An Expensive Pig in a Poke: Estimating the Cost of the District Court's Proposed Breakup of Microsoft[*]

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I.   Executive Summary

❑ The remedy proposed by the government and adopted by the judge in the Microsoft case is likely to increase software prices to consumers, impose additional costs upon software developers, retard innovation in the operating system, reduce competition in the workstation/server marketplace, and lead to confusion and frustration among consumers who will be purchasing computers with non-standardized operating systems.

❑ Breaking Microsoft into two companies, and changing its ownership structure and management is likely to alter its pricing strategies. If the new application company adopts pricing more consistent with typical software firms, and the new operating system company adopts a different pricing strategy, particularly one consistent with the government's economic theory of the case, prices would be expected to rise.

  ❑ **Software price increases would cost American consumers an additional $50 billion over a three year period, and might cost as much as $125 billion** if the two new companies completely turn their back on the prior pricing strategy of Microsoft. **Worldwide, consumers are likely to pay an additional $125 billion, or in the more extreme case, perhaps as much as $310 billion.**

❑ Competition will be reduced in non-desktop markets, particularly the server/workstation/database market and the game console market. This will raise costs to consumers in these markets.

❑ Software Developers will face higher costs. Although it is difficult to put a precise figure on these additional costs, **it is possible that over three years they might be as large as $25 billion in the US or $55 billion worldwide**. Some of these additional costs will be passed on to consumers, others will be borne by the software producers, with some producers being driven out of business.

❑ Improvements to the operating system will diminish since the financial incentive to improve Windows will be weakened.

❑ Consumers will have higher search costs and are more likely to regret their purchase decisions when Windows can no longer be counted on to be a standard that is the same on all machines.

II.   Introduction

Although the Microsoft antitrust trial is still in the appeals process, the district court has pronounced its proposed remedies. The judge and the plaintiffs have claimed that these remedies will help consumers by instilling greater competition in the market. My focus in this report is to examine the costs of such a breakup to consumers, developers, and society at large to better gauge the true impact of the remedy.

The analysis below details the nature and extent of damage that will be caused by Judge Jackson's remedy. The remedy will hurt consumers because they will very likely have to pay higher prices for software previously sold by a single company operating under a single-mindedly focused regime of low pricing, now broken into two separate companies with unknown pricing strategies. This is true in both the market for operating systems, where the potential additional costs are enormous, as well as in the market for software applications. Consumers will also be burdened with a less predictable software environment, forgoing some of the benefits of participating in a large compatible network that they had voluntarily chosen. Software developers are likely to incur extra costs in developing and supporting programs to run under versions of Windows that will have different levels of compatibility. The most severely hurt of these are likely to be small software producers who will be less able to cover the additional costs of creating software in this more complex environment, and who will be forced by higher costs to leave the industry in disproportionate numbers. Innovation in the operating system is likely to be severely retarded by this remedy, as is competition in the high end server/workstation market.

It is impossible to discuss the costs of the breakup without an understanding of the remedy itself. The next section outlines the basic nature of the remedy designed by the Department of Justice and approved by Judge Jackson.

III.   Some Details of the Breakup

Some aspects of the remedy are open to dispute and some have already been disputed, making the task of predicting the impacts of the remedy more difficult. The remedy itself contains two components. First, there is the highly-publicized structural component of the remedy, breaking

Microsoft into two separate companies—an applications company (AppCo) and an operating system company (OpCo). [1] This structural component also includes certain behavioral components—e.g., restricting the two companies from recombining, or doing business with one another—that have a duration of not less than ten years.[2] The details of the remedy contain provisions that magnify the costs beyond what they would otherwise be.

The remedy also contains a separate set of conduct restrictions with a duration of three years. Many of these provisions also have the potential to impose large costs on Microsoft, computer users, and competition itself. [3]

The proposed division of assets and products, in combination with the restrictions on the two companies doing business with one another (Provision 2.B.ii) is not congruent with a rational separation of an AppCo from an OpCo. [4] For example, in section 7 of the remedy, which contains definitions, we find:

> 7.c. "Applications Business" means all businesses carried on by Microsoft Corporation on the effective date of this Final Judgment except the Operating Systems Business. Applications Business includes but is not limited to the development, licensing, promotion, and support of client and server applications and Middleware (e.g., Office, BackOffice, Internet Information Server, SQL Server, etc.), Internet Explorer, Mobile Explorer and other web browsers, Streaming Audio and Video client and server software, transaction server software, SNA server software, indexing server software, XML servers and parsers, Microsoft Management Server, Java virtual machines, Frontpage Express (and other web authoring tools), Outlook Express (and other e-mail clients), Media player, voice recognition software, Net Meeting (and other collaboration software), developer tools, hardware, MSN, MSNBC, Slate, Expedia, and all investments owned by Microsoft in partners or joint venturers, or in ISVs, IHVs, OEMs or other distributors, developers, and promoters of Microsoft products, or in other information technology or communications businesses.

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[1] Here is the text: 1.c The Plan shall provide for the completion, within 12 months of the expiration of the stay pending appeal set forth in section 6.a., of the following steps: 1.c.i. The separation of the Operating Systems Business from the Applications Business, and the transfer of the assets of one of them (the "Separated Business") to a separate entity along with (a) all personnel, systems, and other tangible and intangible assets (including Intellectual Property) used to develop, produce, distribute, market, promote, sell, license and support the products and services of the Separated Business, and (b) such other assets as are necessary to operate the Separated Business as an independent and economically viable entity.

[2] Sections 2.b.i and 2.b.ii.

[3] For the complete text go to: http://www.microsoft.com/presspass/trial/jun00/06-07finaljudg.asp

[4] The restrictions on trade found in 2.b.ii should be unnecessary since the point of a breakup is that each company would then have a fiduciary duty to maximize its own profits. As such, each company would be expected to take actions that are in its own self-interest.

As a practical matter, therefore, the Application Business gets everything except the very narrowly defined operating systems, even if it would make better economic sense and increase competition if some 'applications' that are very closely tied to the operating system remain with the operating system company, as I discuss in more detail later in the report.

IV.   The Likelihood of Higher Software Prices.

Software prices are likely to rise if this remedy is allowed to take effect. Operating system prices will rise, as will application prices.[5] The reason for these likely price increases is that the two new companies that replace the single integrated Microsoft are likely to pursue somewhat more common business strategies. In particular, one or both companies are likely to abandon Microsoft's low price strategy, particularly if the government is correct in its claim that Microsoft has a monopoly in operating systems, to which I now turn.

I must note that this case is a very politicized event. In the event that the breakup takes place, the Department of Justice will undoubtedly attempt to place pressure upon the two government created entities to act in a way that makes the remedy look beneficial to consumers. The Justice Department has the many other aspects of the remedy that it can use as a cudgel against the two entities should they act differently than predicted by the Department of Justice. My analysis, on the other hand, largely ignores such coercion, but I generally assume that prices rise less than the simple economics would suggest, in part to be conservative and in part to take account of factors such as government coercion.

A.   Price of Windows Rising toward Profit Maximizing Level.

There are several reasons to believe that the price of Windows would rise. As has been noted in a declaration by the government's expert Carl Shapiro, and in an Amici brief by Litan, Noll, Nordhous and Scherer, there is a well-known problem that economists refer to as double marginalization.[6] The double marginalization problem occurs when two firms, each with market power, produce complementary products. Each firm attempts to charge a markup that would maximize its profits, taking the other firm's markup as given, and in so doing the price for the two combined goods contains

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[5] I examine some government claims to the contrary in section IV.

[6] Page 49 of the Amici brief contains a discussion of the double marginalization problem, as does page 14 of the declaration of Carl Shapiro.

a higher markup than if a single firm had set a profit maximizing markup for the two goods jointly.[7] Thus, if one believes that both the AppCo and the OpCo will have market power, prices after the breakup would be expected to increase.

Although Microsoft might have market power, it has not in the past exercised this power, as I demonstrated in my book with Steve Margolis.[8] Thus, this theoretical possibility of double marginalization does not, in my opinion, shed much light on the potential pricing problem likely to be unleashed by this remedy. The problem is not that two firms will exercise market power instead of one, the essence of double marginalization, but instead is that one or both of the new firms will exercise market power where none was exercised before.[9]

The recent and current price of Windows, by any reasonable estimate, is now far below what the profit maximizing monopoly price would be, as even the government's own economists testified.[10] During the trial, Richard Schmalensee, testifying for Microsoft, estimated that the profit-maximizing price was between $900 and $2000, assuming the average price of a computer to be $2000.[11] It has been recently re-estimated by economists less friendly to Microsoft, who concluded that the profit-maximizing price of Windows would be $813. This latter price is too low since it depended on the price of computers, which they assumed to be an unreasonably low $1000.[12] I am going to assume

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[7] Simply put, there is a price for the two items which together maximizes profits for the two firms taken together as a team. Under double marginalization, however, instead of each firm taking its 'fair' share of the maximum joint profits, each one tries to obtain almost 100% for itself, raising the price of the joint product above the profit maximizing level and lowering the profit for both firms.

[8] Microsoft has acted as a relentless provider of low priced products. See Chapters 8 and 9 in Stan J Liebowitz and Stephen Margolis, *Winners, Losers & Microsoft: Competition and Antitrust in High Technology,* Independent Institute, Oakland CA, 1999.

[9] This is not inconsistent with the Judge's finding of monopoly since the legal standard merely requires the possession of monopoly power, not its exercise. Whether this is the proper standard, from an economic point of view, is an open question.

[10] See the testimony of Franklin Fisher, page 18, January 12, 1999. Professor Fisher draws the distinction between *exercising* monopoly power and *having* monopoly power, with the latter being all the law cares about in declaring a monopoly. The evidence on software pricing, as revealed in *Winners, Losers & Microsoft,* strongly indicates that Microsoft doesn't exercise monopoly power even in markets where it has a dominant market share..

[11] January 20th 1999 testimony, page 43.

[12] Chris E. Hall and Robert E. Hall, "Toward a Quantification of the Effects of Microsoft's Conduct" American Economic Review, May 2000, Vol. 90: 2, pp 188-91. Although their web page claims they are neutral, I suspect that their predilections might lean against Microsoft because they go on to assume that Microsoft charges a price above the competitive level and then further quantify this assumption even though there is no support for their assumption that Microsoft overcharges consumers. Additionally, Robert Hall has used very similar models before, representing plaintiffs in antitrust cases (e.g., Concord Boat). See also Reddy, Bernard J., Evans, David S. and Nichols, Albert L. "Why Does

throughout this report that the world-wide price for a PC is $1700, the number reported by IDC in 1999, which would raise the Hall's estimate to a level in line with Schmalensee's estimate.[13]

Even the most simple economic analysis makes it obvious that the *monopoly price* for a computer operating system would have to be a reasonably large proportion of the total cost of a computer. Otherwise any given percentage price increase in the cost of the operating system would have a much smaller percentage increase in the price of the computer (which includes the operating system), leading therefore to a relatively small percentage decrease in sales in computers, and thus an increase in profits for the OS monopoly.[14] This is particularly true given that the cost of the computer is often considered only a small percentage of the total cost of computer ownership for corporations. Training and support are usually larger costs than the computer itself, so that the cost of the operating system as a share of the total cost of computer services is much smaller even than its share of the cost of the computer.

The relationship between Windows' share of the cost of a computer and the profitability of a Windows price increase is illustrated in Table 1. This table requires some explanation. The leftmost column lists different assumed shares of the cost of Windows in the price of a computer. Thus, if a computer sold for $500, and the computer manufacturer had to pay $50 for Windows, Windows would account for 10% of the computer's price.[15] The second column assumes that the owner of Windows is considering a 1% increase in the price of Windows and calculates what the impact would be on the price of the computer. This is merely one percent of the first column. An increase in the price of computers naturally leads to a decline in the number of computers sold according to the law of demand, otherwise the price increase would by necessity increase profits for the seller of Windows.

The third column reports the minimum percentage decrease in the number of computers sold (and therefore also measures the decrease in the number of copies of Windows sold) that would more than offset the 1% price increase and thus lead to a reduction in revenues and profits for the seller of

Microsoft Charge So Little for Windows?" mimeo, National Economic Research Associates Inc., Cambridge MA, January 1999.

[13] IDC "WW Quarterly PC Tracker," Jul 21, 2000.

[14] This is just a simple example of an old and famous analysis of derived demand by Alfred Marshall (Bk 5, chapter 6) showing that the derived demand for a factor used in fixed proportions is less elastic the smaller the fraction of costs that goes to that factor.

[15] For simplicity's sake, I assume the OEM does not place a markup upon Windows.

Windows.[16] This is simpler than it sounds. Assume that 1,000,000 computers are sold (and thus 1,000,000 units of Windows). If the price of Windows increases by 1%, say from $50 to $50.50, and if the quantity falls by .99%, (9900 units, do not ignore the decimal point!), to 990,100 units, then the revenue remains at $50,000,000.[17] If the quantity of computers falls by more than this, then revenues and profits of Windows decrease. Alternatively, if the quantity of computers falls by less than .99%, then the price increase in Windows will be profitable.

The point of the table is to illustrate why it is that price increases are more likely to be profitable, the smaller is the share of Windows in total cost. This is done in the rightmost column. This column merely divides column 3 by column 2. This rightmost column actually measures the minimum responsiveness of consumers with respect to computer prices required to keep the Windows price increase from being profitable.[18] The first row of this table, for example, indicates that if Windows accounts for only 5% of the price of computers, then a 1% increase in the price of Windows will be profitable unless consumers reduce their purchases of computers by at least 19.8% in response to this 1% price increase. One doesn't have to be an economist to understand how unlikely it would be for consumers to respond so dramatically to this very small price increase. Thus, a monopolist would find it advantageous to raise the price of Windows in these circumstances.

As Windows' share of the cost of a computer increases, the minimum responsiveness that would make a price increase unprofitable falls. Row 2 shows that if Windows were 10% of the cost of a computer, it would still be profitable to continue raising price unless a 1% increase in price would lead to at least a 9.9% reduction in the quantity of computers sold, still an unlikely high level of consumer responsiveness to price change.[19] After all, does it seem remotely possible, for example, that a 3% increase in price would lead to a 30% decrease in the number of computers sold?

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[16] I assume that there is a fixed cost in creating Windows, but no (variable) cost in producing additional units.

[17] There is a minor rounding error since the number in column 3 should actually be an infinite repeating series of nines and zeros.

[18] It measures what economists call price elasticity of demand for computers, but in this table it is the specific minimum elasticity required to make a Windows price increase unprofitable.

[19] The paper by Hall and Hall mentioned above takes a value of 2 as a reasonable measure.

Table 1			
Window's share of total cost	Impact of a 1% increase in the price of Windows on the price of a computer	Required % decrease in number of computers sold to make the increased Windows price unprofitable	Minumum decrease in computer purchases brought about by a 1% price rise in computers that would cause a Windows price increase to be unprofitable
5%	0.05%	0.990%	19.8%
10%	0.10%	0.990%	9.9%
15%	0.15%	0.990%	6.6%
20%	0.20%	0.990%	5.0%
25%	0.25%	0.990%	4.0%
30%	0.30%	0.990%	3.3%
35%	0.35%	0.990%	2.8%
40%	0.40%	0.990%	2.5%
45%	0.45%	0.990%	2.2%
50%	0.50%	0.990%	2.0%
55%	0.55%	0.990%	1.8%
60%	0.60%	0.990%	1.7%
65%	0.65%	0.990%	1.5%
70%	0.70%	0.990%	1.4%
75%	0.75%	0.990%	1.3%
80%	0.80%	0.990%	1.2%
85%	0.85%	0.990%	1.2%
90%	0.90%	0.990%	1.1%

It is not until Windows accounts for 30% or more of the cost of a computer that the minimum responsiveness starts to reach remotely plausible levels that might be consistent with a price increase in Windows decreasing profits. Remember that Windows currently accounts for less than 5% of the cost of a typical new computer, so we are talking about more than six-fold increase in the price of Windows.[20]

This table makes clear that if Windows really had the monopoly that the government and judge assigned to it, its price would be expected to increase if the owner of Windows adopted a profit maximizing strategy. Although there is no certainty that the new owner of Windows would adopt a more aggressive pricing strategy, as a matter of logical consistency it *must* be the case that the new Operating System company raise the price of Windows, if it were to maximize profits and *if the plaintiffs' theory of the case were correct.*

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[20] I assume that the price of Windows is $50. During the trial, Professor Fisher stated that the price of Windows was approximately $50 (page 16 of his testimony on January 12, 1999, 2:05 p.m.).

Even if we view the characterization of Microsoft's monopoly power by the judge and plaintiffs as a gross exaggeration, however, it still seems likely that Microsoft is charging too little for Windows. How is this to be explained? I believe that examining Microsoft's pricing strategies in other markets, such as applications, provides the key. In those markets, as I discuss in section B below, Microsoft is responsible for lower prices than has been typical for other firms in the software industry. It is certainly possible, given Microsoft's great overall success with its low-price strategy, that it has charged too low a price for Windows. Or alternatively, it might be that most other software firms fail to maximize their long-run profits, underestimate potential competitors, and charge too high a price.

Profit maximization is an assumption that economists make and is one that provides good predictions about markets. Nevertheless, it is certainly the case that at any point in time many firms fail to maximize their profits. Firms might fail to keep their costs as low as possible, or fail to manage their employees properly, or fail to provide consumers with products that best meet their needs. Picking the best price is just one component of maximizing profits. That is one reason that firms pay consultants, even economists, for advice. Often a failure to maximize profits will cause firms to be driven out of business or taken over by other firms whose managers are better able to maximize profits.

It is possible that success in non-pricing aspects of a business would allow a firm to prosper even if it doesn't charge the profit maximizing price. That might help explain how Microsoft, with motivated employees, good products, and low costs, might have failed to charge the profit maximizing price for Windows and still have been enormously successful.

The potential costs to consumers from an increase in the price of Windows—whether because Microsoft charged too little, or because Microsoft's replacement OpCo is likely to charge too much— could be enormous, as illustrated in Table 2. Table 2 takes the number of Windows PCs sold in the US and the world, and then assumes that the price of Windows increases by either $50, $250, $500, or $1000. Even the $1000 increase in the price of Windows, leading to a final Windows price of $1050, and a final computer price of $2750, represents a case where Windows accounts for 39% of the computer's price, well within the estimated profit maximizing *monopoly* price of Windows. Table 2 then takes this increased price of Windows and multiplies it by the number of computers sold in 1999, or those likely to be sold in the three-year period 2000-2002.

Table 2: Additional Costs to Consumers from Higher Windows Price (Billions)				
	In US in 1999	In US 2000-2002 assuming 15% growth rate.	Worldwide in 1999	Worldwide 2000-2002 assuming 15% growth rate.
Number of PCs sold (in millions)	45.10	180.09	113.32	452.53
Extra Cost Assuming Windows Rises by $50	$2.18	$8.71	$5.48	$21.88
Extra Cost Assuming Windows Rises by $250	**$9.54**	**$38.10**	**$23.97**	**$95.73**
Extra Cost Assuming Windows Rises by $500	$16.11	$64.32	$40.47	$161.62
Extra Cost Assuming Windows Rises by $1000	$22.55	$90.04	$56.66	$226.27
Data on PC sales come from the IDC PC Tracker database. IDC estimates yearly growth in 32-bit Windows operating systems and subsystems revenues of 18.9% from 1998-2003. See Table 6, page 15, System Software and Utilities: 1999 Worldwide Markets and Trends, Analysts: R. Paul Mason, Dan Kusnetzky, and Philip Mendoza, IDC 1999. IDC also estimates number of PCs shipped to increase by 17% a year from 1999 to 2001.				

Obviously, as the price of Windows increases, so will the price of computers, causing a decrease from the current prognostications of the number of computers sold. Table 2 adjusts the number of computers downward to account for this effect, using a reasonable 'guess' about how responsive consumers might be.[21] Of course, those consumers deterred from purchasing a Windows computer by its now higher price are also harmed, thus making the estimates in Table 2 *underestimates* of actual consumer harm.[22]

Interpretation of Table 2 is quite straightforward. For example, row 2 presents the additional costs to consumers from a fivefold ($250) increase in the price of Windows.[23] This second row is in boldface, indicating that I am taking these results as my best estimate. Note that this is extremely conservative. If Windows rises to $300, as assumed in row 2, it still represents merely 16% of the cost

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[21] With the $50 increase in Windows, the number of computers is assumed to fall by 3.28%; 15.38% for the $250 increase; 28.57% for the $500 increase; 50% for the $1000 increase. These values fall into the top of the bottom half of table 1.

[22] Since Windows was their preferred choice, consumers are harmed. The amount of harm might be ameliorated somewhat by their switching to Macintosh or Linux computers, but if Judge Jackson is to be believed, these are poor substitutes and thus offer little abridgement of these harms.

[23] These additional costs to consumers are not a measure of inefficiency, or cost to society. They represent higher prices that are paid from consumers to producers. Inefficiency would be caused by the reduced output caused by the higher prices. Footnote 21 indicates a 15% reduction in quantity associated with the five-fold price increase, and any social inefficiency would have to do with the reduction of that output. Still, defenders of the proposed breakup claim that it will be good for consumers. That is why the focus here on the impacts on consumers is apropos.

of a computer. Table 1 indicated that at this share of costs, the profit maximizing Windows price would almost certainly be higher than $300. *The bottom row of table 2, with three-year US costs of $90 billion and worldwide costs of $225 billion, would be a far better estimate if Windows were truly the monopoly the government made it out to be.* I choose the lower values in table 2 in part to be conservative, in part because neither Microsoft nor the replacement OpCo will have the level of monopoly power the government attributes to Windows, and in part because of the government's likely attempts to keep the OpCo from pursuing its bests interests when that makes the antitrust action appear to be a mistake.

What row 2 of Table 2 tells us is that consumers in the US are likely to pay an additional $38 billion, and worldwide consumers are likely to pay an additional $95 billion during a three year period. Even the relatively miniscule $50 increase in the price of Windows imposes almost $9 billion in additional cost to American consumers and $22 billion to consumers worldwide

B. Price of Applications Rising to more Typical Levels.

A detailed analysis of Microsoft's pricing clearly demonstrates that Microsoft's behavior in application markets can be classified as that of a price cutter, or a firm following a low-price strategy.[24] After the breakup, new leadership will exist in one or both companies and each will have to choose a pricing strategy. It is impossible to know in advance what pricing strategies will be adopted by these companies. Although it is possible that both the OpCo and AppCo will follow the same type of low price strategy used by Microsoft, it is likely that at least one, and perhaps both companies, will adopt a different, higher-price strategy, perhaps due in part to the double marginalization factor mentioned earlier.

An instructive example of the impact of Microsoft on price can be taken from the word-processor and spreadsheet market. Figure 1 illustrates average prices for these two markets (in the IBM compatible market).

Although the primary feature of this chart is the very large overall fall in prices, this fall in prices is anything but constant throughout the period. From 1986 until about 1992, prices were either constant

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[24] See Chapters 8 and 9 in Stan J Liebowitz and Stephen Margolis, *Winners, Losers & Microsoft: Competition and Antitrust in High Technology,* Independent Institute, Oakland CA, 1999.

or rising slightly in the word-processing market and from 1986 until 1990 were essentially constant in the spreadsheet market. It was only beginning in 1991 and 1992 that prices fell in a very dramatic fashion.

Fig. 1: Word Processor & Spreadsheet Prices

Source: S. Liebowitz and S. Margolis,: *Winners, Losers and Microsoft: Competition and Antitrust in High Technology, 1999,* Independent
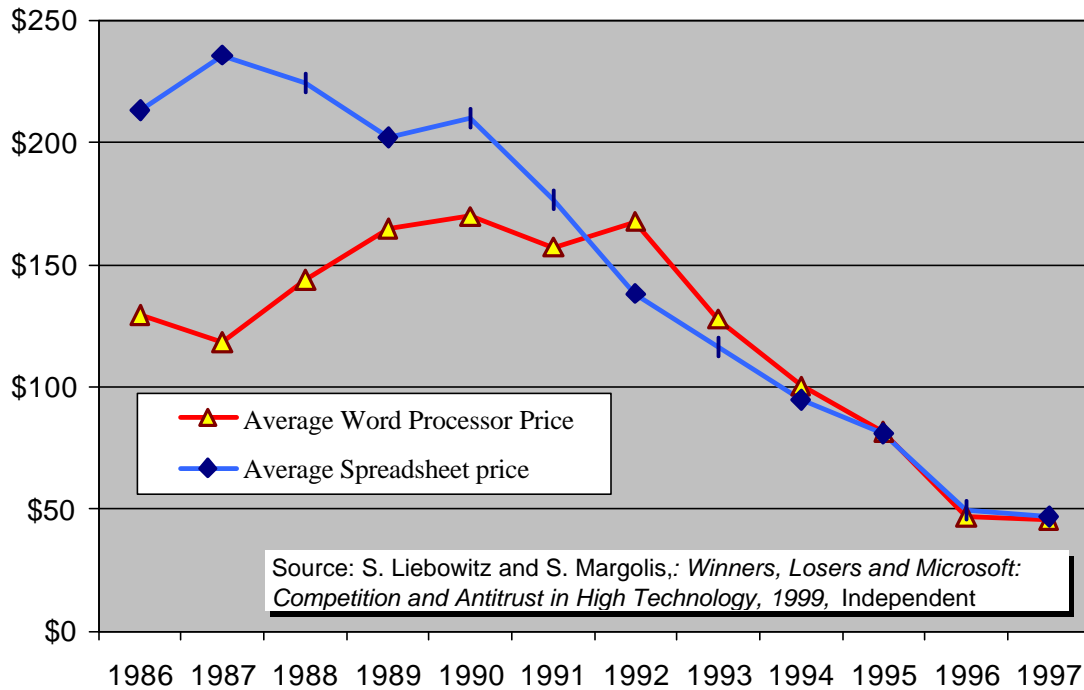
It is accurate to describe the early period as the Lotus era in spreadsheets and the WordPerfect era in word-processing since those firms were dominant in their respective markets. Lotus and WordPerfect picked prices that in retrospect seem high, but which seemed quite normal at the time. The consistency of prices during their reign indicates that there was no reason to believe that prices would fall as time progressed. When Microsoft became the dominant player in these markets, however, pricing changed, to the benefit of consumers.

Of course, the important question is whether prices fell in these markets because of Microsoft or whether some outside factor causing prices to fall just happened to coincide with Microsoft's ascendance in these markets. The evidence supports the view that the decline in prices is due to Microsoft's pricing strategy, implying that if the new government created AppCo changes that strategy, prices may well increase.

The support for the view that Microsoft is responsible for a great deal of the price decreases in software comes from examining the prices of various categories of software and comparing the trends of prices in the markets where Microsoft competes to the trends in prices in markets where Microsoft does not compete. After all, it is possible that the pricing pattern in Figure 1 was just a common response in many markets to some external event that had nothing to do with Microsoft.

It is possible to perform a test of this claim. Dataquest provides fairly consistent market definitions for 14 desktop application software markets for the period 1988-1998.[25] I was able to calculate the average price in each category for each year, treating changes in this 'average price' as if they represented changes in prices for the underlying products.[26]

Figure 2: Yearly Price Changes

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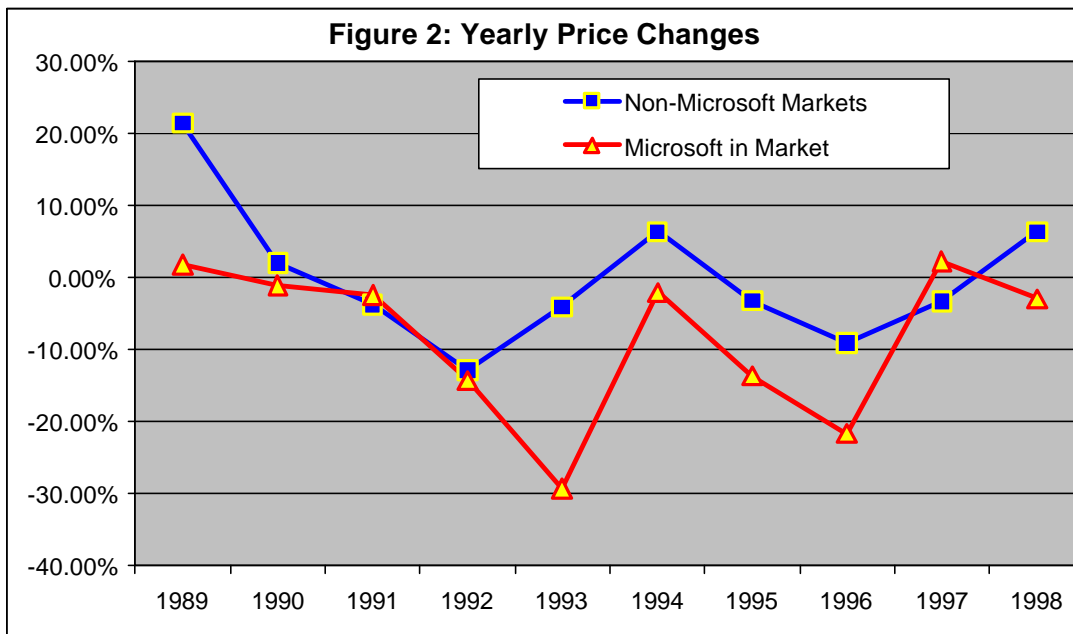
[25] The categories are: accounting, draw and paint, forms, utilities/application, communication, personal finance, presentation graphics, spreadsheets, word processors, database, project management, integrated software, high-end desktop publishing and midrange desktop publishing.. I manually created high-end and midrange desktop publishing by including Microsoft, Timeworks, PowerUp, and Spinnaker in midrange and Quark, Aldus, Adobe, Ventura (Corel) and Frame in high-end.

[26] Average 'prices' calculated in this manner might not reflect actual prices. For example, shifts across products within a category might change the average price even if each price remained constant. I assume that such shifts are either minimal, or similar across product categories.

Next, markets were separated into those in which Microsoft competed and those where Microsoft did not compete.[27] Not every market had useful data for every year. I calculated the yearly price change for each market and then found the average change in price for each year in each category (each application market is given an equal weight). The average yearly price change for the two categories of software applications is found in Figure 2.

Although Figure 2 reveals some general tendency for prices to decline over time (note that almost all yearly changes are negative), the more important result is that prices fell more or rose less, as the case may be, in the markets where Microsoft competed. Only in 1991 and 1997 was this not the case, and in 1991 the the two groups had nearly identical changes in price. This supports the earlier result from the spreadsheet and word-processor markets that Microsoft generates lower prices for consumers.

To get some idea of the cumulative impact of this differential pricing, I calculated what would happen to a typical piece of software priced at $100 in 1988 given the yearly changes in price found in these two categories of software.

Figure 3: Normalized Price Changes

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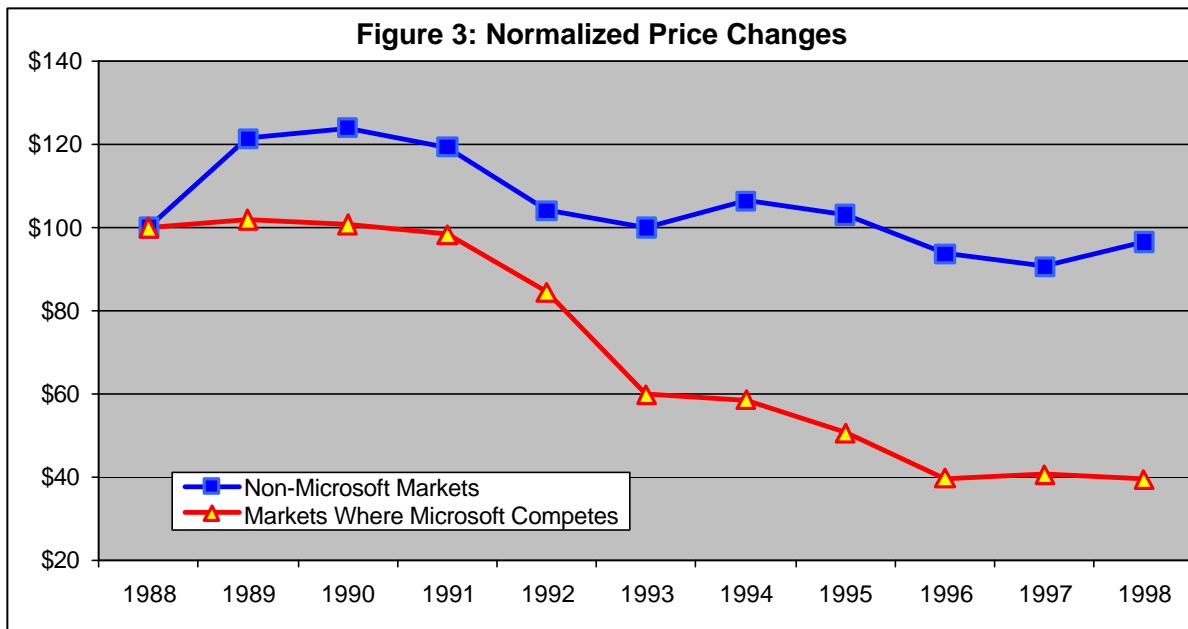
[27] The categories where Microsoft competes are: midrange desktop publishing, personal finance, presentation graphics, spreadsheets, word processors, database, project management, integrated software, utilities, and communication, the last two competing with the Windows operating system. The categories where Microsoft does not have an entry are: accounting, draw and paint, high-end desktop publishing, and forms.

The results are shown in Figure 3. At the end of the eight-year period, the $100 price fell by 60% in markets where Microsoft competed, but hardly at all in markets where Microsoft did not compete.[28] Note that the price decline attributed to Microsoft is not trivial. If all the price cutting that Microsoft had engaged in were to be undone, so that software prices in markets where Microsoft competes were to have fallen only to the extent that prices in non-Microsoft markets had fallen, then software prices in Microsoft's markets could be expected to more than double. This is not a small impact.[29]

Further, there is no evidence of Microsoft raising prices even when market shares above 99% were achieved, as in the Macintosh spreadsheet market. This pattern of very low pricing on Microsoft's part occurred in other markets after Microsoft achieved a very large market share, such as midrange desktop publishing.

Table 3   presents the additional costs that would be imposed upon consumers if software prices were to unravel back to the levels associated with the non-Microsoft pricing strategies. The data in this table are based upon Microsoft's products only, understating the likely size of the market since it ignores the other firms competing with Microsoft who would be expected to follow Microsoft's lead and raise prices in response to Microsoft's price increase. It should also be noted that an increase in price, the way I am using the term, does not mean that prices need actually rise, but merely that they not fall as much as they otherwise might have fallen.

Figures 2 and 3 reported average prices. The data in table 3, however, are based on revenues. I assume that any percentage increase in price will increase costs to consumers by the same percentage, which is the same as assuming that the number of units sold remains constant. Clearly, this is not true since the higher price will reduce the quantity of output sold. Those who continue to purchase the product will have their costs go up by the percentage increase in price. Those who no longer purchase the product lose the 'surplus' that they received at the lower prices.[30] By applying the percentage

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[28] A reader familiar with the *Winners, Losers & Microsoft* might not a small difference between these results and the ones reported there. Not only does this chart go two additional years, but I also made a small change in methodology, such as basing high end desktop publishing on a set of particular firms, as opposed to the entire industry except Microsoft, as was done in the book.

[29] Prices for a $100 software item in 1988 fall to $40 in Microsoft markets, whereas they were essentially unchanged in other markets. If the price in markets where Microsoft competes were to rise back to $100 we get price increasing by 150%.

[30] Surplus is defined as the difference between what a consumer is willing to pay and the price he actually does pay.

increase in price to the revenues in the market, I am overstating somewhat the harm to consumers since consumers who no longer purchase the product suffer a loss somewhat less than the price increase.[31] Hopefully, the understatement of harm discussed in the previous paragraph will balance the overstatement here.

Table 3: Additional Costs to Consumers from higher AppCo Application Prices (Billions)				
	In US in 2000	In US 2000-2002 assuming 25% yearly growth.	Worldwide in 2000	Worldwide 2000-2002 assuming 25% growth.
1. Application Revenues plus 50% Markup	$7.55	$28.77	$17.86	$68.09
2. Extra Cost Assuming Prices rise by 25%	$1.89	$7.19	$4.46	$17.02
3. Extra Cost Assuming Prices rise by 50%	**$3.77**	**$14.38**	**$8.93**	**$34.04**
4. Extra Cost Assuming Prices rise by 75%	$5.66	$21.57	$13.39	$51.07
5. Extra Cost Assuming Prices rise by 150%	$11.32	$43.15	$26.79	$102.13
Data come from IDC Software Review and Forecast, 1999. Application software values comes from page 147 table 1. Development tools comes from page 114, table 8. 1998 values are increased by 25% per year, the expected growth rate according to tables 17 and 18, row for 32 bit Windows market, where app development tools is expected to grow 25.6% annually and application software to grow 28.8%.				

Table 3 presents these estimates of the additional cost to consumers from prices returning back to higher levels, first for the US and then for the world, for a single year or a three year period. There are four price-rise scenarios suggested in Table 3 . The actual approximation to a full reversion of the application prices is found in the bottom row, which implies a three-year additional cost to consumers of $43 billion in the US and over $100 billion worldwide.

There are several reasons that prices might not actually rise by this full amount, however. First, there are the political pressures already discussed that will attempt to keep the government prosecution from appearing foolish. Second, we can not know with certainty that the AppCo will emulate the more typical pricing strategy of other companies.

Therefore, as a conservative estimate, I have assumed that prices return one third of the way toward the more typical levels, as found in the bold row number 3. This leads to a three-year $14

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[31] For consumers who refuse to pay the higher price, the surplus must have been less than the price increase. Nevertheless, I assume that the loss is the same as the price increase.

billion additional cost to American consumers, and a $34 billion additional cost to consumers worldwide.

V.   The Department of Justice's Claim that Prices Would Fall

Although Judge Jackson's name is on the remedy, the arguments for its benefits come from the plaintiffs in the case—the Department of Justice and the states that took part in the proceedings. Among their arguments is the claim that the remedy would lead to lower prices for the operating system. Since this is contrary to my conclusion, it is worth examining this claim.

A.   Alternative Operating Systems Strengthened?

First, they claimed that current alternative operating systems would be strengthened because the AppCo would be more likely to port its products, such as Microsoft Office, to alternative operating systems such as Linux. This extra competition would presumably lower the price of Windows. The argument is that the AppCo, since it no longer has a financial interest in Windows, will be more willing to port its products to other operating systems (Linux being the one that seems most likely, since the Macintosh already has Microsoft Office). The problem with this logic, however, is that it makes two unfounded assumptions. First, it assumes that the AppCo will find it profitable to port its programs to Linux. Second, it assumes that the porting of the AppCo's products to Linux will have an important impact on Linux' relative competitive position.

In fact, there is little reason to believe that the AppCo will find it profitable to port its programs to Linux. The government bases much of its claim on the fact that Corel ported the WordPerfect Office Suite to Linux, and claims that Microsoft has only refused to port its office suite to Linux because of its ownership of Windows.[32]

Corel's action, however, cannot be taken as a harbinger of profitable opportunities, and recent events would indicate just the opposite. Corel has alerted investors of its very possible bankruptcy. In

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[32] On page 29 of Plaintiffs' Memorandum In Support Of Proposed Final Judgment (corrected May 2, 2000) we find: "In spite of Microsoft's claims at trial about the vitality of Linux, it has refused to port Office to Linux; by contrast, competitor Corel, unconstrained by a need to protect an operating system monopoly, has found it profitable to port its Office suite to Linux." Carl Shapiro also believes that Corel's behavior supports the government's view that the AppCo would port its office suite to Linux (see page 9 of his declaration in favor of the government's remedy).

July it received an emergency injection of $30 million to keep it afloat for several additional months.[33] Corel's financial predicament was well known when the government was writing its brief so that the government's claim that Corel is profiting from its Linux investment appears to be, at best, just another unexamined assertion. It was also well-known that Corel's recent business decisions have been highly unusual, influenced no doubt by its declining fortunes.[34]

At the current time, there appear to be virtually no major desktop applications that have been ported to Linux, including those from such market leaders as Intuit, Symantec, Lotus, Adobe, or Quark.[35]

Since most desktop ISVs do not appear to believe it is profitable to port applications to the Linux operating system at this time, there is little reason to believe that the AppCo would find it advantageous to do so at this time.

Of course, if Linux should continue to flourish, we would expect ISVs to port products to Linux, and it is even possible that Microsoft, without the remedy, might find it worthwhile doing so, just as it does for the Macintosh.

Even if the AppCo did port its applications to the Linux market, that wouldn't make the OS market significantly more competitive, not according to the application barrier to entry theory put forward by the plaintiffs and accepted by the Court. The Microsoft Office Suite consists of 5 or 6 very popular applications. Yet, the application-barrier-to-entry theory clearly states that the addition of such a small number of applications would not make Linux a viable substitute for Windows. For example, in paragraph 40 of the Findings of Fact the Judge states: "To provide a viable substitute for Windows, another PC operating system 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. Even if the contender attracted several thousand

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[33] See for example "Corel Cash Crunch May Spur Spinoff of Some Product Lines" Julian Beltrame, The Wall Street Journal online, July 20, 2000.

[34] Corel has been willing to place bets with longer odds than most other software producers as evidenced by the fact that it was one of the very few major ISVs to port its office suite to Java, although that too proved to be a highly unsuccessful undertaking. See "Java Stirs Fervor Among Users But Hasn't Lived Up to Promise," Lee Gomes and Don Clark, The Wall Street Journal Interactive Edition, August 27, 1997.

35 This information comes from querying the web site, www.thelinuxstore.com.

compatible applications, it would still look like a gamble from the consumer's perspective next to Windows, which supports over 70,000 applications."

B. New Competitors to Windows?

Additionally, the government argues that a product such as Microsoft Office might itself become a competitor to Windows.

The government and its experts have suggested that their structural remedy will lead to new competition because the AppCo, by exposing APIs (Application Programming Interfaces—code that allows one program to call on certain functions in another program) in the Office product, might turn into a middleware competitor to the OpCo.[36] This idea that middleware might rise up to become an operating system is an interesting theoretical notion, but one that again, appears to be lacking any factual support.

The desktop PC market has had numerous application companies with large market shares. In Lotus 1-2-3's case, there were thousands of mini applications written for it (known as macros), and it even had special hardware created specifically to allow it to use more memory than the operating system would normally permit. Yet, there is no evidence that Lotus 1-2-3 ever had the type of general desktop applications written for it that would have made it a competitor to the operating system, which at that time was the far simpler DOS.

Similarly, WordPerfect, when it was the dominant word-processor, was ported to work on all major desktop operating systems, including, in addition to DOS, the Macintosh, the Amiga, and the Atari ST. Yet, it too never threatened to usurp DOS's position as an operating system.

Therefore, there appears to be no real-world support for the claim that the AppCo will become a competitor to the OpCo. At best, this claim must be viewed as highly speculative.

The government's claims that prices would fall, therefore, based as they are upon untested and generally false assumptions, can hardly be considered counterweights to the factually based evidence supporting the claim that prices will rise.

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36 See for example paragraphs 102 and 103 in the declaration of Rebecca Henderson.

VI.   Reduced Competition in Non-Desktop markets

It is somewhat ironic, although not surprising given the politics surrounding the case, that certain aspects of the remedy seem designed specifically to reduce competition, particularly in the high-end server/database/workstation markets.

A.   The Database Market

The most important of these is the treatment afforded Windows NT (now Windows 2000). NT is Microsoft's entry in the high-end server/workstation/database market. It was not part of the case and there can be no serious claim that NT has a monopoly in this market. Instead, Microsoft is the challenger against entrenched incumbents such as IBM, Oracle, and Sun. Oracle and IBM use a model based on using Unix and large cadres of consultants/salesmen catering to the large corporations who are customers for these products. Microsoft is choosing a strategy of combining the OS with the database software as a way to break in to this market. Competition is clearly enhanced by the presence of Windows 2000 along with its suite of server software, particularly since Microsoft, as is often the case, is providing a low price solution in this market.[37]

The impact the Microsoft is likely to have on prices in this market can be seen in its very aggressive historical pricing as well as its continuous improvement in product quality. For example, here are some quotes regarding Microsoft's SQL Server software, its high-end database software that competes directly with the likes of Oracle and IBM and runs on the NT platform.

> Although Microsoft SQL Server is positioned as a client/server computing solution *for the masses*, its overall performance--despite a few gaps--puts it in a league with the industry leaders. [38]

> By providing a high-performance database program with management software and a replication server in a single *aggressively priced* package, Microsoft SQL Server 6.0 (SQLS) takes a step forward from its predecessor.[39]

> The solution that offers *the best value* with the least administrative hassle is Microsoft SQL Server 7.0, and we award it our Editors' Choice… ,.Oracle8i has some excellent features.. But… at its *high prices*.. Oracle is hard to recommend… doesn't match up to

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[37] This is a large market with Oracle alone having revenues in excess of ten billion dollars.

[38] Found in the Oct 11, 1994 issue of PC Magazine..

[39] Found in the September 26, 1995 issue of PC Magazine.

what its competitors are offering at less than half the price …Although we didn't see final code, IBM DB2 impresses with its stellar server engine… It *costs more* and will require more care and feeding than SQL Server.[40] (my italics)

Even more to the point is an analysis from International Data Corp:[41]

> The Unix RDBMS [relational database markets] market grew at a sluggish 3.8%, reflecting the strong growth of the relatively cheaper Windows NT platform and the mainstream's further move away from custom solutions based on technology to packaged solutions based on simplicity, ease of use, and price. (p.41)

> IDC believes that Intel systems (or their equivalent) and operating environments will continue to improve throughout the forecast period, making them increasingly attractive from both a performance and price standpoint. This, combined with the dynamics described above, will enable Intel systems to overtake Unix as the primary license revenue generators for the RDBMS market by the end of the forecast period. The operating environments expected to dominate this platform are Windows NT (soon to be Windows 2000 and its successors) and Linux. (p.54)

It should come as no surprise, then, that Sun, Oracle, and IBM feel threatened by Microsoft's presence in this market. Although Microsoft's competitive strategy in this market can only work to improve the interests of consumers, the government's remedy seems intent on reducing the very competition that would most benefit the small, mid, and large-sized businesses that are the consumers of this product. Reduced competition will clearly lead to higher prices than would otherwise be the case, although I can not quantify the impact. It seems impossible to reconcile this component of the remedy with any claim that consumer interests are paramount, or even moderately important to the government's remedy.

The problem with the government remedy is that important components of Microsoft's server software (e.g. transaction server software and others)[42] are given to the AppCo. Yet Windows 2000 without server software is an emasculated high-end operating system. The combination of the two is a key component in Microsoft's attempt to break into this market.

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[40] Found in the July 30, 1999 issue of PC Magazine.

[41] The RDBMS Top 10: Vendor and Market Analysis and Forecast, 1998–2003, Analyst: Carl W. Olofson, Copyright 1999, International Data Corporation.

42 The list of server software given to the AppCo that seem likely to be better suited staying with the OS company are: Internet Information Server, SQL Server, transaction server software, SNA server software, indexing server software, XML servers and parsers, Microsoft Management Server.

The government's intent here is particularly troubling given its claim that the AppCo may in time become a competitor to the OpCo. Under this government scenario, the AppCo, through its control of the server software, largely controls the fate of the high-end operating system with which it is expected to compete. This is the very opposite of a formula for enhanced competition and consumer benefit. This logic is incompatible with increased competition in the operating system market, and hardly fair to Windows 2000, which should be allowed to fail or succeed based on its own efforts and with its own strategy.

Tim Bresnahan has also noted this view of the beneficial competitive impact of Microsoft's entry in this market, well before the government's remedy was even proposed:

> Many analysts will say that the proposed replacement of separate DBMS and server OS firms with a unified, more proprietary structure [i.e., Microsoft's Windows2000/server software combination] is bad. They will favor the continuation of the incumbent Oracle against entrant Microsoft….This is an error…I trust the customers in the server DBMS market to make their own decisions. Customers, spending their own money, will chose between two very different structures….It would be the height of arrogance on our part to tell them to prefer the current situation over its possible replacement.[43]

There is apparently no shortage of arrogance in the Justice Department, which is particularly ironic given that Bresnahan was the chief economist in the Justice Department when the remedy was crafted..

Further, the benefits of reduced competition in the database/server market redound to firms such as Sun, IBM, and Oracle that have vociferously voiced their encouragement of the government's antitrust activities toward Microsoft and have been the most ferocious proponents of draconian breakup remedies.[44] It is disheartening that the government could have allowed the entreaties of a group that clearly has its own self-interest at heart to take precedence over the interests of consumers.

B.   The Game Console Market

Similar concerns arise for other Microsoft operating systems where there can be no question of monopoly power, such as the game console market currently dominated by Sony and Nintendo. The

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[43] Timothy Bresnahan, *New Models of Competition,* in *Competition, Innovation and the Microsoft Monopoly,* edited by Jeffrey Eisenach and Thomas Lenard, Kluwer Academic Publishers, Boston, 1999, page 183.

[44] For a detailed treatment of the political case against Microsoft see Richard McKenzie's book *Trust on Trial*: *How the Microsoft Case is Reframing the Rules of Competition.* Perseus Press, 2000.

game console market is the largest component of the entertainment software industry, an industry with almost ten billion dollars in yearly sales. The X-box, Microsoft's planned game console, will have an operating system as well as hardware created by Microsoft. Microsoft, in a departure from its usual strategy, has decided to produce hardware in this market, most likely because the makers of successful game consoles all have a single owner of both the hardware and operating system. Yet, according to the remedy, the AppCo is to get all hardware while the OpCo gets the operating system software, a result that seem to put the X-Box itself in something of a box.

Of course, defenders of the remedy are likely to claim that the two companies can work together, but this is contrary to current best practices in that industry. More specifically, the way this market works is that the hardware and software are normally sold together at little profit, or even at a loss, with profits coming from the license fees charged to game developers. With separate owners of the operating system and hardware it becomes far more difficult to engage in the type of pricing that has proven most successful. Sony, Sega, and Nintendo all have control over their respective operating systems and hardware.

The only recent example of separate hardware/OS ownership was 3DO, which licensed its OS system to Matsushita (Panasonic), AT&T, Samsung, Sanyo, Toshiba and other hardware producers, although several of these companies did not use their licenses. Despite this star-studded cast of hardware firms, the 3DO product failed in the market. Part of the reason for this failure was due to 3DO's difficulties inducing the hardware firms to sell their machines at sufficiently low prices. 3DO was compelled to resort to providing unwieldy stock options in itself to entice the hardware manufacturers to sell at a competitively low price. The failure of this model bodes poorly for the X-box's future given the district court remedy. With Sega looking increasingly unlikely to survive, this reduced competition is likely to prove especially harmful to consumers of game consoles.

VII.   The Possible Balkanization of Windows/Middleware

Any standard loses its value to consumers if it is allowed to fragment. The Metric system would lose its value as a measure of distance if the meter that Jack used was a different length than the one used by Jill. Windows presents just such a standard to program developers and users. Provision 3.g of the remedy, known as the 'binding middleware' provision, threatens that standard. It is intended to allow OEMs to choose which components of Windows they wish to install on the machines they sell,

and stipulates a particular royalty reduction formula for those components of Windows they do not install. This remedy brings to mind a restaurant where every item on the menu is a la carte.[45]

On its surface, forced a la carte pricing might appear pro-consumer since consumers would seem to be better off if the seller cannot include items that the consumer doesn't want. Yet experience teaches that it is often more efficient, for both consumers and producers, to have complete meals on the menu (bundles). Similarly, most consumers do not really want the extra flexibility of cars without tires or computers without hard drives.

Of course, when a la carte pricing exists, the price that consumers pay normally is related to the market value of the individual products. In Judge Jackson's remedy, the price of these a la carte components of Windows is determined not by the market, but by the amount of computer code. This is equivalent, in the restaurant analogy, to pricing the menu items by the number of letters used in the name of the product.[46]

I put these problems aside, however, to focus on the fragmentation issue. An operating system is a standard that provides additional value because of its consistency across users. There may be no additional value in having everyone at a table eating the same meal, but there is great value in having all Windows users having access to the same set of features.

The potential fragmentation problem can be illustrated with the example of audio compression (one of the components that can currently be turned off in Windows 98).[47] Prior to this remedy,

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[45] The text of provision 3.g: "Microsoft shall not, in any Operating System Product distributed six or more months after the effective date of this Final Judgment, Bind any Middleware Product to a Windows Operating System unless:

    i. Microsoft also offers an otherwise identical version of that Operating System Product in which all means of End-User Access to that Middleware Product can readily be removed (a) by OEMs as part of standard OEM preinstallation kits and (b) by end users using add-remove utilities readily accessible in the initial boot process and from the Windows desktop; and

    ii. when an OEM removes End-User Access to a Middleware Product from any Personal Computer on which Windows is preinstalled, the royalty paid by that OEM for that copy of Windows is reduced in an amount not less than the product of the otherwise applicable royalty and the ratio of the number of amount in bytes of binary code of (a) the Middleware Product as distributed separately from a Windows Operating System Product to (b) the applicable version of Windows."

[46] Lettuce and spaghetti would have higher prices than steak and lobster. This type of pricing is clearly nonsensical, whether for our hypothetical restaurant, or for OEMs who will be given the inane incentive of choosing components of Windows with the price based on the number of bytes of code.

[47] More difficult is a determination of whether an audio codec could be considered binding middleware. Clearly, it isn't one of the five enumerated products in the first part of the definition. But it seems that it might be covered by the second part of the definition. Audio codecs are distributed by Microsoft with Windows, even codecs that do not appear to belong to

developers could count on all (Windows) users having access to these sound decompression routines, since these routines are normally installed with Windows. Even if they were not installed, however, it would be relatively easy for software developers to provide instructions to users on how to install them, since these routines reside on the Windows CD that the user has in his possession due to his purchase of Windows.

Under the government remedy, however, software developers could no longer count on users having access to audio compression routines. OEMs would be given a financial incentive to sell machines with 'stripped-down' versions of Windows. Some OEMs might decide to include audio compression, while others might prefer to reduce their costs by not including it. On Christmas morning, when little Johnny turns on the computer to play his new video game, there will be no sound if his parents purchased a computer missing the needed audio compression routines.[48] The software developer now has one very unhappy customer.[49]

Multiply this problem by many potential middleware products, and it is easy to see how consumers will suffer from a fragmented market. This is a potentially enormous problem.[50]

In spite of this, the government remedy invites OEMs to fragment the Windows standard. In spite of the potential for consumers to be confused by this diminution in Windows compatibility, the government remedy lacks any provisions requiring OEMs to disclose when they are selling threadbare

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third parties. I do not know whether Microsoft distributes codecs separately from Windows or not. Even if Microsoft doesn't distribute the product separately, if a third party distributes separately a product that Microsoft includes with Windows, wouldn't that meet the definition above? We will have to wait for further court rulings to answer these kinds of questions.

48 Many computer-game users have experienced this type of problem because the hardware (e.g., sound cards) in PCs is not fully standardized, and game developers generally write their games to work with only the leading sound cards since it would be too expensive to do otherwise. Although the packaging usually states the hardware requirements, many users are not sufficiently sophisticated to know whether the program will work on their machines.

[49] Defenders of this remedy might claim that the game developer could include on the distribution CD, along with the game, those components of Windows that are needed to run the game but which might have been removed by an OEM. In that case, however, the cost of the game would increase to cover the cost of buying these Windows components, needlessly raising prices for those customers who already have those Windows component installed.

[50] A particularly specious claim by the government is that fragmentation would be nothing new since Microsoft already allows consumers to remove many components of Windows with the add/remove software feature built into Windows (page 64 of Plaintiffs' Reply Memorandum In Support Of Proposed Final Judgment). This is extremely misleading, however, since the source code from the removed component is always there to replace any features of Windows that were not included in a particular installation.

versions of Windows. Even if such disclosure were mandated, it might not do much good since it would be largely indecipherable to many computer users.

Nevertheless, the government asserts that the above concerns are unwarranted, and that only a handful of products would be affected by the binding middleware provision.[51] To be sure, it is far from clear what products exactly would fit into this category of binding middleware, or where the audio compression example would fit in. [52,53]

Even if the government is correct, however, and only a handful of products are affected, there are still potentially serious problems. If some versions of Windows have voice recognition and others not, and some versions have video streaming and others not, the potential for a serious fragmentation problem is still real even with only five or ten middleware products that might or might not be included with Windows.

To this concern the government provides what can only be categorized as an extraordinary series of responses. The government claims that when OEMs remove Microsoft middleware programs to receive a rebate, the underlying code will remain resident, capable of being called by other programs. The government states: "Section 3.g., requires that OEMs and end users be able to remove access only to the middleware product -- in this case the browser -- not to APIs or code."[54] In essence, the government appears to be asking that Microsoft refund money to OEMs when its middleware program is hidden from direct view, but that the program's functionality is to remain intact for any third party

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[51] On page 62 of Plaintiffs' Reply Memorandum In Support Of Proposed Final Judgment, (May 17, 2000) the plaintiffs state: "Microsoft ignores the definition of 'Middleware Product' (§ 7.p), which is the term to which Section 3.g., applies and which is much narrower than 'Middleware' (§ 7.o). That definition ensures that the anti-binding provision will apply to only a small group of products."

[52] From the Definition section of the remedy: 7.r: "Middleware Product" means: i. Internet browsers, email client software, multimedia viewing software, instant messaging software, and voice recognition software, or ii. software distributed by Microsoft that –
   1. is, or has in the applicable preceding year been, distributed separately from an Operating System Product
      in the retail channel or through Internet access providers, Internet content providers, ISVs or OEMs, and
   2. provides functionality similar to that provided by Middleware offered by a competitor to Microsoft.

[53] Would the audio compression be the type of middleware product that section 3g would proscribe? It doesn't fit definition 7.r.i. However, audio codecs do provide functionality similar to that offered by Microsoft competitors, fitting 7.r.ii.2. They have been distributed separately by third parties, although I do not know if Microsoft would have been considered to have distributed it separately from the operating system as required by 7.r.ii.1 (these codecs are automatically downloaded, for example, by Windows Media player if needed). These are the types of problems that make interpretation of the remedy so murky.

[54] Found on page 63 of Plaintiffs' Reply Memorandum In Support Of Proposed Final Judgment.

software written to take advantage of the middleware. Under this scenario the government would be correct in its claim that there would be no Windows fragmentation with regards to Microsoft products. But under this scenario Microsoft is being required to provide virtually all the functionality of its middleware products to OEMs and end users while at the same time it is being forced to issue rebate payments for these programs.

The government's position has to be judged untenable on several grounds. First, it is unreasonable to provide a discount to OEMs when the main functionality of the product they are supposedly foregoing remains intact. Second, OEMs will have virtually no incentive to 'include' any Microsoft middleware since the middleware is still really there if the OEM takes the rebate. Take the hypothetical case of Microsoft voice recognition being added to the operating system. The creators of word processors, personal finance software, and any other software could then access this voice recognition. Why would an OEM pay extra for its inclusion when users can get the main functionality even if the OEM doesn't pay for it?[55]

Lastly, and more importantly, the government's interpretation of this clause vitiates the very purpose of this provision. Since OEMs would get the Microsoft middleware functionality for free, they would have exactly the same incentive to include competing middleware products as they do today when Microsoft middleware is included as a part of Windows at no additional cost.

Under the government's interpretation, this provision cannot achieve the ends that the government desires. Only under the alternative interpretation, the interpretation that would lead to fragmentation, do alternative producers of middleware have increased likelihood of having their products purchased by OEMs. Therefore, it seems reasonable to believe that the eventual legal interpretation of this clause will be that Microsoft middleware code will be removed from Windows in order for OEMs to receive discounts, leading to fragmentation of the standard.

Under this interpretation, there are several possible outcomes that might arise from the binding middleware provision.

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[55] There would also likely be a 'stand-alone' voice recognition program that would not be available to those consumers with versions of Windows that had this component turned off. However, the standalone program is likely to be of limited value since people are going to want to edit the document in their favorite word processor. More generally, a stand-alone program is likely to be of little extra value to software that is truly middleware, since the purpose of middleware is, by definition, to be used by other programs.

A.   OEMs continue to take all Microsoft middleware products because they are the most cost effective.

B.   OEMs remove all Microsoft middleware products to save money, but do not take any replacement middleware products. This might come about because OEMs do not think consumers value the middleware products as much as the cost savings, which might be true given the bizarre method used to determine the cost savings to OEMs.

C.   OEMs replace Microsoft middleware with third party products.

D.   A combination of the other possibilities. OEMs take some Microsoft products, some third party products, and leave some middleware products off their machines entirely.

It seems likely that the result most likely to occur is 'D'. What this means, of course, is that Windows will no longer be a simple standard that can be relied upon by developers. I now turn to the costs brought about by this fragmentation (balkanization) of the Windows standard.

A.   What are the Incremental Software Production Costs from Balkanized Windows/Middleware?

In April of 1999 I estimated the extra costs to developers from having multiple versions of Windows.[56] At that time I identified three costs imposed by fragmentation on developers: research and development, sales and marketing, and support costs. The concern then was that as multiple versions of Windows competed with one another, the number of APIs that differed between the versions would increase, making it very costly for developers to deal with the two or three competing versions of Windows.

The problem now is somewhat different. Instead of two or three owners of competing versions of Windows that differ from one another in numerous ways but that are each individually standardized, we have only one owner of Windows, but a Windows that is no longer standardized.

Developers will face a somewhat different set of problems under this latter scenario. First, some developers are likely to not need the services of middleware at all. This will depend to some extent on the particular middleware. Voice recognition, for example, is likely to be middleware that many

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[56] Stan J. Liebowitz, "Breaking Windows Estimating the Cost of Breaking up Microsoft Windows" Association for Competitive Technology and The ASCII Group, Inc., April 30, 1999

developers will eventually want to use in their programs, and will probably in a few years be considered a normal part of the operating system just as the incorporation of mouse controls is now routine and not the province of esoteric ISVs, as it once was.

Those developers who write to middleware will have to deal with some users who may not have the middleware at all, and other users with different flavors of middleware. This will impose significant extra costs in the spheres of R&D and support.

1. Research & Development

Developers of programs that work with middleware will have significant extra costs if they want their program to work with each of the major competing middleware products assuming that there are two or three middleware products competing in each middleware segment. Competitors will use different APIs and different schemes to try to accomplish their goals. Trying to program for three different voice recognition techniques, for example, will increases the long-term complexity and cost of software maintenance.

Some of these costs include:

- Adding programmers and educating new and old programmers about application programming interfaces for the different middleware products.
- Acquiring, equipping, and maintaining extra development computers for the various versions of middleware.
- Adding testing personnel with knowledge of the different middleware.
- Creating test plans to ensure that middleware differences do not interfere with "inter-operability" on networks.
- Creating, printing, and maintaining new on-line help and user documentation.

Although it is clear that this will translate into higher costs, it is not at all clear just how much costs might increase. In my previous study software firms were asked to estimate their extra costs in porting applications from one operating system to the next. Here, firms would have to 'port' the middleware-using components of their products to work under each of several different middleware products. The costs will obviously depend on how important the middleware is to the functioning of the product and the complexity of dealing with programming to the middleware.

In a survey conducted for the earlier study, ISVs reported that they expected their R&D costs to increase by 80% for each new version of Windows they had to write for. I do not have any specific estimates of the costs incurred for writing to new middleware. Indeed, given the difficulty of defining

middleware, and the uncertain impact of the remedy on the number of middleware products that may or may not be incorporated with Windows, it would be difficult to even craft a useful survey instrument.

2. Incremental Support Costs

Even if there are only five middleware categories, each with three competing products (and the option of choosing none), that would imply over one thousand different combinations of middleware products. Support staff, if they are to do their jobs properly, need to be able to replicate the same screens, features, and "bugs" as the callers. The potential complexity is enormous, and ISVs will probably find it too expensive to provide support for every combination of middleware products, thus they are likely to limit their support to the leading combinations of middleware products provided by the leading OEMs, making it difficult for the smaller OEMs to survive unless they follow the lead of a leading OEM in their choice of middleware products.

Having multiple middleware options will require additional training for current support staff, and increase the training and ramp-up time for new and replacement staff. Call handling times are increased by any complexity that makes it harder for support staff to understand and replicate a caller's problem.

In my previous study, respondent ISVs indicated that they believed their support costs would increase by almost 50% for each competing version of windows.

B. Size of Windows Market

The data on current and predicted software revenues in the Windows market are found in Table 4. The numbers come from a 1999 IDC study representing expected revenues in Windows 32-bit markets for various categories of software.

There are three major categories of software in the Windows market: tools, applications, and infrastructure. Infrastructure includes the sales of the operating system itself, and thus we remove an estimate of the sales of 32 bit Windows operating systems from the sum of tools, applications and infrastructure revenues to derive the expected revenues from software in the 32-bit Windows market. These estimates appear in the last row of Table 4. These estimates will be used to derive the dollar value of incremental costs of writing for multiple middleware versions of Windows.

Table 4: Predicted Revenue in Windows Markets (Billions)				
	Forecast Period			3-year
Sotware Revenue within 32-bit Windows	2000	2001	2002	Total
Tools: spreadsheets, information access, programming environments, databases, components, objects, internet tools	$17.28	$21.85	$27.48	$66.61
Applications: consumer applications, personal productivity, games, accounting, office applications and other cross-industry packages, office automation, vertical industry applications	$31.18	$39.68	$49.46	$120.32
Infrastructure: system management, security, and middleware	$17.31	$21.31	$26.38	$65.00
less: Windows 32-bit operating systems	-$8.51	-$10.12	-$12.18	-$30.80
Total Sotware Revenue within 32-bit Windows	$57.26	$72.72	$91.14	$221.12
Sources: IDC report "1999 Worldwide Software Review and Forecast" Analysts: Steve McClure, Steve Hendrick, Clare Gillan, Paul Mason, Richard Heiman, and Gary Ingram, May 1, 1999. Information on Tools comes from Table 17, Applications from Table 18 and Infrastructure Table 19. Infrastructure revenues include sales of the operating system which were then removed based on estimates of these revenues found in Table 6, "System Software and Utilities: 1999 Worldwide Markets and Trends", IDC.				

C.   Deriving Estimates of Incremental Costs

The predicted revenues from Table 4 make it easy to determine the predicted incremental costs from multiple middleware versions of Windows, once we assign the percentage increase in costs imposed on vendors. Assigning the likely increase in costs, however, is a difficult task.

There are two factors that need to be estimated. First is the additional costs to the ISVs from the increased variation in Windows/middleware combinations brought about by this remedy, both in support costs and R&D. Second is the percentage of developers that write software using OS middleware.

I am going to use the average survey estimate of the additional costs to ISVs of porting a product to a related operating system as a benchmark for the additional cost to ISVs of writing software in the balkanized OS/middleware environment produced by the remedy. This was a 47% increase in technical support and a 78% increase in R&D for each new version of Windows. Although I would surmise that the technical support costs would increase relative to R&D costs for the middleware balkanization problem, I do not directly build that into my estimate, although it would be easy enough to do if some additional evidence can be adduced in that regard.

Table 5: Incremental Cost Percentages for Middleware Balkanization (as percent of revenue)			
	Share of Revenues	Incremental Factor	Impact on Total Cost
R&D	17.32%	78.00%	13.51%
Technical Support	6.83%	47.00%	3.21%
Total Increase in Costs as a Percentage of Revenue			16.72%
Share of Revenue data come from appendix to "Breaking Windows" Liebowitz, 1999, which itself is based on Software Publishers Assocation, 1997 Financial Profile of Software Publishers, prepared by KPMG Peat Marwick LLP; Tables 2-4, pages 9-11. Incremental factors from survey discussed in "Breaking Windows".			

Table 5 indicates how additional costs in these two factors relate to the total revenue in those industries. What this table tells us is that if the middleware balkanization increased technical support costs by 47% and R&D costs by 78%, that the increase in costs to the typical ISV would be 16.72% of revenues. Multiplying the $221 billion 3-year total Windows revenue found in the bottom rightmost cell of Table 4 provides a cost figure of $27.4 billion dollars. This is the benchmark value for the calculations found in Table 6. It can be found in the last column, fourth row of data, the intersection of 100% and 100%.

Table 6: Excess Worldwide Development Costs from Balkanized Middleware, 2000-2002 (in billions)						
		% of firms writing to middleware				
Complexity of writing to various middleware variations compared to complexity of porting to one additional operating system.		20%	40%	60%	80%	100%
	25%	$1.370	$2.740	$4.111	$5.481	$6.851
	50%	$2.740	$5.481	$8.221	$10.962	$13.702
	75%	$4.111	$8.221	**$12.332**	$16.442	$20.553
	100%	$5.481	$10.962	$16.442	$21.923	$27.404
	125%	$6.851	$13.702	$20.553	$27.404	$34.255
	150%	$8.221	$16.442	$24.664	$32.885	$41.106
	175%	$9.591	$19.183	$28.774	$38.366	$47.957
	200%	$10.962	$21.923	$32.885	$43.847	$54.808
	225%	$12.332	$24.664	$36.996	$49.327	$61.659
	250%	$13.702	$27.404	$41.106	$54.808	$68.510

Interpretation of Table 6 is as follows. On the left hand side we have a measure of the complexity and cost of developing and supporting software to run on balkanized Windows/middleware configurations. Complexity is measured relative to that of developing and supporting programs to run

on a different version of Windows. These values on the left hand side might surpass 100% because there are potentially dozens if not hundreds of different varieties of middleware products included with Windows. It is possible that even though writing to a single new middleware product might be less complex than writing for a single alternative operating system, the very large number of middleware alternatives might impose greater costs than a single different versions of Windows.

On the top of the chart are the percentage of firms whose costs of development and support are impacted by different software being included as middleware within Windows. If all ISVs had their costs impacted by the middleware combinations within Windows, and the costs were identical to those involved with dealing with a second version of Windows, then one would read off the values found in the row and column labeled '100%' which would indicate the cost to be $27.4 billion, the benchmark value.

This chart is useful in showing the range of possible costs. These costs are of a different nature than the costs of the last two sections. There is quite a wide range of values represented in this table. Without further information, however, it is difficult to choose a single row or column and derive an estimate of the costs.

These costs, representing as they do additional resources used, are costs to society, not necessarily costs to consumers. Although consumers will undoubtedly bear some of these costs, a portion is likely to be borne by ISVs themselves, particularly since product support is largely a variable cost.

VIII.   Other Costs

A. Lower Quality Windows OS

The remedy also has the potential to hamper innovation in the operating system. Part of this comes from the "Binding Middleware" restriction. Obviously, if OEMs can use new middleware innovations without paying for them, Microsoft will have less incentive to create innovative middleware. There is another serious problem, however, that I will illustrate with the example of voice recognition technology.

Voice recognition is going to be one of the most useful features that will become available to computer users in the next few years, particularly for users with visual impairment or disabilities hindering the use of their hands. There are currently several firms producing voice recognition software, including IBM, Lernout & Hauspie, and Dragon Systems, with prices ranging from about

$100 for basic versions to several hundred dollars for more advanced versions. This software has been improving, but still leaves much to be desired. Most of these programs allow voice recognition to be used with a handful of other programs, usually Microsoft Office and one or two others.

There are important advantages in having voice recognition included in the operating system as compared with having it as a stand-alone program.[57] If it is part of the operating system, every firm writing applications for Windows, instead of just a handful, can take advantage of voice recognition, using the feature built in to Windows, just as they currently draw upon mouse operations or printer drivers. Consumers will also benefit since the cost of voice recognition, based on the historical precedent of Windows pricing, will probably be only a few dollars instead of the few hundred dollars that it now takes to purchase these stand-alone programs.[58]

One would expect, absent the remedy, that Microsoft would adopt the voice recognition software that provides the best combination of price and functionality, since that would create the greatest net value for consumers and therefore have the most favorable influence on Windows' profitability. This might entail using a product designed in house, acquiring another software producer, or licensing the product from a third party.

How does the government's remedy impede this process? Under the government remedy, voice recognition software goes to the AppCo. Suppose that the best voice recognition product now belongs to the AppCo, and that the efficient outcome would be for the AppCo voice recognition software to be included in Windows. It appears that provision 2.b.ii of the remedy would disallow this outcome. This provision essentially prevents the two former Microsoft companies from doing business with one another for a period of ten years.[59] Instead, the OpCo would have to deal with one of the other voice

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[57] The analogy here that might make the point more transparent is the situation with printer drivers and DOS. DOS did not include any printer drivers, meaning that ISVs had to create their own printer drivers. Since there were hundreds of printers, this was very expensive and time consuming, as well as being grossly inefficient. Since the effort involved in writing printer drivers would be independent of the number of sales, this cost fell disproportionately on small ISVs making it more difficult for them to compete with large ISVs. Microsoft's inclusion of printer drivers in Windows allowed ISVs to costlessly have their programs print to any printer with a driver, was clearly efficient, and benefited small ISVs the most.

[58] The cost to consumers of features such as disk compression, disk fragmentation, undelete programs, fax software, Internet sharing software and so forth have been added into Windows at a rate of pennies on the dollar compared to the previous stand-alone prices.

[59] Here is the text: "2.b After Implementation of the Plan and throughout the term of this Final Judgment, the Operating Systems Business and the Applications Business shall be prohibited from… ii. entering into any Agreement with one

recognition vendors, causing an inferior product to be included in Windows. This is just one example of how innovation in the operating system can be deleteriously impeded by the remedy.

B. Increased uncertainty among consumers of Windows.

With several competing versions of middleware, and the possibility that the best middleware might not be offered at all, consumers will have more to decide when buying a computer than just which OEM sells the best hardware at the best price.

If this remedy comes to pass, it will be important that consumers dig deeper and discover what middleware products are included or not included with the version of Windows that they purchased. If sellers of stand-alone software want to avoid disappointed customers, the software package would have to list all the 'middleware' programs that need to be installed into the operating system in order for the program being purchased to work. This will add a great deal of extra complexity into the purchase decision since consumers, who often barely know any details of their operating system, will need to have a far more intimate knowledge of their machine to interpret these requirements.

Depending on the proper definition of middleware, and the behavior of OEMs, there may be a great deal of chaos in the market as consumers purchase computers only to find out that the machines do not work as expected. The nature of these problems has already described in footnote 48 above and the surrounding text.

The fact that the remedy imposes upon OEMs no obligation to provide details to consumers about which middleware is included or not included with the version of Windows embedded in their machines only exacerbates this problem. Of course, once it become generally known that different versions of Windows come from different OEMs, consumers will insist upon, and OEMs will provide, disclosure of this information. Still, costs from mistaken purchases will be higher under this scenario, both in the short and long run.

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another under which one of the Businesses develops, sells, licenses for sale or distribution, or distributes products or services (other than the technologies referred to in the following sentence) developed, sold, licensed, or distributed by the other Business.

IX.   Summing Up

I have estimated dollar values for two costs associated with this remedy, provided a dollar range for a third cost, and outlined the nature of several additional costs. The first two costs are costs to consumers from higher prices (for Windows and applications). The third cost, excess development costs, is a social cost that will fall partly on the shoulders of developers and partly on consumers.[60]

Table 7: Three year (2000-2002) Cost of Remedy (Billions $)				
	Best Guess		High-End	
	US	World	US	World
Windows Pricing	$34.734	$87.281	$82.098	$206.301
Applications Pricing	$14.383	$34.045	$43.150	$102.135
Total Cost from Higher Prices	$49.117	$121.326	$125.247	$308.435
Plus				
Extra Development Cost	?	?	$27.044	$54.808
Reduced Competition in Other markets	?	?	?	?
Consumer Frustration from non-standardized Windows	?	?	?	?
Lower Quality Windows	?	?	?	?

Table 7 lists the various costs of the remedy. Although I cannot put dollar values on many of these categories, it is clear that the potential costs to consumers and society are enormous, whether looked at from a purely American perspective, or looked at from a worldwide perspective.

X.   Conclusions

A remedy is supposed to fix a problem. An antitrust remedy is supposed to help consumers. The current remedy does neither.

Over a three year period the remedy put forward by Judge Jackson can be expected to cost American consumers upward of $50 billion in higher software prices alone, compounded by additional development and support costs, reduced competition in the server/workstation market, a lower quality Windows operating system and an inferior shopping and utilization experience for PC consumers. The total price tag will undoubtedly wind up being much larger than this conservatively estimated $50 billion.

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[60] For the high-end costs I assumed that all ISVs use some middleware, and that the cost of writing to multiple middleware environments is twice as high as the cost of writing to a second version of Windows.

What will consumers get for these additional payments? Two firms where previously there was one, with new management and ownership. By itself, this is of no value. Neither is there any reason to expect increased competition in either the operating system market or application markets. At best the government can offer only the vague promise of increased innovation, with neither theory nor empirical support to back up such a claim.

When the full extent of the costs of the government remedy are revealed, they are seen to be enormous. They are not just the relatively minor costs associated with voluntary spin-offs commonly discussed in the business sections of most newspapers. Nor are they the typical costs associated with a benign restructuring of a firm. Instead, these are costs associated with a wholesale dislocation of business units, business strategies and products, occurring in the midst of one of the most rapidly growing and evolving markets. Consumers and government leaders need to ask themselves if the antitrust action against Microsoft is what they expect and deserve or whether it is indicative of a policy run amuck.