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**ECONOMIC ASPECTS OF THE MICROSOFT
CASE: NETWORKS, INTEROPERABILITY AND
COMPETITION**

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Economic Aspects of the Microsoft Case: Networks, Interoperability and Competition

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Abstract:

In this paper, we discuss the main economic aspects of the European Microsoft case; in particular, Microsoft's refusal to supply the necessary information to make the competitors' work group server systems interoperable with Windows Operating System. The case can be seen as an example of competition between networks. We review the relevant economics literature with the objective of understanding the motivations behind Microsoft's strategies.

JEL codes: L4, O3, L1

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1. Introduction

Microsoft has been under scrutiny of both the Department of Justice in the US and the European Competition Commission in the EU (EC henceforth) in two complex cases that spanned over a number of years. These cases have been followed with great interest by economists, both academic economists and practitioners, all around the world. This is perhaps due to the fact that the computing industry is an

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industry in which a number of economic arguments such as network effects, complementarities and R&D incentives interplay and affect the effective level of competition. In fact, there is a feeling among economists that we can learn a lot about strategic behaviour in rapidly changing environments by understanding Microsoft's strategies (Carlton, 2001).

In the European case, two of Microsoft's strategies were investigated. First, Microsoft's refusal to supply the essential information to make Sun Microsystems's work group server operating system, Solaris, compatible with Windows. This investigation followed the formal complaint by Sun Microsystems before the EC, in which it accused Microsoft of behaving anti-competitively by denying this necessary information. Microsoft was accused of trying to reduce the interoperability of Windows with other products produced by competitors in order to leverage its market power in the PC operating systems market onto the work group operating system market, market in which Microsoft was also active.

The second issue involved in the case was Microsoft's practice of tying Windows Media Player with Windows operating system, two complementary products. Microsoft was accused of abusing its dominant position in the PC operating system to foreclose competition in the media player market. The investigation of this practice was initiated by the EC by its own initiative, that is, without a third party filing a formal complaint against Microsoft. This second issue is reminiscent of the US case, in which Microsoft was under trial because of tying Windows with Explorer. Although the two practices assessed by the EC (denying the essential information to achieve compatibility and tying) are quite different, they also share some similarities, as both can be seen as ways to leverage market power onto a

complementary market. Moreover, in both cases, the existence of network economies is at the core of the discussion.

The EC's duty is to enforce the European Competition rules on anticompetitive business practices and abuses of monopoly power within the entire European Union when competition and the free market are affected. The EC can impose changes in the company behaviour (the so-called remedies) and also impose fines.

On the 24th of March 2004, the EC published its decision on the case,¹ concluding that Microsoft had breached the EC law by leveraging its monopoly power in the PC operating systems market onto the work group servers operating market and onto the market for media players. The remedies imposed on Microsoft were as follows: First, Microsoft was required to disclose to its competitors the necessary information to make their products interoperable with Windows operating system.² Second, Microsoft was ordered to untie Windows and Media Player. In other words, Microsoft was ordered to offer to PC manufacturers a version of Windows without Windows Media Player. In addition to those remedies, Microsoft was imposed a fine of €497 million for abusing its dominant position in the European Union.³

Mario Monti, who was the European Competition Commissioner at that time, stated that the decision would restore the conditions for fair competition in the markets concerned. The Commissioner also expressed the EC's concerns about the

¹ See EC Decision Case COMP/C-3/37.792 Microsoft.

² It is important to clarify that Microsoft was not asked to disclose the source code of Windows but only "complete and accurate specifications for the protocols" used by Windows work group servers in order to interoperate with Windows.

³ Microsoft appealed to European Court of Appeal without success. Microsoft was also been fined for not compliance, that is, for not implementing the remedial measures, at later stages. The largest non-compliance fine imposed on Microsoft amounted €899 million. In May 2008, Microsoft appealed again (this time to the European Court of First Instance) with the objective of overturning the €899 million fine.

Microsoft's general business model, which was thought to deter innovation and to reduce consumer choice. The Commissioner expressed his conviction that the decision would establish clear principles for the future conduct of Microsoft.

Generally, we can say that competition policy aims at ensuring that competition in the marketplace is not restricted in a way that is detrimental to society (Motta, 2004). The basic underlying principle is that a monopoly is allocatively inefficient. In other words, it leads to a loss in surplus (or deadweight loss).⁴ This constitutes the rationale behind policy makers' interest in creating the conditions that make markets as competitive as possible, as the lower the degree of competition, the less (allocatively) efficient the market is. However, the usefulness of this argument in guiding competition policy is rather limited, especially in R&D intensive industries. Allocative efficiency is related to the market performance in "static" terms. However, one should also consider the dynamic effects of competition in order to assess the welfare effects of monopolies or, by extension, of oligopolies. For example, it is far from clear that innovation rates and market power are negatively related, as firms will not have incentives to conduct R&D unless they can appropriate the returns to their investments.

The objective of the article is to provide a broad picture of what economics can say about competition in computer industries in general and about the European Microsoft case in particular. To achieve this aim, we will review the academic

⁴ The basic story is the following: A monopolist typically charges higher prices than a perfectly competitive firm would do. As a consequence, consumers are worse-off than they would be if the market was perfectly competitive (in other words, consumer surplus is lower in a monopoly than in perfect competition). However, a monopolist also earns higher profits than the competitive firms (in other words, producer surplus is higher in a monopoly than in perfect competition). Crucially, the latter cannot compensate for the reduction of consumer surplus and therefore social welfare is found to be lower in a monopoly than in a perfectly competitive market.

contributions within the economics literature that are relevant for the case. Due to space constraints, we will focus on the first of the two practices, that is, Microsoft's refusal to supply competitors with the essential information to achieve interoperability with Windows.

So that to lay the grounds for the rest of the article, first we will describe the different elements in computer systems and how they give rise to separate but complementary markets. The definition of a market is a crucial step in the antitrust process and therefore, we will discuss this definition in the case. Next, we will discuss the nature of competition in the computer markets. It is relevant to note that although there are only a small number of firms in each of the computer markets, this does not necessary imply lack of competition. In fact, many analysts regard computer markets are highly dynamic and exposed to a lot of competition. The type of competition in these markets can be defined as Schumpeterian. In this article, we will describe the dynamics of competition in Schumpeterian markets.

Since one of the reasons why computer markets are Schumpeterian is the existence of network externalities, we will provide an overview of the literature on network economics and will use its main results to discuss the Microsoft case, paying particular attention to the (potential) reasons for Microsoft's actions. We will discuss that the case can be seen as competition between two systems (Wintel platform) vs. platforms around work group servers. Typically in such cases, the incumbent firm (dominant platform) has incentives to deny interoperability so that to protect its market dominance. We will discuss the incentives to degrade interoperability as studied by the economics literature. Finally, we will consider the

remedies imposed by the EC and its implications in terms of innovation and welfare, which are far from univocal.

The structure of the article is as follows: In section 2, we will describe the elements integrating computer systems. In section 3, we will define what network economies are and the extent of their existence in computer markets. In section 4, we will analyse the market definition in the Microsoft case. In section 5, we will discuss the Schumpeterian nature of competition in computer markets. In section 6, we will discuss economic contributions regarding foreclosure and interoperability. Section 7 is devoted to the innovation and welfare implications of the remedies imposed on Microsoft. Section 8 summarises the article and provides some final remarks.

2. Computer systems: Definition and elements

A computer system is constituted by hardware and software. The hardware are the physical components of the system and the software are the computer programs. Software can be system software or application software. An application is a piece of software that targets a specific user's need. For example, word-processing or playing music. Two examples of Microsoft applications are Word and Windows Media Player for word-processing and playing music respectively. The purpose of the system software is to control the hardware of the computer and linking the applications and the hardware. This link can only work if both the applications and the system software use the same application programming interface (API). Some examples of interfaces are UNIX API or JAVA API.

Users and sellers of hardware and software normally interact around “platforms”. According to the definition in The Linux Information Project (LINFO)⁵, the term *platform* refers to (i) the type of *processor* and/or other hardware on which a given operating system or application program runs, (ii) the type of operating system or (iii) the combination of the type of hardware and the type of operating system running on it. Examples of platforms are IBM System 360, Apple Macintosh or Windows, the platform controlled by Microsoft. For the purpose of this chapter, we will use the second meaning of “platform”, that is the type of operating system.⁶

The system software can also be called “platform software”, as it serves as a platform for all the applications that use the same interface than the operating system. For example, the interface needed to interact with Windows operating system is the Win 32 API, also property of Microsoft. To allow any software application to function in a computer using Windows, it would be necessary to make it compatible with the interface Win 32 API. Other examples of interfaces are UNIX API and Java APIs.

Typically, computer users will interact among them. In order to do so, their computers will have to be interconnected, constituting a network, typically through a server computer. In such a situation, a further piece of software is needed, the so-called “work group server operating system”, which enables the communication

⁵ <http://www.linfo.org/platform.html>

⁶ Interestingly, different platforms are vertically integrated to different extents (Bresnahan and Greenstein, 1999 and Evans et al., 2004). In the case of mainframe computers, there is a single platform offered by a single firm (IBM) with high levels of vertical integration (including hardware). In the case of the PCs, the IBM PC platform was initially controlled by IBM, although later it became controlled by two other companies, one active in the (applications and operating systems) software market, Microsoft, and the other, in the micro-processors market, Intel. For an interesting discussion of the role played by extent of vertical integration on the success of different platforms see Evans et al. (2004).

between (non-server) computers and servers. The “non-server” computers connected to the server are often referred to as “client” computers. As mentioned above, the first of the issues in the Microsoft case regarded Microsoft’s refusal to supply Sun, a work group server operating system producer, the necessary information to make its product, Solaris, which is UNIX based, interoperable with Windows.

It is obvious that the different elements of the systems described above are goods that are complements from the point of view of the consumer, as they have to be used in conjunction. Two goods are complements if their demands are positively related. For example, take Windows and the applications for Windows. If there is a decrease in the price of the operating system Windows would give rise not only to an increase in its own demand but also to an increase in the demand of applications supported by Windows.⁷ The existence of complementarities between products has important implications for the market power that a firm dominant in one of the markets can extend into the complementary market. It is also relevant to note that given the need that computer users have of interacting with other computer users, computer systems will be subject to network effects. In the next section we describe the nature of those effects.

3. Network effects

Since computer users interact among them, computer systems or platforms are subject to network effects. The higher the number of users of one specific platform or system, the higher the demand of this platform is. This is a typical example of network effect, because the utility the system provides to each individual user

⁷ If goods are substitute, a decrease in the price of one leads to an increase in the demand of the other.

increases with the total number of users of the same platform. The intuition is clear: Computer users share frequently documents created in their own computers with other users. Consumers therefore benefit from an increase in the number of users of their platform, as this reduces incompatibility risks and costs. In fact, the above is an example of “direct” network effect.

Additionally, an “indirect” network effect arises when a particular feature of a network is likely to be improved in a large network (see Scotchmer, 2004). For example, the number of applications written for a given platform increases with the number of users of this platform; therefore a user of a given platform would benefit from an increase in the number of users of that platform through the wider range of available software.

It is worth mentioning that the wide availability of software is, in any case, a major determinant of the success of platforms. Interestingly, Apple and Microsoft have tried to encourage the writing of applications for their platforms. For example, in the late 90s Microsoft was spending over \$250 million yearly on developer-related activities, such as training programs, marketing or research (Evans et al., 2004). By helping developers, they were facilitating the creation of new software applications, which in turn, increased the likelihood of new users’ adopting Windows. In addition, the availability of applications available for a platform would constitute an entry barrier for other operating systems/platforms.

All in all, it is important to bear in mind that not only the existence of network economies but also the size of the networks (or in our case, the number of users in a platform) affects crucially the competitive environment in an industry. Further, there are interesting strategic implications of making a network or platform

compatible or incompatible with another competing network. We will discuss with this issue in more detail in section 6. Now we turn our attention to the definition of the relevant markets in the Microsoft case.

4. Definition of relevant markets

The first stage in the assessment of any antitrust case is the definition of the relevant market. A market comprises all the products or services that are substitutable by the consumer. In principle, based on the description of computer systems made above, the markets for the different elements of the computer system should be considered to be separate (although complementary) markets. The EC identified two markets as relevant for the Microsoft case and separate from the point of view of the consumer: the market for (client) PC operating systems and the market for work group server operating systems. The EC considered that the operating systems created for servers could not be used on PC hardware. Their argument was that such use would either not be technically viable or would deprive the user of hardware or software capabilities. Further, the EC stated that the work group server operating systems fulfilled a specific demand need and neither other server operating systems or PC operating systems were realistic substitutes for them.⁸

The definition of the relevant market made by the EC was based on qualitative (mostly technical) judgements. As far as I am aware, no statistical or econometric study was conducted by or on behalf of the Commission to estimate the demand of the two identified markets. Such an analysis could have been used to test the

⁸ The Commission conducted a market enquiry to study the substitutability between different types of servers. For more details on this and Microsoft's statements, see section 5.11.2.11 in the Commission Decision Case COMP/C-3/37.792 Microsoft.

validity of the qualitative analysis referred above. Interestingly, Van Reenen (2004) conducted an empirical study to estimate market level elasticities for servers, the results of which lend support to the EC's view that the work group server and their operating systems are a separate market from other servers or other type of operating systems (such as PCs operating systems) is correct. Van Reenen's estimates of demand elasticities for work group server systems (hardware and software) are relatively low,⁹ indicating that a price increase in the work group server operating systems would not affect dramatically the quantity demanded of work group servers. This implies that there are no good substitutes for work group servers from the consumers' point of view.

The empirical analysis of the work group server operating systems is more difficult as its demand is derived from the demand for the work group server hardware, as Van Reenen (2004) highlights. Further, hardware and software are often sold as bundles. This implies that it is difficult or impossible to collect good data on prices of server software. It can be argued, however, that given that the demand of work group server operating systems is derived from that of the work group server, if the latter is inelastic, the earlier has to be even more inelastic, therefore showing the existence of a market for work group server operating systems which is separate from those of other types of operating systems (server and client).

Apart from making any judgements about demand-side substitutability, it is also necessary to consider the separation from the point of view of the supply in order to reach any conclusions regarding the separation of the PC operating systems and the work group server software markets. Two markets are deemed to be separate from point of view of the supply if a small but significant permanent price increase in

⁹ Often the work group servers are sold as a hardware and software bundle.

one of the markets would not lead to entry into that market by firms active in the other market.¹⁰ In the absence of entry barriers, such a price increase would attract entry. However, the need of incurring in high development costs or the existence of network externalities, either direct or indirect, may act as barriers to entry and make entry unprofitable. The EC rejected the existence of supply-side substitutes for PC operating systems by concluding that software developers in adjacent markets would not be able to start producing PC operating systems without substantial costs and risks. Similar arguments were used to support the same conclusion regarding work group server operating systems.

5. The nature of competition in the computer industry

The prominence of Microsoft in the computer industry is obvious. Their market share in the operating systems market was at the time of the antitrust case as high as 95% according to the EC. Was therefore Microsoft an unthreatened (quasi) monopoly at that time?

It is difficult to deny that there is competition in the industry, even in those segments where there are “quasi-monopolies” such as the PC systems segment. The computing industry is a rapidly evolving, constantly changing technological sector. Often companies become dominant, but their dominance is contested by new entrants (normally, as a result of technological innovations). In some cases these new companies even manage to displace the former incumbents. Bresnahan (2002) and Bresnahan and Greenstein (1999) illustrate with examples how the computer industry has followed those dynamics. This type of competition dynamics can be labelled as “Schumpeterian”.

¹⁰ Markets which are close either geographically or technologically.

The Schumpeterian paradigm describes competition in a dynamic fashion from an evolutionary perspective. An incumbent firm holds a dominant position until a firm enters the market with a successful innovation and displaces the former incumbent. This theory therefore explains progress and economic growth by means of this “creative destruction”.¹¹ Innovation, in Schumpeterian terms, is only a source of temporary market power. In the computing industry, there are only a small number of software platforms at any one time due to the existence of network economies. Further, sunk costs incurred by both consumers and software application developers imply that the incumbents in the platform markets will enjoy market dominance until a successful innovator appears in the market. The length of time during which an incumbent can hold its dominant position can be assimilated to a technological era.

This leads to a second question regarding the successful innovator: Where can such firm come from? An innovator can come from a neighboring market, for example, the market for a complementary good. According to Bresnahan (2002), technologies spend years without competing with each other by serving different segments of the market. These different technologies can become competitors by technological or market change, this is the so-called “indirect entry”.

If we believe that competition in the computing industry takes place in a Schumpeterian way, Microsoft is so dominant because the nature of the industry leads to this type of outcomes (large dominant firms). This does not mean that it is not facing any competitive threat (Evans and Schmalensee, 2000). In fact, some very reputed scholars, such as Economides or Schmalensee, question the need or even usefulness of antitrust actions against Microsoft.

¹¹ For more details see Schumpeter (1942).

Economides (2001) emphasizes that the fact that there are dominant firms in the market does not imply the existence of weak competition and claims that antitrust intervention in the computing industry is futile due to a number of reasons. In particular, given that the industry is a “winner takes most” (due to the existence of network effects),¹² imposing a different market structure would generate inefficiencies. Further, even if antitrust authorities eliminate barriers to entry, once a few firms are established in the market, the addition of a new firm would not change dramatically market shares and prices.

Schmalensee (2000) indicates that traditional tests for monopoly should not be used in the computing industry. Given that the industry is Schumpeterian, the leaders will necessarily have high market shares and the existence of network and scale economies will act as barriers to entry. Using traditional tests will lead to the conclusion that the software industry is highly monopolised (by different companies in different segments) and therefore should be under tight scrutiny of antitrust authorities. However, Schmalensee (2000) points out that this conclusion goes against the view of many analysts, who consider the computing industry as highly competitive, with aggressive innovation races and current monopolists being threatened and frequently overtaken by superior products. This type of competitive threat is not accounted for in the traditional tests for monopoly power. Further, if there can be only one survivor, the incumbent must exclude its competitors; otherwise, it will disappear from the market place. This poses the question whether strategies to survive can be labelled as “anticompetitive”. Even more importantly, if the natural equilibrium is to have a monopoly, restraining competition can only harm welfare, especially if competition involves investments in innovation, product

¹² We will discuss in more detail the literature on network effects later in this article.

development or low prices. It follows from Schmalensee's argument that no antitrust action should be taken against Microsoft, as the corporation is simply trying to secure its survival.

In the upcoming sections we will discuss some relevant academic contributions regarding network effects that are helpful to understand the reasons that might exist behind Microsoft's actions as well as the consequences of them.

6. Foreclosure and competition between systems

In this section we will provide a concise overview of the academic contributions dealing with network economies, paying special attention to the strategic issues derived from the choice of compatibility (or interoperability) between competing systems. Before starting, let us summarise the case building on the basics discussed in the previous section.

Microsoft produced two goods, operating systems and group server software, which are complement products. Sun was also in the market for server software, therefore competing in that market with Microsoft. Microsoft was clearly the market leader the operating systems market, with Windows installed on most PCs. As a consequence of the ubiquity of Windows and the existence of network effects, Sun needed to make its product compatible or interoperable with Windows; otherwise, Solaris would be of very little value to a vast majority of consumers. In fact, even evidence supplied by Microsoft to the EC¹³ highlighted the importance for work group servers of the degree of interoperability with PC (and therefore with their operating systems). It is obvious therefore that Microsoft's refusal put Sun in a very difficult competitive situation in the work server market.

¹³ See page 106, EC Decision Case COMP/C- 3/37.792 Microsoft.

All in all, as indicated in the introductory section, Microsoft was accused by the EC of leveraging its market power onto work group server operating systems market. However, according to the traditional views of economists, a monopoly in one market does not have incentives to monopolise a complementary market. Furthermore, Microsoft's strategy changed overtime. Interestingly, in the beginning of the development of the market for work group server operating systems, Microsoft did disclose all the necessary information to make Windows compatible with its competitors' products. To understand the reasons behind Microsoft's early and late strategy, let us turn our attention to the economic literature on complementary markets and competition between networks.

6.1 The view of the Chicago School versus the incentives to foreclose potential competitors.

The main line of defence of Microsoft is based around the Chicago School argument of "one monopoly profit theory".¹⁴ According to this view, a monopolist does not have any incentives to monopolise a complementary market since it can extract all the profits from it by increasing the price in the monopolised market. Illustrating this argument with the case, Microsoft could have raised the monopoly rents in the server software market by increasing the price of Windows operating system. Reducing the interoperability of Windows with the servers produced by the competitors would only lead to a reduction of the price consumers would be willing to pay for Windows.

Following the Chicago School's argument, we cannot find any reason to accuse Microsoft of behaving anticompetitively by degrading interoperability. In the

¹⁴ See recital 765 in the EC decision, COMP/C-3/37.792 Microsoft.

Chicago School theory, the monopolist firm does not have any incentives to foreclose rivals in adjacent markets because of the lack of threat of entry. But is it very realistic to assume that Microsoft did not face any threat of entry?

On one hand, entry in both the PC and work group server operating system markets seemed to be expensive and time consuming. In fact, the EC stated these reasons to reject the existence of supply-side substitutability. Windows operating systems is protected by the wide range of applications available in the Windows platform, which act as a short run barrier. This, in principle, should preserve Microsoft's (quasi) monopoly of the operating systems market.

However, the Commission also stated that it could not be excluded that in the future there would be firms challenging Microsoft's dominant position in the PC operating systems market. Microsoft's actions could therefore aim at foreclosing potential competitors. By strengthening its position in the work group server market, Microsoft could reinforce the barriers to entry into the PC operating systems market: Any future competitor in the PC operating system market would have to produce a system which would need to be interoperable with Microsoft's work group server operating system.¹⁵ It is important to note that there is evidence that Microsoft worried about some competitors (Sun, Oracle and Netscape)¹⁶ pushing for a model of centralised computing, with servers at the core of the systems.¹⁷ Microsoft seemed to acknowledge the threat to the dominance of the Windows platform which this new computing model constituted.

¹⁵ See recital 769 in , COMP/C-3/37.792 Microsoft.

¹⁶ See recital 771, COMP/C-3/37.792 Microsoft.

¹⁷ It seems that Microsoft is also pushing for this model now, with the launching of Microsoft Azure cloud platform.

Kuhn and Van Reenen (2007) explain very clearly how this new model threatened the dominance of the Windows platform: In the late 90s, a larger number of applications could be delivered via servers, therefore putting users in less need of purchasing an expensive operating system such as Windows for their personal computers, as they could simply use the applications thorough the servers. If users started using more frequently applications delivered by servers, software developers would increasingly write applications in the open standards which server operating systems typically use.

It is worth reminding here the competitive dynamics of Schumpeterian industries. As discussed before, in Schumpeterian industries, competition derives from technological advances and competitors often come from neighbouring markets. In this case, although the server operating systems were not directly competing with the PC operating systems (as both constitutes different markets), they were posing a threat due to the technological changes which were making Windows operating system less necessary for computer users.

Given this threat, Microsoft could have chosen to protect itself by monopolising the server software market, consequently eliminating the potential competition of Windows. This would protect Microsoft's operating system in two ways. First, as indicated by the EC, if Microsoft was dominant in the work group operating systems, any PC operating system producer would have to seek interoperability with Windows work group server operating system. This would constitute an additional barrier to entry into the operating system market. Second, if Microsoft increased its market share in the server operating systems market, software developers would gradually shift away from writing software for other platforms,

this would lead consumers to switch to Microsoft, reducing again the incentives of software developers to write software for other platforms (Kuhn and Van Reenen, 2007).¹⁸

All in all, we have seen that Microsoft could have had incentives to foreclose competition in the complementary market of work group servers as a way to eliminate the potential threat of work group server software to PC operating systems. Essentially, the case can be interpreted as follows: Microsoft's operating system, Windows, is at the core of the dominating system. Potential competitors to this system arise in the late 90s: The systems around work group server operating systems (and in particular, around Solaris). Naturally, Microsoft would want to foreclose the (potential) competing system. A way to this is to degrade interoperability. In the next section, we review some contributions regarding competition between systems, so that to better understand the dynamics of competition between systems.

6.2. Basic aspects of competition between systems with network effects

As discussed above, computer systems are subject to network effects. It is therefore appropriate to discuss the literature on competition between networks to understand competition between computer systems. As each system has a network associated to it, the number of users of the system determines the size of its network.

Competition between systems has some distinctive features that separate it from competition between individual goods. Katz and Shapiro (1994) or Scotchmer

¹⁸ In addition to this dynamic incentives to foreclose competition, Kuhn and Van Reenen (2007) provide another static motivation: By dominating the server market, Microsoft could price discriminate more effectively in the operating systems market. Large firms would typically be less sensitive to the price of operating systems and therefore Microsoft would like to charge them a higher price than it would charge to small firms. Microsoft could identify large firms because they are willing to pay more for the complementary product (server systems).

(2004) highlight the fact that in many cases, the components for a system are bought in several stages. For example, at individual level, a consumer typically buys a computer, an operating system and some pieces of software at a given point in time, but will buy (at least she might consider buying) some other pieces of software or upgrades at a later stage. As a consequence of this, consumers will have to create some expectations about the availability of software for their purchased computer in the future. Other things being equal, software developers will write more applications for those platforms with a higher number of users.

Furthermore, different generations of consumers will be buying these goods in different periods of time. When buying goods in time 1, a consumer will make her expectations about the future number of users of the network around each system and will adopt (other things being equal) the system that will have the highest number of users. In both cases, it can be clearly seen that competition between systems is not static. In fact, the market outcomes in one period will affect dramatically the competitive situation in upcoming periods. Therefore, we can say that competition between systems or networks is inherently dynamic.

According to Katz and Shapiro (1994), another main feature of network competition is the coordination problem. It is clear that consumers face a problem of coordination: When two competing goods affected by network economies are first introduced in the market, consumers would like to find a way to coordinate in choosing one of the two, as choosing different ones would result in inefficiencies. Firms also face a similar coordination problem. When developing new software, for example, a software creator would like the new application to be compatible with the main operating system platforms. Interestingly, given that consumers

benefit from a network being as large as possible, these markets often end up being dominated by one of firms initially present in the market. In other words, systems or network markets often tip towards one of the firms' goods. These are the so-called "tipping equilibria", as labelled by Mahlueg and Schwarz (2006). If tipping occurs, the losing system will be progressively adopted by fewer and fewer consumers until effectively disappearing from the marketplace (Farrell and Saloner, 1986 and Katz and Shapiro, 1992)

Firms will try to use some strategies to make the market tip in their favour. For example, firms can opt to set heavily discounted prices in the early life of a good. This will secure a large number of costumers in those initial stages, which will consequently increase the probability of new consumers buying that good or system in latter stages of the life of the good. The existence of a good in the market place that is perceived by firms to be superior to other goods could lead to the same result. Therefore, in those early stages, firms will frequently use aggressive advertising campaigns to promote the image of their goods.

Another key issue which requires our attention is the interoperability or compatibility properties of the system. Often computer users need to interact with others using a different system. It is therefore crucial from the point of view of users that a system is able to operate or communicate with another system. This property is called "interoperability". So that two systems are interoperable, they must be compatible and interconnected. From now on, we will use the terms compatibility, interoperability and interconnectivity interchangeably.

Katz and Shapiro (1994) cite a number of benefits of compatibility, such as lower marginal costs due to scale economies, technological spillovers and learning

effects, etc. Further, Matutes and Regibeau (1988) point out that compatibility also makes possible for consumers to mix and match components from various systems. This, in turn, should make competition between firms stronger. Taking the Microsoft case as an example, if Solaris and Windows were compatible, consumers could pick Windows as operating system and Solaris as group server software. If they were incompatible, consumers using Windows would almost be bound to use Windows group server. In principle, competition should be stronger in the first case than in the second. In fact, Katz and Shapiro (1986a) show that compatibility relaxes competition earlier in the product life cycle but prevents one firm from gaining control of the market and therefore intensifies competition in later stages.¹⁹

It should be obvious that compatibility generates benefits for consumers (as it makes easier the communication between users of different systems) but it will not always be preferred by firms. Sun wanted Solaris to be compatible with Windows, as otherwise their market potentially would have been dramatically reduced. However, some firms might be interested in deliberately making their product incompatible with other products in the market, even if they are complementary products, for a number of reasons. In the case of Microsoft, by denying compatibility to Solaris, Microsoft was strengthening the market position of its work group server software (as it would be perceived as superior to Sun's due to its perfect interoperability with Windows). Another reason behind the degradation of interoperability could be that Microsoft perceived work group server and their operating systems as potential competitors to Windows and wanted to protect itself from its threat, as discussed before.

¹⁹ This result seems to be in line with Microsoft's move from favouring interoperability to degrading it. We will discuss this change in more detail later.

In the next subsection, we will review some seminal contributions from the economics literature on competition between networks in order to explain in detail the incentives of firms to grant or degrade interoperability.

6.3 Competition between networks: dominance and compatibility

A seminal paper in the literature on competition between networks is Katz and Shapiro (1985), who modelled a game between oligopolistic firms in a static framework in order to study firms' incentives to make their goods compatible with their competitors'. The authors highlight the importance of consumers' expectations: If consumers expect a firm to be dominant, then they will be willing to pay more for its good, and, as a consequence, the firm will in fact become dominant.²⁰ This means that in equilibrium there could be one dominant firm or many competing firms, depending on the consumers' expectations.²¹ Regarding compatibility, it is shown that firms with good reputations or large networks will tend to degrade compatibility. Small firms, in contrast, will tend to be in favour of compatibility.

The limitation of Katz and Shapiro (1985) is the lack of dynamics. As we have discussed before, competition between systems often takes place in a multiperiod scenario. Therefore, it seems important to consider the implications of those dynamics.

Farrell and Saloner (1986) consider a game between consumers who take their purchasing decisions at different points in time. Over time, new superior

²⁰ The authors use a refined version of the Nash equilibrium, the “fulfilled expectations equilibrium”, which will be the recurrent equilibrium solution used in posterior contributions. This solution implies that consumers' expectations regarding the size of the competing networks are correct in equilibrium.

²¹ They also show the existence of multiple equilibria for some sets of expectations.

technologies appear. Each consumer decides which network to belong (that is to buy the old or the new good or technology) given what the other consumers have chosen. The equilibrium outcome depends therefore on the size of the installed base when a new good or technology is introduced, the difference in quality between the new good and the old one and how quickly the network externalities around the new good are realized. Interestingly, one of the main results in the paper is that network economies may actually inhibit innovation. This problem is referred by the authors as “excess inertia”, a socially excessive reluctance to change to a new standard (that is, the new good or technology becoming dominant) even when this new standard outperforms the old one (that is, the old good or technology being dominant). So that this effect happens, there must be strong network externalities around the old standard. The authors also show that incumbent firms can use product preannouncements and predatory pricing to deter entry. Both strategies would aim at protecting the differential in the sizes of the incumbent’s and entrant’s networks, which are the core of the competitive advantage of the incumbent.

Katz and Shapiro (1986b) show that generally compatibility tends to be below socially optimal level and highlight the importance of technology sponsorship in determining which firm will become dominant (and therefore, which good or technology will become prevalent). A firm is said to “sponsor” a technology if it uses an aggressive pricing strategy in the early stages of the product life and recoup its investment in later stages when being already dominant. Naturally, this can only happen if the firm is the sole owner of the right to it in the production of a good (for example, through a patent). In the absence of sponsors, the firm which is dominant today will have an advantage due to the installed base and the derived

network effects. If two technologies are sponsored, the one that will be superior tomorrow will have the advantage. It is worth commenting here that if there were scale economies, it would be difficult for a new entrant to sponsor the technology to the same extent than the incumbent, as its unit production costs would be higher.

More recently, Crémer et al. (2000) build on and extend the model by Katz and Shapiro (1985) to analyze connectivity in the internet. In particular, they study the incentives of dominant backbones to provide interoperability with “smaller” providers. Their model can also be interpreted more generally as a model of competition between systems. The authors assume a market for a network good and two firms which can endogenously determine the degree of interoperability of their products. Unlike Katz and Shapiro (1985), where goods produced by each pair of firms can only be perfectly compatible or totally incompatible,²² Crémer et al. (2000) contemplate also intermediate degrees of interoperability. The network around each of the two goods is constituted by the number of users that have already bought the good from the company in the past and are therefore users of the network around the good produced by the firm. For simplicity, we will refer to the firm the larger installed base as the “incumbent” and the firm with the smaller installed base as the “entrant”. In our case, Microsoft would be the incumbent and Sun the entrant.

Apart from the current users of the network, there are also a number of new costumers who have to choose from which firm to buy. In other words, they choose which network they join. Users benefit from network externalities, in the sense that their utility is higher the higher the number of consumers in the network. Further,

²² Although Katz and Shapiro (1985) also analyse the case of firms opting to become compatible with some other firms but incompatible with others. They refer to this case as “partial compatibility”.

this network externality extends on the number of users in the other network if the goods are interoperable, corrected by the degree of interoperability between the two networks. In other words, if the goods are fully incompatible, consumers would only benefit from an increase in the number of consumers using the same network than them; if goods were fully interoperable, consumers would benefit as much from an increase in the number of users in their same network than from an increase in the other network. If the goods were only partially interoperable, consumers would also benefit from the number of users in the other network but only to the extent of the degree of interoperability.

Motta (2004) discusses the “tipping equilibria” in the Crémer et al. (2000) framework, that is when the market tips in favour of the incumbent or in favour of the entrant and find the less compatible the goods are, the more likely the market will tip towards the incumbent. Further, if goods are incompatible, tipping towards the entrant cannot occur. In other words, if the incumbent denies compatibility, it protects its market dominance. This can help us explain the incentives that Microsoft had to deny compatibility, as by doing so, it protected its competitive advantage. The competitive advantage the incumbent has derives from having a larger installed base, which will make a new consumer more likely to choose the incumbent’s network instead of the new entrant’s network.

However, Crémer et al. (2000) also show that in some circumstances, the incumbent might actually prefer full interoperability. This can only happen when the installed base is small relative to the number of new consumers. Although full interoperability erodes the incumbents’ competitive advantage, it also increases the demand of new consumers in the market.

All in all, the incumbent (or the firm with the largest installed base) will choose full or zero interoperability while the entrant (or firm with the smallest installed base) will always prefer full interoperability. More recently, Mahlueg and Schwartz (2006) extended Crémer et al. (2000) model by allowing more than two firms. Interestingly, according to their results, reducing interoperability may actually tip the market away from the incumbent. When facing multiple competitors, denying compatibility can (but does not necessarily need to) actually worsen the competitive position of the incumbent. In fact, this is more likely to happen the higher the number of rivals for a given size of the installed base. Further, the smaller the installed base, the lower the incentives to deny compatibility. Again, as in Crémer et al. (2000), the incumbent faces a trade-off between increasing the demand and sacrificing its competitive advantage by making its product compatible with that of the entrants.

To sum up, here we have turned our attention to the literature on competition between networks. This literature is highly relevant for the Microsoft case, as computer systems are subject to network effects. We have seen that the expectations of consumers regarding the future size of networks are crucial in explaining which systems become dominant. We have also seen that markets with network externalities often tip in favour of one of the firms. Firms will therefore try to implement strategies to tip the market in their interest.

According to the literature, if two competing networks are incompatible, tipping towards the smaller network cannot occur. Therefore, a dominant firm would have strong incentives to deny compatibility so that to protect its competitive advantage. Incompatibility will confer a competitive advantage to the firm with the largest

network: If two systems cannot communicate with each other, a typical consumer will choose the system with the highest (expected) number of users, other things being equal. This could explain Microsoft's refusal to supply Sun with the necessary information to make their work group operating system compatible with Windows. In contrast, the firm with the smallest network would prefer full interoperability so that the difference in the size of the networks does not impact consumers decisions.

If the market is still growing, the dominant firm faces a trade-off: By favouring interoperability, it will increase its demand but it will erode its competitive advantage. Interestingly, Microsoft initially chose to disclose the information to make work group operating systems compatible with Microsoft. In contrast, at a later stage, it chose the opposite strategy. We have seen some reasons which could explain this change of strategy: Initially, when network computing was in its infancy, Microsoft could have chosen to achieve high degrees of interoperability to drive up its own demand. At that time, the market was still growing and the potential size of the market was still very large relative to the current number of users. When the market was mature and its own network was already large relative to the number of new consumers, it chose to deny compatibility presumably to protect its competitive advantage.

7. Interoperability, innovation and welfare

In the previous section we have analysed the motivations behind Microsoft's strategy. Here we discuss the implications of interoperability on innovation and welfare. Before starting this discussion, it is important to note that innovation rates and market power are not necessarily negatively related: Although it is true that

competition can stimulate innovation, it is also true that firms will not have incentives to conduct R&D unless they can appropriate the returns of their investments. Therefore, it is important to bear in mind that in some instances excessive enforcement of competition law may damage the incentives to invest in R&D (Gilbert, 2007).

As mentioned in the introduction, the EC showed concerns about Microsoft's general business model, which was thought to deter innovation and reduce consumer choice. However, it is far from clear that forcing interoperability (as the remedy imposed) necessarily benefits investment in innovation. On one hand, forcing Microsoft to disclose the necessary information so that the other software companies can make their products compatible with Microsoft's should result in cost savings for those firms. Furthermore, interoperability should increase the sales of Microsoft's competitors, as now their products are more valuable to consumers (due to the network economies described earlier). The increase in sales should in turn increase the incentives to innovate of Microsoft competitors (Kuhn and Van Reenen, 2008).²³ However, in order to assess the effects of the remedy on the industry incentives to innovate, it is not enough to consider Microsoft competitors' in isolation; the impact on Microsoft is also relevant, especially when Microsoft is such a large firm relative to the other firms in the market.

The impact of the remedy on Microsoft's incentives to innovate is far less clear. On one hand, if the measure would lead to a decrease in Microsoft's market share, naturally Microsoft's investment on innovation would decrease. However, one may also expect Microsoft to invest more intensively in innovation in order to protect its

²³ Typically, the R&D costs do not depend on the number of units of output actually produced. Therefore, the higher the quantity of output, the lower the R&D cost per unit of output and therefore the higher the profitability of the investment on R&D.

position from the new competitors rather than relying on foreclosing strategies such as tying or denying compatibility.

Interestingly, some analysts believe that Microsoft has never been particularly innovative and that its core products are essentially copies of already existing products. In fact, it seems that relevant people in the industry believe that innovation would be enhanced if Microsoft's monopoly position was removed.²⁴ A word of caution is needed here, as the industry association has an obvious interest in this matter.

The results in the economics literature with regard to the welfare implications of incompatibility in Schumpeterian markets are quite ambiguous. In particular, it has been shown that if a monopoly supplier of an essential system component (in the Microsoft case, Windows operating system) is prevented from restricting interoperability, the market for the complementary market can tip in favour of a less efficient firm (Gilbert and Riordan, 2007). If that happened, welfare could be harmed by forcing interoperability.

There are some reasons to believe that, in computer markets, the best solution from the social point of view would be to have open interfaces with hardware and software applications protected by Intellectual Property Rights (patents etc.): If the interfaces were open, the prices for the different elements of the system would be determined by the extent of those rights rather than by the market power derived from the network effects around the platform (Scotchmer, 2004). From the policy point of view, unless there is a violation of the competition law, in which case

²⁴ As Ed Black, president of the Computer & Communications Industry Association (CCIA). Said "We're convinced that innovation will be greatly enhanced and improved if Microsoft's heavy hand of monopoly is removed from the industry". See "Has Microsoft stifled innovation?" in BBC News, available at <http://news.bbc.co.uk/1/hi/business/781765.stm>.

authorities may choose to force firms to disclose the interfaces, as in the Microsoft case, it is typically difficult to find tools to make the interfaces open. Reverse engineering could be one of those tools but might not work if the technologies are very complex (Samuelson and Scotchmer, 2002).

8. Summary and final remarks

In this paper, we have discussed the main economic aspects of the Microsoft case and, in particular, those related to the first of the practices assessed by the European Commission, that is, the refusal to supply the necessary information to make the competitors' work group server systems interoperable with Windows Operating System. We have highlighted that network economies and complementarities between the different elements integrating computer systems are at core issues in the case. We have paid particular attention to the rationale behind Microsoft's strategies according to the economics literature.

According to traditional theories, a (quasi-) monopolist such as Microsoft would not have any incentives to monopolise a complementary market, as it could extract the monopolist rents in complementary market (the work group server operating system market) by raising the price of the monopoly good (Windows operating system). In order for the argument to be correct, a firm must hold an uncontested life-long monopoly position. However, Microsoft showed concerns about the birth of a new computer model based on server, which some competitors were pushing at the time, which could pose a threat on Windows.

We have argued that the case can be viewed as a game between systems or platforms with network externalities: The Microsoft platform (centred on the Windows operating system) and the platform (or platforms) based on servers.

Microsoft could have chosen to protect itself from the threat of other platforms by degrading the compatibility of Windows operating system with work group server operating. The literature on network economics has shown that those markets with network externalities often tip in favour of one of the firms. According to the literature, if two competing systems are incompatible, tipping towards the one with a smaller network cannot occur. Therefore, a dominant firm, such as Microsoft, would have strong incentives to deny compatibility so that to protect its market position.

We have also discussed Microsoft's change of strategy regarding interoperability. The economics literature has shown that when a market is developing, the incumbent firm may choose to achieve high degrees of interoperability to drive up its own demand (as its installed base is small relative to the market potential). When the market is already mature and the firms' network already large relative to the number of new consumers, the incumbent firm would have incentives to protect its competitive advantage by degrading interoperability. This seems to fit well with Microsoft's change of strategy.

All in all, we have found support in the economics literature to the European Commission's argument that Microsoft had incentives to leverage its market power onto the work group server systems. Does this mean that taking action against Microsoft was justified? The advocates of the Schumpeterian paradigm would say it was not. In dynamic markets with network effects, any sort of intervention would be at best wasteful and at worst distorting.

Interestingly, the European Commission seemed to acknowledge that the computer markets are Schumpeterian. At least the decision on the case seems to indicate that,

as the Commission explicitly states that software markets are subject to “shifts in paradigm” (see recital 770 in the EC Decision). However, the Commission did not take the Schumpeter argument as far as saying that intervention would be worthless or would lead to inefficiencies. In fact, the European Commission was concerned about the fact that Microsoft was systematically eliminating potential competitors. The Commission believed that Microsoft was actually hampering dynamic competition by abusing its dominant position in the PC operating systems market. The refusal to supply the necessary information to reach compatibility between work group server operating systems and Windows would be just another example of this general business model.

Furthermore, although the Commission seemed to recognise the threat of the new “server centred” model to the Windows dominance, it considered the market for PC operating systems and the market for work group server operating systems as separate markets. One may wonder whether a wider definition of market could or should have been used, given this potential shift in paradigm. If so, perhaps the outcome of the case would have been more in the line with Microsoft’s interest.

There are other issues regarding the antitrust process in dynamic industries that I believe should be mentioned here. On one hand, the antitrust process can take too long. In highly dynamic industries such as computing, two or three years might be an eternity. In the Microsoft case, the process spanned much longer than that. In fact, Microsoft only announced it would disclose interoperability information in 2008, four years after the initial decision was published and ten years after Sun filed its complaint. New technologies might “die” in that time interval if they are not given a fair chance in the market.

Further, the computer industry is highly globalised while antitrust laws or their enforcement are not. It would be more efficient and appropriate to assess cases in highly globalised industries with major international players on the basis of international antitrust standards and in international courts.

Finally, in highly dynamic industries, it is very difficult to evaluate the welfare effects of firms' actions. In a static setting, prices convey a lot of information regarding welfare. Besides, competition law practitioners have at their disposal some econometric tools, such as the antitrust logit model, which can be used to estimate the impact of firms' actions in a number of situations. However, a welfare analysis in a dynamic setting is typically very complicated and can lead to ambiguous results, as it implies to make a judgement on dynamic efficiency, especially if issues such as innovation incentives and uncertainty are taken into account.

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