very likely rise with a lengthening of the time frame covered by the survey, meaning the findings may understate the variety of programs a firm would need to dominate the operating-system market.

Clearly, Microsoft has a strong market advantage because of the many applications written for its operating system. At the same time, it is obvious that a sizable segment of computer users—maybe a fifth (or more, given that the survey was distributed to users who are likely to be far more computer savvy than the general population of users)—could be adequately served with an operating system that has a few dozen applications written for it. Surely, a few hundred well-chosen applications might be all that would be needed for a new entrant to surmount the “applications barrier” and to make a credible challenge to Windows.

A fifth of the U.S. market covers something on the order of 20–25 million computer users. A fifth of Microsoft’s operating system revenue amounts to about \$2 billion annually. That seems like a fairly sizable market, which any number of firms would be eager to enter *if Microsoft were ever to act like a monopolist—that is, charge monopoly prices that would make the cost of staying with Windows prohibitive*. Then, Microsoft would surely be vulnerable to entry.

Sun Microsystems obviously doesn’t believe that tens of thousands of applications are needed to make headway in the operating-system market. Sun is seeking to become a network “application services provider” (as are Microsoft and several other firms). Sun intends to rent computing services over the

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**Table 2**  
**Distribution of Windows Applications Used by Fully Employed (and part-time)**  
**MBA Students**

Application	Percentage of Students
Only the applications in Microsoft Office	19%
1-3 applications in addition to Microsoft Office	42%
4-6 applications in addition to Microsoft Office	22%
More than 6 applications in addition to Microsoft Office	16%
Number of different work-related applications used by all respondents	186
Number of different entertainment or education applications used by all respondents	47

Note: Survey undertaken by the author during June 2000 at the Graduate School of Management, University of California, Irvine.

Web and charge by the use. Toward that end, Sun started its ASP venture with the eight business applications acquired in its 1999 buyout of Star Division. To build its business base, it has been doing what Microsoft did with Internet Explorer: giving away its software products.

past decade, without adjusting for product enhancements.<sup>27</sup> Now, Windows 98 upgrades sell at retail for \$89, but that figure overstates the cost of Windows to nearly 90 percent of PC users, who get their operating system when they purchase a new computer. Microsoft sells copies of Windows to computer manufacturers for approximately \$65 (or less). The Graduate School of Management at the University of California, Irvine, is able to license copies of Windows 98, plus all of the applications in Office 2000 and Front Page (several hundred dollars' worth of software when bought at retail), for \$47.50 a year for faculty and staff and \$18.60 a year for MBA students. Do those sound like the prices that a monopolist, protected by a "prohibitive" barrier to entry, would be expected to charge?

A second problem with the judge's findings is that nowhere in his analysis of the operating-system market does he find that Microsoft has actually raised its price "substantially above competitive levels for a significant amount of time." Microsoft's price for Windows is at or below the prices competitors like IBM, Sun, and Apple charge for their operating systems. Moreover, the price of Windows has fallen in real (inflation-adjusted) terms by over 50 percent over the

Indeed, Judge Jackson never found evidence of monopoly pricing. Instead, he concluded: "The debut of Internet Explorer and its rapid improvement gave Netscape an

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### **The Absence of Monopoly Pricing**

incentive to improve Navigator's quality at a competitive rate. The inclusion of Internet Explorer with Windows at no separate charge increased general familiarity with the Internet and reduced the cost to the public of gaining access to it, at least in part because it compelled Netscape to stop charging for Navigator. Those actions thus contributed to improving the quality of Web browsing software, lowering its cost, and increasing its availability, thereby benefitting consumers."<sup>28</sup>

Why did Microsoft do all of those good things? According to the judge, "to protect the applications barrier to entry, and hence its monopoly power."<sup>29</sup> But the issue the judge doesn't address is why Microsoft would want to protect the kind of "monopoly power" that requires it to upgrade Windows to include browsing capability and then to give that added benefit away. The usual barrier to entry would allow the protected firm to restrict sales with the intent of raising its prices. The "applications barrier to entry" doesn't sound like much of a "monopoly barrier." Still, the judge managed to find that Microsoft's tactics caused "consumer harm by distorting competition." Is not responding to the entry of a rival with improved products and lower prices the very essence of competition?

Nevertheless, Judge Jackson concluded that the "predatory course of conduct Microsoft has pursued since June of 1995 [in the main, integrating Internet Explorer into Windows and then giving away the browser functionality] has revived the *dangerous probability* that Microsoft will attain monopoly power" in the browsing market.<sup>30</sup> But so what if Microsoft attains "monopoly power" if it uses that supposed power to improve the "quality of Web browsing software, lowering its cost, and increasing its availability, thereby benefitting consumers"?<sup>31</sup> In addition, the judge fails to acknowledge that Microsoft has helped to break down whatever applications barrier to entry there is by rewriting its own Office applications for the Apple Mac operating system, thus ensuring that its own applications will not stand in the way of Mac's taking over a larger share of the market.<sup>32</sup>

In essence, when the judge's findings of fact and conclusions of law are stripped of legal parlance, it is clear that he really found that Microsoft charged too little, not too much, for Windows. Remember, he found that the zero price for the integrated browser, Internet Explorer, was "predatory," designed to ruin Netscape as a viable competitor.<sup>33</sup> Those pricing facts are hard to reconcile with the judge's claim about Microsoft's monopoly power because any self-respecting monopolist would take advantage of its market power by restricting sales and raising prices. If the current owners have no interest in doing so, then surely other savvy investors would be willing to buy a controlling interest in Microsoft and change its pricing policies—if *Microsoft had the market protection the judge thinks it has*.

The charge that Microsoft could act like a monopolist in the future has been leveled for at least a decade, yet all the while the real price of Windows has continued to fall. One might think the judge would wait to condemn Microsoft until it had actually raised its prices above competitive levels before proposing to break up the company and restrict its ability to give away the browser. One might also think the judge would understand this basic proposition: If Microsoft had to respond with such force and a zero price to Netscape's market entry—a Web browser that was written in four months by seven recent graduates of the University of Illinois—the applications barrier to entry must not be what he made it out to be.

## Worries about the Near Term and the Long Run

At several points in his analysis of Microsoft's behavior, the judge is clearly worried about what Microsoft might do in the near term, over the next two or maybe three years.<sup>34</sup> He obviously believes that, with its supposed protection from normal competitive forces, Microsoft has the requisite market power to raise its prices substantially by cur-tailing sales. Microsoft might in fact have such

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power—in the near term. After all, many computer users would be hard-pressed to switch to another operating system in the near term, but that in no way means that Microsoft has the requisite incentive to raise its prices in the near term. That is because near-term price hikes can cut sales. Moreover, as Judge Jackson determined, software markets are beset with “network effects,” or the tendency of sales to build on sales with time.<sup>35</sup> If more copies of Windows are sold, application developers have more reason to develop programs for Windows. With more applications, the value of Windows rises along with sales.

Network effects can also work in reverse. A reduction in near-term sales due to a price increase can leave a market opening for some other operating system that can establish a beachhead with lower prices leading to greater sales, which attract application developers. More applications can lead, in turn, to more sales of the new operating system at Microsoft's expense. Therefore, Microsoft might be able to raise its profits in the near term, but those near-term profits would entail an even greater *loss* of profits in the long term. As a consequence, a price increase for Windows today could translate into a reduction in the price of Microsoft's stock. The current stock price should reflect the stream of expected future earnings, which could well be lower than they would be if Microsoft did not raise its current price for Windows. One reason Microsoft has not behaved as if it is protected by the “applications barrier to entry” is that the barrier is simply not what the government and judge pretend it is. Microsoft's key employees also have their sights focused on the company's stock price (because of their stock holdings and stock options), not on its current bottom line. How else can a retail price of \$89 for Windows 98 or an annual lease payment for students of \$18.60 for Windows and Office be explained if Microsoft is such a dominant producer camped out behind a “wall” of applications?

Seen from that perspective, the “barrier to entry” that is protecting Microsoft is not the

applications but the prices it charges. Because Microsoft constrained the price of its operating system (say, relative to the price charged by Apple), program developers were willing to write for Windows, which led to the much-heralded “network effects” (i.e., sales of Windows resulting in more applications that, in turn, led to more copies of Windows being sold).

In effect, Judge Jackson has, with the stroke of his pen, converted the 70,000 applications, which consumers value and use, into a source of consumer harm caused by Microsoft's supposed anti-competitive tactics. And what did Microsoft do? Well, it didn't prevent anyone from using any of those supposed 70,000 applications. There has never been a moment when consumers could not use Netscape Navigator with Windows. All Microsoft has ever done is upgrade Windows by integrating its browser, Internet Explorer, into Windows. Then it gave away the browser functionality by not raising the price of Windows. In the process, Microsoft forced Netscape to lower the list price for Navigator from \$39 before Microsoft entered the browser market to zero afterwards.

By integrating a browser into Windows, Microsoft gave practically every user of Intel-compatible and Apple computers the technology necessary to go to Netscape's Web site and download Navigator for free. In doing so, Microsoft may have actually stimulated the use of Navigator, especially since Microsoft made browsing virtually ubiquitous and, hence, encouraged the speedy development of the Internet world, as the judge acknowledges. In short, Microsoft gave more people more reason and more ability to download and use Navigator.

Granted, after Microsoft entered the so-called browser war, Netscape lost market share, as practically everyone knows. But what is not so widely known is that the actual count of Navigator users exploded during the two years of the trial from 15 million in 1996 to more than 35 million at the end of 1998, the period during which Microsoft was supposedly foreclosing Netscape from the

browser market. And the number of Netscape users may have doubled again since the trial started in May 1998.<sup>36</sup>

In any event, Netscape's NetCenter provides a variety of e-commerce services and has become a major hub of Web-based economy, which partially explains why America Online was willing to pay more than \$10 billion for Netscape while the Microsoft antitrust trial was going on. A part of that purchase price might have been attributable to Microsoft's helping to make browsing ubiquitous in a way that Netscape alone could not have done in the same time frame. And Windows allegedly dominated the operating-system market because of those supposed 70,000 applications. That means the so-called applications barrier to entry might have been seen, contrary to the judge's imagery, as a "conduit" through which Netscape was able to flourish because the Web developed more rapidly than it would have otherwise.

We can't be certain, nor can the judge, whether Microsoft's supposed "predatory" actions were, on balance, a boon or a bane to Netscape. No evidence was introduced at trial that spoke to that empirical issue. But we do know one thing for sure: Microsoft did not predatorily (or anti-competitively) drive Netscape from the market.

### **Consumer Gain from the "Applications Barrier to Entry"**

Judge Jackson doesn't seem to realize that the mere existence of 70,000 Windows applications (as if there really were that many) indicates that Microsoft must have eased the entry of hordes of program developers into the market for Windows-based applications. In doing so, the company, no doubt, stirred competition among a multitude of application firms, leading to product improvements and falling prices, and thus raising the value of Windows and personal computers to users. And, by elevating the value of the Wintel platform, Microsoft spurred competi-

tion among computer makers, ensuring that the price of computing would also decline.

Even if Microsoft has been charging monopoly prices (which, again, has not been demonstrated),<sup>37</sup> it does not follow that Microsoft has, *on balance*, harmed consumers. The reduction in the prices of Windows applications resulting from the ease of entry into that market, as well as the decrease in the price of computing, may have more than offset any increase in the price Microsoft might have charged for Windows itself. Had Microsoft not been able to gain in some way from its encouragement of the development of applications that supposedly form a "barrier" to competition, there might not have been as much competition in applications and computers as there has been. The market might have been dominated by the Apple model of computer markets, under which the operating system and computer are sold as a tied package—and at higher prices than comparable personal computers running Windows.

The judge speaks of the applications barrier to entry as if it came into existence more or less naturally, as a consequence of network effects that are, like gravity, not the product of human ingenuity and effort. That is hardly the case. Getting independent developers to write for any operating system is not a consequence of natural forces, nor is it a costless undertaking. Indeed, Microsoft has spent billions of dollars facilitating the work of software developers. No company would undertake such an investment if it did not expect to get something in return. By the same token, if programmers expected to be trapped by a monopolist that would charge monopoly prices once they had written their applications, they certainly would be less inclined to write programs. That means a firm like Microsoft would have to invest more resources (or charge lower prices) in order to get the programmers' cooperation. The threat of Microsoft's charging monopoly prices in the future could similarly encourage developers to write for alternative operating systems, which could open up the market to new entrants.

**Microsoft stirred competition among a multitude of application firms, leading to product improvements and falling prices, and thus raising the value of Windows and personal computers to users.**

**Microsoft could be said to have used the aggressive tactics it did to defend the interests of developers—not because Microsoft is altruistic, but because developers’ interests overlap Microsoft’s own long-run interest.**

Microsoft has a history of charging low prices, then lowering its prices still further and enhancing Windows over time.<sup>38</sup> That helps to make credible Microsoft’s commitment to remain the operating-system standard. Apple, by contrast, has far fewer applications even though Apple’s graphics-based operating system is much older. It is likely that Apple has invested fewer resources in encouraging program developers. Moreover, Apple has a reputation for being pricey. Perhaps those reasons—not the applications barrier to entry—account for Apple’s role as a minor player in the personal computing market.

Judge Jackson appears convinced that greater consumer mobility among operating systems would be a boon to competition and consumer welfare. But is that necessarily the case? If consumers could move among operating systems with complete ease, it is doubtful that operating-system companies would be willing to work as hard at getting program developers to write applications. Programmers might not be so willing to make the investments they have to make. Hence, the so-called applications barrier to entry in the operating-system and applications market can be seen as a boon to the development of applications. An applications barrier of some magnitude can give operating-system companies and program developers the incentive they need to enter their respective markets.<sup>39</sup>

Moreover, program developers are not as unsophisticated as the judge implies when he writes that they are trapped behind the applications barrier to entry. They understand that the value of their applications is related to how widely Windows is used. Like Microsoft, they understand that the success of the Windows standard is related to its price. If they expected Microsoft to charge monopoly prices in the future, they would be less likely to write for Windows, which means that the mere threat of Microsoft’s acting like a monopolist can undermine the supply of Windows applications. The fact that Microsoft has so many applications written for Windows suggests that the company has been highly successful in convincing pro-

grammers that it will not charge prices so out of line with competitors’ prices that sales will be inhibited. In other words, the many Windows applications (whatever the count) are a mark of Microsoft’s competitiveness. If Microsoft did not show that it could and would remain competitive, vis-à-vis alternative operating systems, it would not have the large count of applications and, accordingly, would not have achieved its dominant position in the operating-systems market.

Because Microsoft integrated Internet Explorer into Windows and then did not charge for the browser functionality, Judge Jackson concludes that Microsoft had “predatory” intentions, in the main, to destroy Netscape. According to the judge, “[P]redatory conduct, by definition as well as by nature, lacks pro-competitive business motivation.”<sup>40</sup> Microsoft’s efforts with its browser may have been intended to harm Netscape, but such harm should be expected in competitive markets. Competitors are destroyed all the time.

Moreover, Microsoft’s “motivation” may very well have been pro-competitive. Microsoft may have understood that the viability of the Windows standard, and all its applications, depended on ensuring that Windows remained ubiquitous. It would not have remained so if Windows did not have browsing capability. The program developers could also see what Microsoft saw: If Microsoft had not included a browser in Windows, many program developers would have turned away from Windows, thus undermining the acclaimed network effects and causing the Windows standard to unravel. Microsoft’s zero pricing of Internet Explorer is one way Microsoft alerted the program developers that it intended to remain competitive in the face of a strong challenge, a stance that fortified the Windows standard (which the judge mistakenly interpreted as anti-competitive behavior).

In effect, Microsoft could be said to have used the aggressive tactics it did to defend the interests of developers—not because Microsoft is altruistic, but because developers’ interests overlap Microsoft’s own long-run interest. It is hard to see how a software firm can get more

“pro-competitive” than that. Maybe that’s why Microsoft’s rivals have been so critical of Microsoft. Had Microsoft acted like a true monopolist—one that restricted sales to raise its prices—rivals would have applauded because they, too, could then have made more sales at higher prices.

## **How Windows Applications Can Open the Operating-System Market**

Finally, Judge Jackson (and just about everyone else who agrees with his decision) has treated the array of Windows applications as if it were an unmitigated blessing for Microsoft. Without question, as recognized throughout this paper, those applications are an important marketing advantage for the company. At the same time, when considering ways to upgrade Windows, Microsoft must be ever mindful that it cannot move too quickly in its upgrades, or else it runs the risk of disaffecting its program developers who have invested heavily in Windows technology, a problem that has important but easily overlooked negative consequences for Microsoft.

Foremost, Microsoft must restrict (to one degree or another) its upgrades of Windows, as it has done for years in not moving computer users to what the company knows to be superior, more stable operating-system technology, for example, Windows NT (now 2000). If Microsoft readily makes existing applications obsolete with each new release of Windows, it increases the computing costs for consumers, given that consumers then must buy new versions of their applications or work without as many applications. The company would also increase the costs to developers, since developers would then have to rewrite their applications with every new Windows release. As a result, Microsoft would have to invest more to get program developers’ cooperation or would have to lower the price of Windows to keep their allegiance to the Windows platform, or both. That implies that the economics of software

development can militate against Microsoft’s making Windows as good as it could be.

Another way of stating the problem is that Microsoft must ensure that Windows is backward compatible, meaning new versions of Windows can also run applications that were written for earlier versions of Windows (say, Windows 95, if not Windows 3.0). Therefore, Windows will always have many more lines of code than would be required for it to run only the up-to-date versions of applications. Moreover, the current version of Windows will be more complex than would be necessary if Windows did not have to be backward compatible. Those problems explain why Windows is less stable, perhaps slower, than it could be, absent the backward compatibility requirement.

Therein lies the potential for a market opening for new entrants who are unencumbered by having an operating system based on old technology or who do not have to accommodate an array of existing applications. As a consequence, Microsoft has to weigh the ability of new entrants to leapfrog its established operating-system technology in its decisions to exploit what Judge Jackson sees as market power. It must also stand ready to radically revise its operating-system technology in relatively short order when it detects a new technology that shows promise of leapfrogging Windows (which may explain the company’s abrupt change in its operating-system development plans when Bill Gates openly recognized the Internet browser threat in May 1995).<sup>41</sup> Microsoft’s radical revisions can be viewed as protecting not only its own investment but also the investments of consumers and application developers.<sup>42</sup> If Microsoft were to act like the monopolist it has been accused of being, it would give potential new entrants with new technology all the more incentive to invade the operating-system market.

## **Conclusion**

Judge Jackson’s use of the word “barrier” conjures up the image of an impregnable

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fortress. Ironically, Microsoft stands convicted of antitrust violations partially because of the prominence of "applications barrier to entry" in the trial. On close examination, it is not the fortress the judge has made it out to be. If it were, Netscape could not have challenged Microsoft. Microsoft would not have been compelled to respond to Netscape's challenge in the way and to the extent it did. Microsoft could have remained content behind its impregnable barrier. It might never have upgraded Windows to include browsing capability, and it would certainly not have given that capability away.

If Microsoft were the protected monopoly it has been made out to be, it would have charged far more than it has for Windows. There would then have been real harm to consumers, who would have bought fewer copies of Windows at inflated prices. There would then have been real antitrust violations. If Microsoft had acted like a protected monopolist, it might never have achieved its dominant market position and would not have been charged with antitrust violations. Microsoft's market rivals would have applauded its sales restrictions and above-competitive prices because those rivals would have been able to sell more operating systems at higher prices.

The reason that Microsoft has charged no more for Windows than it has, and responded the way it did to the Netscape challenge, is that the so-called barrier to entry made up of 70,000 (or 100,000) applications is a gross exaggeration of just how many up-to-date, available Windows-based applications are in use. Thus, Judge Jackson erred in a major way when he concluded that "the amount it would cost an operating system vendor to create that many applications [70,000] is prohibitively large." If Microsoft had acted like the monopolist the court declared it to be, and if Microsoft's users had demanded the 70,000 applications that Judge Jackson posited, then competitors might indeed have been barred. Fortunately for consumers, none of that is true.

## Notes

The author is indebted to Gary Byrne, Kenneth Elzinga, Robert Levy, Albert Nichols, Alan Reynolds, and William Shughart for their comments and editorial improvements on earlier versions of this paper.

1. Judge Jackson seems to have taken the concept of the "applications barrier to entry" from David Boies, the government's lead attorney on the case, who noted in his opening statement before the court: "In fact, what is being in the driver's seat here is the desire to shut out the Netscape Navigator, and as the court will see when we talk about AOL, they were prepared to do that, even at the extent of disfavoring their own MSN network in competition with AOL, because winning the browser battle was of paramount important and was of paramount importance, I will repeat, for two reasons. One, it represented an ability to reerect the applications programming barrier to entry and, second, it allowed them to gain control of the browser, which was, as they have themselves recognized, the choke-hold on the Internet." *United States v. Microsoft Corporation*, U.S. District Court for the District of Columbia, civil action no. 98-1232 (TPJ), Transcript of Proceedings, June 7, 1999 (A.M. session), p. 61. Cited hereafter as Transcript of Proceedings. In turn, Boies appears to have taken the concept from the direct testimony of the government's two economic witnesses, Franklin M. Fisher and Frederick Warren-Boulton. Fisher called the concept the "applications programming barrier to entry": "For example, if Internet browsers and/or Java in fact threatened to eventually undermine Microsoft's operating system monopoly by eroding the applications programming barrier to entry that protects that monopoly, the economic costs of permitting Microsoft to rebuild that barrier to entry by stifling non-Microsoft browsers and Java will be substantial." *United States v. Microsoft Corporation*, Franklin M. Fisher, Direct Testimony, filed October 14, 1998 <http://www.usdoj.gov/atr/cases/f2000/2057.pdf>.

Similarly, Warren-Boulton testified: "As an operating system gains popularity, the incentive to develop software for that operating system increases because the larger number of users for the operating system product implies a greater potential market for software developers. The development of yet more applications for that operating system, in turn, increases the value of the operating system to end users who, as explained, purchase operating systems in significant part based upon the quality and variety of applications available for it. As Hewlett-Packard's Frank Santos explained, demand for an operating system is driven by the availability

of ‘applications that run on the operating system.’ The operating system’s market share, therefore, is likely to increase, and that, in turn, is likely to cause software developers to devote yet more resources to writing applications for that operating system product. That phenomenon—known in economics as ‘positive feedback’—creates what is best termed the ‘applications barrier to entry.’ Simply put, an operating system product can rise to dominate the market, and once that dominance is achieved maintain it, because of both the large number of complementary software applications available for it and the flow of new applications that are written to it.” *United States v. Microsoft Corporation*, Frederick R. Warren-Boulton, Direct Testimony, filed November 18, 1998, ¶¶ 53–54, [http://www.usdoj.gov/atr/cases/f2000/2079.htm#footbody\\_27](http://www.usdoj.gov/atr/cases/f2000/2079.htm#footbody_27).

Interestingly, while Fisher and Warren-Boulton stake their claim of Microsoft’s monopoly power on the existence of the “applications barrier to entry,” neither ever offers any evidence on exactly how many applications are in the barrier to entry. The closest either gets to an exact count is when Warren-Boulton wrote that Microsoft was intent on “preserving the barrier to entry created by the *large* stock of Windows applications” (¶ 7, emphasis added). He adds later, “[B]arriers to effective entry into the PC operating system market are high, and other PC operating systems cannot easily increase their shares of that market because the huge stock of applications written for Windows 95/98 will not run on those systems” (¶ 43).

2. *United States v. Microsoft Corporation*, Findings of Fact, November 5, 1999, ¶ 54. Cited hereafter as Findings of Fact.

3. Computer users could incur the switching costs but then effectively cover those costs with reductions in the cost of their software.

4. For more details on Judge Jackson’s narrow market definition, See Alan Reynolds, “U.S. v. Microsoft: The Monopoly Myth,” *Wall Street Journal*, April 19, 1999, p. A12.

5. Judge Jackson wrote: “Every year for the last decade, Microsoft’s share of the market for Intel-compatible PC operating systems has stood above ninety percent. For the last couple of years the figure has been at least ninety-five percent, and analysts project that the share will climb even higher over the next few years. Even if Apple’s Mac OS were included in the relevant market, Microsoft’s share would still stand well above eighty percent.” Findings of Fact, ¶ 35. That finding fortifies his earlier finding: “It follows that, if one firm controlled the licensing of all Intel-compatible PC operating

systems world-wide, it could set the price of a license substantially above that which would be charged in a competitive market and leave the price there for a significant period of time without losing so many customers as to make the action unprofitable. Therefore, in determining the level of Microsoft’s market power, the relevant market is the licensing of all Intel-compatible PC operating systems world-wide.” *Ibid.*, ¶ 18. What the judge doesn’t say is that Microsoft’s 95 percent “market share” for the “last couple of years” is not a fact at all. It was introduced early in the trial as a projection of Microsoft’s installed base for the next couple of years. The 95 percent figure bears no relationship to current or future sales. There is no market for DOS operating systems, a point emphasized by Reynolds. In a personal communication on July 21, 2000, Reynolds informed the author that the International Data Corporation puts Microsoft’s market share of current operating system sales, not installed base, at closer to 66 percent.

6. Findings of Fact, ¶ 31.

7. *Ibid.*, ¶ 40.

8. *Ibid.*

9. *Ibid.*, ¶ 47.

10. *Ibid.*, ¶ 40.

11. *Ibid.*, ¶ 36.

12. Judge Jackson found: “Software development is characterized by substantial economies of scale. The fixed costs of producing software, including applications, are very high. By contrast, marginal costs are very low. Moreover, the costs of developing software are sunk—once expended to develop software, resources so devoted cannot be used for another purpose. The result of economies of scale and sunk costs is that application developers seek to sell as many copies of their applications as possible. An application that is written for one PC operating system will operate on another PC operating system only if it is ported to that system, and porting applications is both time-consuming and expensive.” *Ibid.*, ¶ 38.

13. Indeed, Apple’s market share may now be “small” simply because it has tried to act more like a monopolist than Microsoft has. Its premium prices for both hardware and software could have curbed Apple’s sales. And those reductions in sales could have had “network effects,” checking the number of applications written for Apple and thus subsequent sales. In addition, the very fact that Apple has charged premium prices could have caused both computer users and developers justifiable concern about joining the Apple network.

Users and developers may have had reason to believe that Apple would, if it became the standard, act even more like a monopolist in the future, soaking up the gains the users and developers might hope to realize by joining the Apple network.

14. Many of the Windows-based games counted as part of the applications barrier to entry are rapidly becoming obsolete because Internet-based games offer multiuser features not available on single-user computers.

15. At one point, Justice Department attorney David Boies pressed John Rose, "Now, back to the question I started with, there are 70,000 applications, approximately, for the Windows operating system; correct?" Rose then explained, "There are 70,000 PC applications. Not all of them were written for Windows. Some of them go back to the DOS environment and carry forward into the Windows environment. But over the course of the 17 years of the PC industry, there have been approximately 70,000 applications developed, and that continues to grow." Transcript of Proceedings, February 17, 1999 (P.M. session), p. 24.

16. Findings of Fact, ¶ 40.

17. No computer user, no matter how dedicated, would ever attempt to use 70,000 applications (even if that many usable, unique applications were available, which is not the case) over the course of his or her life. If it took an average of 30 minutes for a user to install and learn each application, it would require 35,000 hours to install and learn all 70,000 Windows applications. If the user spent 40 hours a week working only on new applications, it would take 109 years to install and learn them all.

18. Productivity software includes all applications except children's, educational and references, homes and hobbies, and personal digital assistant software. See <http://www.amazon.com/exec/obidos/tg/browse/-/289961/104-4623710-6770356>.

19. For more on the economics of versioning, see Carl Shapiro and Hal R. Varian, *Information Rules: A Strategic Guide to the Network Economy* (Cambridge, Mass.: Harvard Business School Press, 1999), chap. 3.

20. The various versions of software might be equated with given car models with and without luxury or sports packages.

21. Rose's testimony may well have gone unchallenged by Microsoft's lawyers because he was their witness. To challenge him on the count of appli-

cations could have undermined his credibility on other points. By leaving the count unchallenged, however, Microsoft gave the government an opportunity to repeat the 70,000 count several times, which gave the judge all he needed to find the entry barrier that was necessary to make the monopoly charge stick.

Richard L. Schmalensee, Microsoft's chief economic witness, did state in his direct testimony that the relationship between numbers of applications and sales of operating systems is less clear than the government claimed. He pointed out that the Palm operating system had 1,000 applications at the time of his testimony but more than 2 million users. Apple had more than 12,000 applications and 12.5 million users. By contrast, Linux had only 250 applications but 7.5 million users. BeOS had over 900 applications but only 750,000 users. *United States v. Microsoft Corporation*, Richard L. Schmalensee, Direct Testimony, filed January 3, 1999, pp. 53-54, <http://www.microsoft.com/presspass/trial/schmal/schmal.asp>.

The author has searched for studies that show there are 70,000 applications. Microsoft does not have such a study. Interestingly, even Microsoft supporters have used the 70,000 count to bolster their case for Microsoft. For example, syndicated columnist Robert Samuelson wrote, "The world might be better off if there were a universal computer language that allowed applications software to run on any machine. Microsoft's rivals are pursuing such a solution. If they succeed, Windows' position would decline. Until then, standardization around Windows creates benefits. Roughly 70,000 applications are written for Windows, compared with 12,000 for Macintosh." Robert Samuelson, "Consumers Don't Believe They've Been Hurt by Microsoft," *Chicago Tribune*, November 19, 1999, p. 31. Similarly, economist Nicolas Economides concluded: "[D]espite Judge Jackson's best efforts, any breakup is unlikely to increase competition. Justice's original two-way breakup plan was premised on the hope that an autonomous applications company would create a new operating system to compete with Windows. But more than 70,000 applications run Windows, creating what the government calls 'the applications barrier to entry' in the operating-system market. However capable the new applications company, it still wouldn't be able to single-handedly create a successful rival operating system. Separately, even with a new applications company's support, Microsoft's biggest operating-system competitor, Linux, is unlikely to become a serious desktop threat to Windows." Nicolas Economides, "What's Worse Than Two Baby Bills? Three," *Wall Street Journal*, May 26, 2000, p. A22.

22. Microsoft Corporation, "Windows NT Workstation Licenses Exceed 11 Million: Top 18

PC Manufacturers Demonstrate Innovative Windows NT Workstation-Based Solutions in the Microsoft Partner Pavilion at COMDEX,” Press release, Las Vegas, November 17, 1997, <http://www.microsoft.com/presspass/press/1997/Nov97/NTW40Pr.asp>.

23. Perhaps a portion of this applications entry barrier could be surmounted by software. An application is much like “data” that operating systems use to perform various functions, like word processing. That is to say, applications are to operating systems what “data files” are to applications. That means a new operating-system entrant doesn’t necessarily have to write a totally new collection of all the applications its system needs to be a viable competitor. The new entrant can play off the installed base of, say, Windows applications by writing another application (called an “emulator”) that is compatible with the new operating system and can interpret Windows applications for the new operating system. The big disadvantage of that solution is that it introduces another layer of code in the form of another application, which means that the speed of the computer system could be impaired (without an offset in the form of faster computing hardware) and the prospect of errors could increase. Still, computer users could tolerate those problems if their only other option was to use Windows that carried monopoly prices.

24. No attempt was made to develop a count of the unique nonproductivity applications because of the difficulty of deciding which applications should be counted.

25. See the original complaint against Microsoft filed by the government in 1998 (*United States v. Microsoft Corporation*, Joel I. Klein et al., Complaint, May 20, 1998) and the testimony of the government’s chief economic witnesses (*United States v. Microsoft Corporation*, Franklin M. Fisher, Direct Testimony, filed October 14, 1998, <http://www.usdoj.gov/atr/cases/f2000/2057.pdf>, [http://www.usdoj.gov/atr/cases/f2000/2079.htm#footbody\\_27](http://www.usdoj.gov/atr/cases/f2000/2079.htm#footbody_27)).

26. There were 476 MBA students surveyed with 152 responding, for a more-than-respectable response rate of 32 percent.

27. See tables 2.2 and 2.3, along with figure 2.1, in Richard B. McKenzie, *Trust on Trial: How the Microsoft Case Is Reframing the Rules of Competition* (Boston: Perseus, 2000), pp. 40, 42. Product enhancements beginning with Windows 3.0 can be found in table 2.4, p. 43.

28. Findings of Fact, ¶ 408.

29. *Ibid.*, ¶ 409.

30. *United States v. Microsoft Corporation*, Conclusions of Law, April 3, 2000, p. 22 (emphasis added). Cited hereinafter as Conclusions of Law.

31. Findings of Fact, ¶ 408.

32. Judge Jackson proposes that Microsoft be split into two companies, mainly to encourage the new applications company to develop a version of Office Suite for Linux. It would appear from Apple’s experience that an operating-system firm’s having its own version of Office is not necessarily the key to success. The fact that Microsoft has written a version of Office for the Mac operating system indicates that Microsoft is not unalterably opposed to rewriting Office for other operating systems when they gain sufficient market share.

33. The judge admits in his findings of fact that “it is not possible with the available data to determine with any level of confidence whether the price that a profit-maximizing firm with monopoly power would charge for Windows 98 comports with the price that Microsoft actually charges. Even if it could be determined that Microsoft charges less than the profit-maximizing monopoly price, though, that would not be probative of a lack of monopoly power, for Microsoft could be charging what seems like a low short-term price in order to maximize its profits in the future for reasons unrelated to underselling any incipient competitors. For instance, Microsoft could be stimulating the growth of the market for Intel-compatible PC operating systems by keeping the price of Windows low today. Given the size and stability of its market share, Microsoft stands to reap almost all of the future rewards if there are yet more consumers of Intel-compatible PC operating systems. By pricing low relative to the short-run profit-maximizing price, thereby focusing on attracting new users to the Windows platform, Microsoft would also intensify the positive network effects that add to the impenetrability of the applications barrier to entry.” Findings of Fact, ¶ 65. In short, even if Microsoft is not charging monopoly prices now, it is still in violation of the antitrust laws because there is a “dangerous probability” that it will charge monopoly prices in the future. The judge concluded: “Even if the first two elements of the offense are met, however, a defendant may not be held liable for attempted monopolization absent proof that its anticompetitive conduct created a dangerous probability of achieving the objective of monopoly power in a relevant market. The evidence supports the conclusion that Microsoft’s actions did pose such a danger.” Conclusions of Law, p. 23 (citation omitted).

34. More precisely, Judge Jackson made this point

several times in his findings of fact: “To the extent that developers begin writing attractive applications that rely solely on servers or middleware instead of PC operating systems, the applications barrier to entry could erode. As the Court finds above, however, it remains to be seen whether server- or middleware-based development will flourish at all. Even if such development were already flourishing, it would be several years before the applications barrier eroded enough to clear the way for the relatively rapid emergence of a viable alternative to incumbent Intel-compatible PC operating systems. It is highly unlikely, then, that a firm not already marketing an Intel-compatible PC operating system could begin marketing one that would, in less than a few years, present a significant percentage of consumers with a viable alternative to incumbents.” Findings of Fact, ¶ 32.

35. Judge Jackson explains “network effects” in this way: “Consumer demand for Windows enjoys positive network effects. A positive network effect is a phenomenon by which the attractiveness of a product increases with the number of people using it. The fact that there is a multitude of people using Windows makes the product more attractive to consumers. The large installed base attracts corporate customers who want to use an operating system that new employees are already likely to know how to use, and it attracts academic consumers who want to use software that will allow them to share files easily with colleagues at other institutions. The main reason that demand for Windows experiences positive network effects, however, is that the size of Windows’ installed base impels ISVs to write applications first and foremost to Windows, thereby ensuring a large body of applications from which consumers can choose. The large body of applications thus reinforces demand for Windows, augmenting Microsoft’s dominant position and thereby perpetuating ISV incentives to write applications principally for Windows. This self-reinforcing cycle is often referred to as a ‘positive feedback loop.’” Ibid., ¶ 39.

36. Calculating how many consumers use Navigator is difficult because many users buy their computers already loaded with both Navigator and Internet Explorer. But a rough estimate can be made. There are currently more than 300 million Web users in the world. See Marc Saltzman, “Searching on a Sea of Web Pages: Specialized Sites Evolve to Better Help Surfers Find Bearings,” *USA Today*, January 13, 1999, p. 4D. If Navigator is used by only a quarter of those users—the low end of the commonly reported Netscape market share—there would be 75 million or more Navigator users worldwide.

37. Judge Jackson suggested that Microsoft might have charged a monopoly price for its operating system, but he based his argument on nothing more than an internal study stating that a Windows 98 upgrade could profitably have been sold for \$49 rather than its actual price of \$89. Findings of Fact, ¶ 63 (“[I]t is indicative of monopoly power that Microsoft felt that it had substantial discretion in setting the price of its Windows 98 upgrade product. . . . A Microsoft study from November 1997 reveals that the company could have charged \$49 for an upgrade to Windows 98—there is no reason to believe that the \$49 price would have been unprofitable—but the study identifies \$89 as the revenue-maximizing price”). Judge Jackson must have realized that the internal study was a thin reed on which to rest such an inference; he omitted any mention of monopoly price gouging from his conclusions of law.

38. See Stan J. Liebowitz and Stephen E. Margolis, *Winners, Losers and Microsoft: Competition and Antitrust in High Technology* (Oakland, Calif.: Independent Institute, 1999), chaps. 7–9.

39. There is actually a strong argument for allowing firms in markets for network goods to “exploit” consumers who are “locked in” because of “switching costs.” The ability of a firm to engage in such “exploitation” can lead to lower up-front prices for consumers and a greater variety of more sophisticated applications. That argument is detailed in Dwight R. Lee and Richard B. McKenzie, “The Case for Letting Firms Exploit Network Effects and ‘Locked-In’ Customers,” Graduate School of Management, University of California, Irvine, working paper, 2000.

40. Conclusions of Law, p. 8.

41. See Bill Gates, “The Internet Tidal Wave,” memorandum, May 26, 1995, the Justice Department’s exhibit 20, p. 1, [http://www.usdoj.gov/atr/cases/ms\\_exhibits.htm](http://www.usdoj.gov/atr/cases/ms_exhibits.htm). In that memo to his executive staff, Gates radically upgraded company-wide interest in and commitment to the Internet, outlining both the threats and the opportunities the Internet presented. He insisted that his executive staff give the Internet the “highest level of importance.” Indeed, in that memo, as in his 1995 book, Gates equated the importance of the Internet to Microsoft with the development of the first IBM PC and asked all company divisions to rethink and redesign their products with the Internet in mind, indicating the problems Microsoft would face in playing catch-up to existing Internet players and noting that the proposed network computer was a “scary possibility.” Later in 1995 in an Internet strategy workshop, Gates once again insisted that the company had to, in effect, turn on the proverbial dime to make

the company's operating system and applications Internet ready. Bill Gates, "Internet Strategy Workshop Keynote," internal Microsoft memorandum, Decembser 7, 1995.

42. The problem Microsoft faces—how radically it can and should upgrade its operating system to discourage potential competitors—is one shared by many successful firms wedded to proven tech-

nologies that they have efficiently exploited for a long time. See Michael L. Tushman and Charles A. O'Reiley III, "The Ambidextrous Organization: Managing Evolutionary and Revolutionary Change," *California Management Review* 38, no. 4 (Summer 1996): 1-23; and Clayton M Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Cambridge, Mass.: Harvard Business School Press, 1997).

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