DECLARATION OF KENNETH J. ARROW

I. QUALIFICATIONS AND INTRODUCTION

A. I, Kenneth J. Arrow, am the Joan Kenney Professor of Economics and Professor of Operations Research at Stanford University. I received the degrees of B.S. in Social Science from The City College in 1940, M.A. in mathematics from Columbia University in 1941, and Ph.D. in economics from Columbia University in 1951. I have taught economics, statistics, and operations research at the University of Chicago, Harvard University, and Stanford University, and I have written more than 200 books and articles in economics and operations research. I am the recipient of numerous awards and degrees, including the Nobel Memorial Prize in Economic Science (1972). A significant part of my writing and research has been in the area of economic theory, including the economics of innovation and its relation to industrial organization. My curriculum vitae is attached.

B. I had been asked by the Antitrust Division to consult with them on the possible courses of action with regard to Microsoft Corporation, before the filing of the proposed Consent Decree. I have now been asked by them to comment on the Memorandum of Amici Curiae against the proposed final judgment offered by Gary L. Reback and others.

II. THE ECONOMIC RATIONALE FOR THE GOVERNMENT'S COMPLAINT

A. The Elimination of Artifical Barriers to Entry

The Government's complaint against and settlement with Microsoft will eliminate artificial barriers that Microsoft had erected to prevent or slow the entry of competing suppliers of operating system software products for IBM-compatible PCs. The complaint addressed certain practices associated with Microsoft's MS-DOS and Windows operating system software products and the successors to those products (specifically, the product code-named Chicago to be released as Windows 95).

Microsoft erected artificial barriers to the entry and growth of competing operating system vendors through its contractual relations with original equipment manufacturers of IBM-compatible PCs (OEMs). These practices included the following: (i) contract terms that required OEMs to pay Microsoft based on the number of computers shipped whether or not those computers had a Microsoft operating system preloaded (the "per-processor" contract); (ii) unnecessarily long terms for the contracts with OEMs for the use of Microsoft's operating system software products; and (iii) large minimum purchase obligations for OEMs ("minimum commitments").

Microsoft's contractual relations with OEMs had created strong economic incentives for OEMs to deal exclusively

with Microsoft. OEMs with a per-processor contract were obligated to pay Microsoft a royalty fee for every computer they sold with a specified type of microprocessor (e.g., the Intel 486). The royalty had to be paid even if the OEM elected to load an operating system on the machine from a different vendor. As a consequence, OEMs who did elect to load competing operating system software products had to pay a double royalty - one to the supplier of the software actually used and a second royalty to Microsoft.

The per-processor incentives for exclusive purchases from Microsoft made it more difficult for suppliers of competing operating systems to find willing outlets for their products in the important OEM distribution channel. This barrier was compounded by Microsoft's long contract terms and by the inclusion of large minimum commitment obligations in the OEM contracts. The long contract terms, along with the exclusivity incentives of the per-processor contract, made it difficult for OEMs to switch to an alternative supplier of operating system software products. OEMs with a per-processor contract had a large financial incentive to deal exclusively with Microsoft for the duration of the contract.

Large minimum commitments had an economic effect similar to that of the per-processor contract. An OEM with a minimum commitment has a "take-or-pay" obligation for the amount

of the minimum commitment. As in the per-processor contract, this obligation can force an OEM into a situation where purchasing from a competing supplier of operating system software products would require the OEM to pay a double royalty. For example, suppose the OEM had planned to sell 100,000 computers and agreed to a minimum commitment with Microsoft for 100,000 units of MS-DOS. The OEM would face a financial penalty if it purchased operating system software from another supplier and if, as a consequence, the OEM's purchases from Microsoft fell below the minimum commitment of 100,000 units. In that event, the OEM would have to pay royalties to both Microsoft and the alternative supplier for each unit that the OEM buys from the alternative buyer.

B. Opening Access to the OEM Distribution Channel

A new competitor has to overcome the natural barriers to entry that exist in many markets and especially the software markets. The Department of Justice's complaint against Microsoft and the resulting settlement eliminated unnecessary and artificial obstacles erected by Microsoft to disadvantage future competition. This action will not eliminate natural advantages enjoyed by Microsoft which result from its own innovative activity and the commercial success of the IBM-compatible PC platform.

Despite the importance of natural advantages (see section III below) in the market for IBM-compatible PCs, the complaint and proposed remedies addressed competitive issues that are critical to the success of new competition in this market. The most effective and economic point of entry for sales of IBM-compatible PC operating systems is the OEM distribution channel. New operating system software products should have unimpeded access to this channel. The Government's complaint and proposed settlement provide needed relief to facilitate the entry of new competitors, such as IBM's OS/2.

III. INCREASING RETURNS AND BARRIERS TO ENTRY

A. The Presence of Increasing Returns and Barriers to Entry

The analysis of the Department of Justice and the *amici curiae* brief agree that the software market is peculiarly characterized by increasing returns to scale and therefore natural barriers to entry. Large-scale operation is low-cost operation and also conveys advantages to the buyer. Virtually all the costs of production are in the design of the software and therefore independent of the amount sold, so that marginal costs are virtually zero. There are also fixed costs in the need to risk large amounts of capital and the costs associated with developng a reputation as a quality supplier. Further, there are

network externalities, in particular, the importance of an established product with a large installed base and the related advantage of a product that is compatible with complementary applications.

Installed base generally refers to the number of active users of a particular software product. A software product with a large installed base has several advantages relative to a new entrant. Consumers know that such a product is likely to be supported by the vendor with upgrades and service. Users of a product with a large installed base are more likely to find that their products are compatible with other products. They are more likely to be able successfully to exchange work products with their peers, because a large installed base makes it more likely that their peers will use the same product or compatible products. Installed base is particularly important to the economic success of an operating system software product. The value of the operating system is in its capability to run application software. The larger the installed base of a particular operating system, the more likely it is that independent software vendors will write programs that run on that operating system, and, in this circular fashion, the more valuable the operating system will be to consumers.

The large installed base of IBM-compatible PCs that use Microsoft's operating system software reflects Microsoft's

dominance of that market and undoubtedly contributes to its competitive advantage over competing operating system vendors. One important question is the theoretical analysis of the consequences of this advantage in a world of increasing returns. In particular, it is necessary to ask to what extent, if any, would government policy to interfere with natural advantages of scale lead to an improvement from the viewpoint of the consumers. A second question is the extent to which the anticompetitive behavior complained of has in fact contributed to Microsoft's dominance.

B. First-Mover Advantage and Increasing Returns

On pages 36ff. of the *amici curiae* brief, there is a penetrating discussion of the role of increasing returns in altering conclusions based on competitive markets with constant returns. I have little disagreement with the bulk of the statements made but do not agree with the implications for policy that the writers of the brief draw.

It is correct that under strongly increasing returns, the tendency of the market is towards monopoly. The brief does not, to be sure, allow very much for the theoretically and empirically very well-known possibility of imperfect competition.

Economies of scale need not lead to a single producer, though they do lead to market power for the producers.

However, there is undoubtedly the possibility of monopolization, and it is certainly possible that the monopolization is inefficient. But notice that most of the steps in the dynamic process leading to monopoly or imperfect competition are steps in which the growth of the monopoly arises by offering a cheaper or superior product. As indeed the brief emphasizes, the process is entirely natural in the market. On what basis can a government intervene to insure a better outcome?

If monopolization is inevitable, as the *amici*'s argument, implies, then the outcome can only be criticized on the basis that the wrong monopolist survived. We are dealing with a complex system in which the outcome is not easily predictable. Indeed, predictions in the whole modern history of the information business have been very poor. AT&T did not realize the consequences to it of the development of the transistor, which eventually destroyed its monopoly. IBM was hesitant about entering the electronic computer industry altogether and failed to understand the potential of PCs; otherwise, it would have made a very different contract with Microsoft. Xerox developed the basic ideas which developed into Apple and took no economic advantage of them. This unpredictability is precisely what would be expected of a complex self-organizing dynamic system. But it

also means that the government is not in a position to predict either, and interference to pick the winner of this dynamic process is likely to be counterproductive.

The *amici curiae* brief notes that, "once a market is 'tipped' in favor of a particular competitor, it would take *truly massive* forces to return the market to a state of equilibrium (i.e., competition)" (p. 40; italics added). There are two remarks to be made here. (1) Clearly, competition is not a state of equilibrium or at any rate not of stable equilibrium, as a preceding quotation on the same page makes clear. (2) "Truly massive" forces are very likely to impose their own truly massive costs, which have to be weighed against the gain from competition, which, under increasing returns, is sure to be inefficient, or from "tipping" the equilibrium in the right direction, which is usually unknowable.

To be more concrete, in this situation, any set of remedies is likely to be of the form of penalizing whatever firm happens to be leading, Microsoft in this instance. This may take the form of disintegrating the firm horizontally or vertically or of imposing constraints on its ability to enter certain markets. A rule of penalizing market successes that are not the result of anticompetitive practices will, among other consequences, have the effect of taxing technological improvements and is unlikely to improve welfare in the long run.

This is not to deny that a firm with a large installed base or other realization of scale economies may sometimes be in a position to impose artificial barriers, and these should be regulated or prohibited, as the present proposed Final Judgment already does. But interfering with purely natural barriers to entry can be dangerous to the economy's welfare.

The *amici curiae* brief does in fact a good job of presenting possible arguments for not going further in trying to break up a natural monopoly (pp. 74-83): inevitability of monopoly, entry by alliances, Microsoft's own self-interest in competition in applications software, and the efficiencies of integration. The brief attempts to refute these, but in my judgment makes only small critical points.

C. Anticompetitive Conduct and the Present Installed Base

The brief makes much of the fact that Microsoft's installed base has increased in five years from about 18 million units to 100 million or more. It ascribes this growth to anticompetitive behavior. It seems to conclude that even though, given the installed base, there might be large real costs in effecting changes, they should be made anyway, since the installed base was itself the result of anticompetitive actions.

This conclusion appears flawed for a number of reasons. Clearly, the six-fold growth in the installed base is primarily the result of the extraordinary commercial success of the IBM-compatible PC platform, in which MIcrosoft's product development and marketing played a part. In such a situation of rapid growth, the previous installed base should have provided a relatively weak constraint on entry. For the most part, Microsoft appears to have achieved its dominant position in its market as a consequence of good fortune and possibly superior product and business acumen.

It appears that the effect of Microsoft's OEM licensing practices on its installed base is far less than claimed in the *amici* brief. Microsoft's anticompetitive licensing practices, although a significant impediment to the use of the OEM distribution channel by competing operating system suppliers, made only a minor contribution to the growth of Microsoft's installed base. Even this minor contribution overstates the economic impact of Microsoft's licensing practices on its installed base barrier to the entry and growth of competing operating systems.

Microsoft first instituted its per-processor licensing arrangement in 1988. However, this contract did not affect enough of the OEM channel to foreclose competition until FY 1992,

when 50% of all OEM sales of MS-DOS were sold pursuant to per-processor licenses. The corresponding number was 20% in FY 1989, 22% in FY 1989, and 27% in FY 1991.

The data on the fraction of the OEM channel affected by Microsoft's anticompetitive licensing practices lead to the inescapable conclusion that the per-processor contract did not have a material impact on the installed base of Microsoft operating system software. The complaint and proposed Final Judgment address the effects of Microsoft's licensing practices on *future* sales of competing operating systems.

In any case, increased sales of DR-DOS would not have significantly affected Microsoft's installed base advantage. DR-DOS was marketed as an operating system software product that was fully compatible with MS-DOS. Because DR-DOS supported the same application program interfaces as did MS-DOS, application program developers would have continued to write for MS-DOS (or Windows) even if DR-DOS sales had been much larger.

D. The Transience of First-Mover Advantage and the Importance of Open Markets

The history of market shares in PC application software has been marked by great volatility. Although first-mover advantages and increasing returns are important, there are

many examples to show that such advantages are far from permanent. As examples, consider the fates of Wordstar, Apple Computer, and IBM itself. All were once dominant in critical PC-related product markets; yet each has experienced rapid loss of market shares.

Noting this transience is not a justification for complacency. On the contrary, it requires effort to maintain the openness of markets, so that new technologies can have an opportunity to enter and show their value relative to older ones.

Accordingly, the proposed settlement appropriately addresses and remedies the anticompetitive effects of the practices challenged in the complaint.

I declare under penalty of perjury under the laws of the United States that the forgoing is true and correct.

Executed on the 17th of January 1995.

Kenneth J. Arrow