Market Leaders, Antitrust Policy and the Software Market

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JEL Code: L11, L13, L16

Key Words: Stackelberg Competition, Free Entry, Leadership, Antitrust Policy

Vol. 5., February, pp.9-30, *Journal of Industrial Economics*, Icfai Press

Abstract

I apply the theory of market leaders and endogenous market structures developed in Etro (2007) to the analysis of an important market of the New Economy, the software market. First, I describe its evolution and different aspects of competition in the market and for the market. Then, I analyize the antitrust cases concerning Microsoft and develop new theoretical arguments on the role of this market leader in its sector and on the bundling and interoperability parts of the European case.

A recent growing literature has analyzed from a theorical and empirical point of view the role of market leaders in sectors with barriers to entry and with endogenous entry. In particular Etro (2007)[1] has developed a full fledged theory of market leaders and based a new approach to antitrust policy on this. This article starts from those results and studies an important example of market leadership and technological leadership, that of Microsoft in the software market, which is also associated with well known antitrust cases. The choice of Microsoft as a symbol of market leadership is somewhat natural: Microsoft is one of the most visible and relevant companies in the New Economy, one of the most innovative firms in one of the most dynamic industries. The antitrust cases in which this company has been involved in both the US and the EU attracted primary attention of media, policymakers and observers. Many important economists were

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[1]See also Etro (2008), Maci and Zigic (2007), Ino and Matsumura (2007), Kato and Honjo (2007) and Erkal and Piccinin (2007) for recent extensions of this approach.

involved in these antitrust cases in both the US and the EU, and many others were inspired by them while developing theoretical and empirical analysis on the structure of the software market, on the role of Microsoft in this market and on the role of antitrust policy for the New Economy.

In a recent important book, Evans *et al.* (2006) have emphasized the crucial role that software platforms are playing in shaping our economies, in enhancing the development of many traditional sectors, and ultimately in affecting our way of living. These "invisible engines", as they call the software platforms, power not only the PC industry but also other industries like those associated with mobile phones and other handheld devices, video games, digital music, and (with strong externalities for the rest of the economy) on-line auctions, online searches and web-based advertising. Their claim is that software platforms and microprocessors are at the basis of a new industrial revolution, exactly as the steam engine had been at the basis of the first industrial revolution (1760-1830) and electric power at the basis of the second industrial revolution (1850-1930). The third industrial revolution began with the introduction of commercial PCs in the early 80s and had a second phase starting in the mid 90s with the diffusion of the Internet. Observers have talked about "Intel economics", "Microsoft economics" or the "Internet economics" to refer to this period of innovations in general purpose technologies, and to describe the ultimate engine of growth in the New Economy.

What follows in this article surveys the wide academic debate on these issues. Our aim is not to provide a comprehensive analysis of the software market or of the role of Microsoft, but to point out relations between the theory of endogenous market structure and the structure of this market, and use this theoretical background to evaluate antitrust issues involving Microsoft.

The article is organized as follows. Section 1 describes the development of the software market within the New Economy, and the role of Microsoft in this environment. Section 2 describes the genesis of the antitrust cases which involved Microsoft and the remaining sections adopt our theoretical instruments in evaluating the basic issues emerging in these cases: whether Microsoft is a monopoly in Section 3, whether its bundling strategies are predatory in Section 4, and whether its innovations should be disclosed to promote interoperability in Section 5. We conclude in Section 6.

1 Analyzing the software sector

In the 1960s, the computer industry was dominated by IBM, which manufactured mainframe computers used by large enterprise customers. These computers were expensive to purchase and expensive to maintain. As a result, very few consumers had access to computers. Apart from IBM, mainframes were offered by firms such as Sperry, Control Data, Philco, Burroughs, General Electric, NCR, ect. In the mid 70s the US market was still dominated by IBM

followed by Honeywell, Burroughs, Sperry, Control Data, NCR, Digital, G.E. and Hewlett-Packard. There was little or no interoperability among mainframes from different vendors. For the most part, an enterprise customer was required to choose an all IBM solution or an all Sperry solution. In the 1970s, Digital Equipment achieved considerable success with a line of less expensive minicomputers that were well-suited to engineering and scientific tasks. Again, however, there was little or no interoperability between these minicomputers and mainframes offered by IBM and others. The structure of the industry at that time was still largely vertical. By 1980, a number of companies had started offering less expensive microcomputers which, again, were not interoperable with one another. Early PCs by Altair, Tandy, Apple, Texas Instruments, Commodore and Atari ran their own operating systems, meaning that applications written for one brand of PC would not run on any other brand: the industry was fragmented. Apple, founded by Steve Jobs and Steve Wozniak in 1976, developed a very successful software platform, especially because of VisiCalc, an electronic spreadsheet which was introduced in 1979 and soon became a killer application for Apple II.

In the early 80s, IBM announced plans to introduce an IBM personal computer. The first one was offered with operating systems (OSs) produced by others: CP/M-86 from Digital Research (a rewrite of the leading OS at the time), UCSD-p System by Softech Microsystems, and PC-DOS developed by Microsoft, a company founded by Bill Gates, a young software architect who dropped out of Harvard University to create what was going to become a symbol of market leadership in the New Economy. Microsoft's OS won the race mainly because it was cheaper than CP/M-86 ($ 40 against $ 240) and faster than p-System. Moreover, Microsoft managed to keep the right to license its OS to other PC makers, under the name MS-DOS: this drove its success in the software market. As Evans *et al.* (2006) noticed, "having multiple operating systems run on a hardware platform is a poor strategy. The idea, of course, was to ensure that the hardware, not the operating system, became the standard that defined the platform and determined its evolution. Indeed, IBM followed an important economic principle for traditional industries: all firms would like everyone else in the supply chain to be competitive. IBM didn't seem to recognize that this was far from a traditional industry... Applications are generally written for software platforms, not the underlying hardware. The more fragmented the installed base of operating systems, the less attractive it is to write an application for any one of them."

Not surprisingly, IBM's multiple-OS strategy did not work, the hardware sector became always more fragmented, with many PC manufacturers producing clones of the IBM PC and most of them running MS-DOS, the exact replica of the operating system running on IBM PCs. In the second half of the 80s IBM reacted by developing a new operating system, OS/2, while Microsoft independently developed Windows, whose lead at that point became unreachable. According to some observers, IBM based its strategy on its brand name and its

research capacity, while Microsoft invested more in supporting the developers of software applications and in what is often called "evangelization": convincing software producers to develop applications for Windows. This was the winning strategy: the share of IBM in the market for the so-called IBM-compatible PCs decreased over time (in 2004 IBM arrived to the point of selling its PC division to Lenovo), while the market share of Microsoft in the software market increased.

Over time, the computer industry had moved from the old vertical structure toward a horizontal structure. This was characterized by a market for chips (Intel as a leader, Motorola, ARM, TI, AMD,..), one for hardware and peripheral equipment (IBM, Dell, Hewlett-Packard, Packard Bell, Compaq, Gateway, Acer, Fujitsu,...), one for operating systems (Windows as a leader, OS/2, Unix, Linux, Solaris,..), one for application software (Office, Scientific Workplace, Adobe Acrobat, Macromedia Dreamweaver,..) and one for sales and distribution, with competition within horizontal levels and higher interoperability across levels. A similar horizontal structure has emerged in the industries for mobile phones and personal organizers. This is not by chance: such decentralized structures can work well when technical interactions between complementary products are stable and well defined, while vertical structures would become too rigid to control them.[2]

1.1 Network Externalities

A software platform is a software program that makes services available to other software programs through external "hooks" called Application Programming Interfaces (APIs). Examples are the operating systems running on PCs as Windows, Mac OS or Linux, those employed by videogame consoles as the Sony one for PlayStation or Windows 2000 for the Xbox, the Symbian operating system for cellular phones, Palm OS for personal digital assistants (PDAs), RIM for the BlackBerry, iPod OS for the Apple iPod, Linux for Google's Android and so forth.

To understand the peculiarities of the software market in general it is convenient to focus briefly on the main functions of PC operating systems. The main one is to serve as a platform on which applications can be created by software developers. OSs supply different types of functionality, referred to as system services, that software developers can call upon in creating their applications. These system services are made available through APIs. When an application calls a particular API, the operating system supplies the system service associated with that API by causing the microprocessor to execute a specified set of instructions. Software developers need well-defined platforms that remain stable over time. They need to know whether the system services on which

[2]Apple, the only large player remaining a fully integrated structure producing both hardware and software for its PCs and for other devices, had to become quite active in attracting applications from other software developers, in order to build network externalities.

their applications rely will be present on any given PC. Otherwise they would have to write the software code to provide equivalent functionality in their own applications, generating redundancy, inefficiency and a lack of interoperability. Moreover, modern OSs provide a user interface, the means by which users interact with their computers. User interfaces for computers have evolved dramatically over the last decades, from punch card readers, to teletype terminals, to character-based user interfaces, to graphical user interfaces, first introduced (at a low price) by Apple with Macintosh in 1984. Finally, OSs enable users to find and use information contained in various storage devices: local ones, such as a floppy diskette, a CD-ROM drive, a jump drive or the hard drive built into a PC, or remote ones, such as local area networks that connect computers in a particular office, wide area networks that connect computers in geographically separated offices, and the Internet.

Over time, the OS of Microsoft became the most popular because Microsoft continually added new functionality and licensed it to a wide range of computer manufacturers with extremely aggressive price strategies. Microsoft recognized early on that an OS that served as a common platform for developing applications and could run on a wide range of PCs would provide substantial benefits to consumers. Among other advantages, development costs would fall and a broader array of products would become available because products could be developed for the common platform rather than for a large number of different platforms. By providing a single OS that ran on multiple brands of PCs, Microsoft enabled software developers to create applications, confident that users could run those applications on PCs from many different computer manufacturers. In addition, applications developed for a single platform are more easily interoperable because they rely on the same functionality supplied by the underlying OS.

The original winning strategy of Microsoft was the creation of these network effects between hardware producers, software developers and consumers: computer manufacturers benefit because their PCs can run the many applications written for Windows and because users are familiar with the Windows user interface; software developers benefit because their applications can rely on system services exposed by Windows via published APIs and because they can write applications with assurance that they will run on a broad range of PCs; consumers benefit because they can choose from among thousands of PC models and applications that will all work well with one another and because such broad compatibility fosters intense competition among computer manufacturers and software developers to deliver improved products at attractive prices. But this argument should not be overemphasized: for many years, PC-DOS and OS/2 had as many applications as Windows, but IBM's decline did not stop. There is indeed another and more traditional element that is fundamental also in the software market: the other crucial aspect of the strategy of Microsoft was its aggressive pricing strategy. This was strengthened through the development of the same network effects: conquering market shares, Microsoft could spread

its huge fixed costs of production over a larger market and reduce the price, which in turn could enhance the network effects.

1.2 Multi-Sided software platforms

Software platforms, as we have seen, deal with multiple sides. Microsoft deals with at least three: consumers, software developers and PC manufacturers. Apple produces hardware internally, hence it deals with the remaining two sides: consumers and software developers. Sometimes relationships are even more complex, as in the platform for smart mobile phones where, beyond OSs, software developers and handset makers, there are network operators (as Vodafone, NTT, T-Mobile, Orange, China Mobile, Telecom Italia Mobile,..) playing a coordinating role.

In the presence of multiple sides with network effects between them, the choice of which ones should be charged more to use the platform is not simple. Rochet and Tirole (2003) have noticed that software platforms, as other similar multi-sided platforms, give rise to market structures that are quite different from the traditional ones. For simplicity, here we will refer to two-sided platforms, which connect two sides in such a way that for each side the valuation of the interactions with the other side depends on the number of agents on the others side. These network externalities, and in particular the non neutral impact of the pricing structure on both sides (and therefore on these externalities) distinguishes a two-sided market from a traditional one-sided market with different consumers (and possibly price-discrimination between them).

An analogous situation to software platforms emerges in many completely different contexts. A classic example, useful to understand the implications of any kind of platforms, is given by newspapers. They are sold to readers, but they also sell advertising space to advertisers: the reader is not only a "customer" of the newspaper, the reader is also a supplier of "eyeballs" that the newspaper sells to advertisers. In this case network effects emerge because advertisers value their advertising more in a newspaper when the number of its readers is higher (the effect in the other direction may exist but is typically less important). This has crucial consequences on the pricing structure since a low price for the readers increases the number of sold copies and in turn enhances the value of advertising. Such a phenomenon is stronger when a newspaper is competing with other newspapers, and a low price reduces the readers of competing newspapers and the value of advertising on these competing newspapers.

Other two-sided platforms include other media networks as television channels, real estate agencies, traditional auction houses, shopping malls, night clubs, payment card systems, telephone networks and many industries of the New Economy as those related with video game consoles, smart phones, digital music, PDAs, i-Mode, search engines (Google), on line communication (Yahoo! and Skype), on line social networks (MySpace, asmallworld, or Second Life), on line academic articles (JSTORE or SSRN) and on line shopping (Amazon and

eBay). In many of these markets, *multi-homing* on at least one of the two sides is common: people often buy more than one journal or watch more TV channels (as companies advertise on multiple medias), hold multiple credit cards (as merchants accept multiple cards) and software developers prepare applications for multiple OSs (while individuals typically use only one).

In each one of these examples, network externalities are crucial to the success of a software platform, and the pricing structure toward buyers and sellers is crucial to the creation of these network effects. In particular, a platform typically ends up charging one of the two sides less than the other, taking into account demand elasticities and which side values the other side more: the aim is to get on board as many agents as possible from one side, so as to increase the value of the platform for the other side and earn more revenue from it. For instance, when the price is the strategic variable, it is optimal to charge the side whose demand is more elastic, because this allows one to maximize the total volume of interactions. Prices will be constrained downward when there are competing platforms (especially in the case of multi-homing), and further bias may emerge for strategic reasons, but the general principles on the balanced price structure between the two sides remain unchanged. In extreme cases, one side may even receive its goods or its services for free or even be subsidized so as to maximize earnings from the other side.

The above theoretical results are fully confirmed by what happens in the above mentioned two-sided markets, whose companies typically settle on pricing structures that are heavily skewed toward one side of the market or, in other words, adopt what is sometimes called a "divide and conquer" strategy. Newspapers, television networks and even websites typically earn more from advertisers than from consumers, real estate agencies earn more from sellers (or from landlords) than from buyers (or renters), auction houses from sellers rather than from the buyers, shopping malls from stores rather than from the shoppers, night clubs from men rather than from women and payment card companies from merchants rather than from cardholders. Similarly, phone operators earn more from originating calls rather than from receiving ones, video game platforms from royalties on game developers rather than from buyers of consoles (that are often sold below cost), while most of the other software platforms, including PC OSs, earn more from end users rather than from software developers.

Notice that, in spite of the network effects, most of these two-sided markets are also characterized by a certain degree of fragmentation between platform providers, often associated with a certain degree of differentiation. Only when technological innovation is particularly important and fixed costs of investment in R&D are high, while marginal costs of production are particularly low, the number of competing platforms is endogenously reduced, as in the above mentioned markets of the New Economy. Nevertheless, tipping on a single leader rarely happens, especially when product differentiation and multi-homing have a role, as for video games. And even in these cases competition for the market

can be quite effective and induce periods of persistent leadership with occasional replacement of the leader: pathbreaking innovations (or "killer applications") are what competitive firms really look for. For instance, in the console video game industry, sequential innovations brought to leadership a number of companies as Atari (that reached 80% share of the market in 1980), Nintendo (90% of the market in 1987), Sega (leader in the early 90s), Nintendo again (in the mid 90s) and Sony with the PlayStation in different improved versions (during the last decade): recently Microsoft Xbox started gaining market shares, and Nintendo is still active, but the leadership of Sony (65% market share in 2004) does not appear under threat yet, especially after the recent successful launch of PlayStation 3. Similarly, after a number of unsuccessful attempts by many companies, Palm's PDA gained success and leadership in the market for OSs for organizers thanks to a simple handwriting recognition system (65% market share in 2000) until Microsoft competing platform and other handheld devices, including Blackberry, Apple's iPhone and (in perspective) Google's Android, started gaining success.

Having described the role of network effects and multi-sided relations, it is now time to return to the software market, where these elements play a crucial role.

1.3 The market leader in the software sector

Microsoft was founded in 1975 by Bill Gates and Paul Allen to develop BASIC interpreters for the first PC, Altair 8800, and then other programming languages. Only later, did it start producing major software programs. In 1981, Microsoft released its first operating system, MS-DOS, which had a character-based user interface that required users to type specific instructions to perform tasks. In 1985, Microsoft introduced a new product called Windows that included a graphical user interface, enabling users to perform tasks by clicking on icons on the screen using a pointing device called a mouse (basically the only piece of hardware produced by Microsoft for PCs). Windows 3.0, shipped in 1990, was the first commercially successful version of Windows. In 1995, Microsoft released Windows 95, which integrated the functionality of Windows 3.1 and MS-DOS in a single operating system. In 2000, Microsoft shipped Windows 2000 Professional, a new generation of PC operating system built on a more stable and reliable software code base than earlier versions of Windows. Windows XP represented a further evolution with a range of added functionality for both business and home users. In 2007 Windows Vista has been released worldwide: it was the fruit of five years of work by eight thousand designers, programmers and testers and of an estimated investment of $ 10 billion to rewrite from scratch a new code. This impressive effort was probably related to the competitive pressure coming from the open source community, which is strongly supported by many large corporations willing to strengthen valid alternatives to Windows.

Even if complete and homogenous data are unavailable, consistent evidence

suggests that the market share of Windows on sales of OSs for PCs rapidly increased towards 80% in the first half of the 90s to gradually arrive at 92% in 1996, 94% in 1997, 95% in 1999, 96% 2001, and remained above 90% since then (while the average consumer price of Windows, calculated as average revenue per licence to PC manufacturers based on Microsoft sales, remained around $ 44-45). Nevertheless, one should keep in mind that Linux, after having made inroads into corporations' server computers, is now expanding into a much broader market, that of employees' PCs, that a minor group of PC users (but strongly increasing in number, especially between expert users) downloads open source OSs from the Internet, and that on the top of this market there are Apple computers running Mac OS. It is clear that Microsoft has reached a robust leadership in the PC operating systems market for Intel-compatible computers. In line with our previous discussion, Evans *et al.* (2006) state four key strategies that have driven Microsoft to become the leader of the PC industry: "(1) offering lower prices to users than its competitors; (2) intensely promoting API-based software services to developers; (3) promoting the development the development of peripherals, sometimes through direct subsidies, in order to increase the value of the Windows platform to developers and users; and (4) continually developing software services that provide value to developers directly and to end users indirectly."

Beyond OSs, Microsoft is the leader in other markets for software applications. Some essential applications have been freely bundled with the operating system: for instance a basic word processing software (WordPad), a browser to access Internet (Internet Explorer) and media player functionality (Windows Media Player) have been gradually added for free to subsequent versions of Windows when they became standard components of a modern OS. Other more sophisticated applications are supplied separately. Most notably this is the case of the Office Suite consisting of the word processor Word (first edition released in 1983), the spreadsheet Excel (1985), the presentation software PowerPoint (1987) and more. The main two applications, Word and Excel, have been successfully competing against alternative products like WordPerfect, WordStar, AmiPro and others on one side and Lotus 1-2-3, Quattro and others on the other side. Liebowitz and Margolis (1999) have shown convincing evidence for which a better quality-price ratio together with network effects were at the basis of this evolution (it is important to note that Microsoft achieved leadership in the Macintosh market, hence without exploiting the presence of its own OS, considerably earlier than in the PC market).

In the market for word processing applications, Microsoft's market share was hardly above 10% at the end of the 80s, but gradually increased to 28% in 1990, 40% in 1991, 45% in 1992, 50% in 1993, 65% in 1994, 79% in 1995, 90% in 1996, 94% in 1997 and arrived to 95% in 1998, remaining around this level afterward. Meanwhile the average consumer price of Word (calculated as average revenue per license) decreased from $ 235 in 1988 to $ 39 in 2001. In the market for spreadsheet applications, Microsoft followed a similar progress, with a market

share of 18% in 1990, 34% in 1991, 43% in 1992, 46% in 1993, 68% in 1994, 77% in 1995, 84% in 1996, 92% in 1997 and 94% in 1998, with minor progress in the following years, while the average consumer price of Excel was decreasing from $ 249 in 1988 to $ 42 in 2001.

Finally, Microsoft is also active in other strategic markets as a follower, in particular with the personal finance software Money (the leader being Intuit Quicken), the operating systems for smart phones Windows Mobile (the leader being Symbian, with a 60% market share in 2004), the video game console Xbox (the leader being Sony PlayStation, with a 65% market share in 2004), the search engine based portal Windows Live (the leader being Google, with more than 80% of searches on the Internet) and more. In 2006, Microsoft, led by the CEO Steve Ballmer, had revenues of $ 44.2 billion, 60% of which derives from Windows and Office, and net income of $ 12.4 billion, 80-90% of which derives from Windows and Office.

2 Antitrust in the New Economy: the Microsoft cases

Microsoft's leading position induced large opposition in the industry and the emergence of multiple antitrust cases with importance at the global level. Microsoft has been under investigations in the US by the Federal Trade Commission and the Department of Justice since 1990, primarily for its contracts with computer manufacturers and for bundling secondary products with its OSs. However, the most important US case began only in the late '90s under the Democratic Clinton Administration, followed after a few years by the EU case.

2.1 The American case

In the main Microsoft vs. US case, started in 1998, the software company was accused of protecting its monopoly in the OS market from the joint threat of the Internet browser Netscape Navigator and the Java programming language, which could have developed a potential substitute for OSs allowing software applications to run on hardware independently from the desktop OS. Basically, the hypothetical threat for Microsoft was the development of an alternative to the software platform based on the OS, a sort of middleware platform or a web-based platform leading to the "commoditization" of the OS (as ten years before the software platform led to the commoditization of hardware), and hence to the loss of leadership of Microsoft. Microsoft reacted by improving its Internet Explorer (IE) browser, engaging in contractual agreements with computer manufacturers and Internet service providers to promote preferential treatment for IE, and finally tying Windows with IE.

As Klein (2001) pointed out, "Microsoft spent hundreds of millions of dollars developing an improved version of its browser software and then marketed it ag-

gressively, most importantly by integrating it into Windows, pricing it at zero and paying online service providers and personal computer manufacturers for distribution. All of this was aimed at increasing use of Microsoft's Internet Explorer browser technology, both by end users and software developers, to blunt Netscape's threat to the dominance by Windows of the market for personal computer operating systems." Microsoft's investments in browser technology, which largely improved IE until it became a superior product compared to Netscape Navigator (see the empirical analysis in Liebowitz and Margolis, 1999), and Microsoft's pricing of IE at zero (as always since then) appear to us as examples of aggressive strategic investment and aggressive pricing by a market leader facing competition, and not as anti-competitive strategies. According to Klein (2001), "a crucial condition for anticompetitive behavior in such cases is that the competitive process is not open. In particular, we should be concerned only if a dominant firm abuses its market power in a way that places rivals at a significant competitive disadvantage without any reasonable business justification. Only under these circumstances can more efficient rivals be driven out of the market and consumers not receive the full benefits of competition for dominance. The only Microsoft conduct ... that may fit this criteria for anticompetitive behavior are the actions Microsoft took in obtaining browser distribution through personal computer manufacturers"

This is correct: a number of contractual restraints imposed by Microsoft on its distributors were potentially harmful and have been correctly forbidden.

After a failed attempt by Judge Richad Posner to mediate in settlement negotiations, Judge Thomas Penfield Jackson decided to impose heavy behavioral and structural remedies on Microsoft, including the break up in an operating system and an application company (the so-called "Baby Bills", as Baby Bells were the companies derived from the 1984 break up of AT&T). At the time, this draconian remedy was criticized by many economists with different perspectives on the case, for excessively penalizing the company without a clear relation between the punishment and the alleged crime, and for inducing perverse consequences for consumers. For instance, on the pages of *The New York Times*, Paul Krugman pointed out the risk of creating two monopolists engaging in double marginalization "The now 'naked' operating-system company would abandon its traditional pricing restraints and use its still formidable monopoly power to charge much more. And at the same time applications software that now comes free would also start to carry heftly price tags" (Krugman, 2000).

After the appeal phase and the return of the Republican Administration with George W. Bush, the DOJ changed attitude looking for a settlement. The November 2002 ruling of the District of Court decided on behavioral remedies aimed at preventing Microsoft from adopting exclusionary strategies against firms challenging its market power in the market for OSs. Moreover, the Court adopted forward looking remedies that required limited disclosure of APIs, communication protocols, and related technical information in order to facilitate interoperability, and created a system of monitoring of Microsoft's compliance

which has been working quite well in the last years. Since other derivative private actions have also been dismissed or settled, it seems that this long-standing conflict has arrived to its end in the US.

2.2 The European case

The Microsoft vs. EU case was subsequently developed on somewhat similar issues. In particular, Microsoft has been accused of abuse of dominance in the market for OSs through technological leveraging and in particular in two ways: first, by bundling Windows with Media Player, a software for downloading audio/video content, and, second, by refusing to supply competitors with the interface information needed to achieve interoperability between work group server OSs and Windows. Contrary to the US case, the bundling part of the EU case is a traditional case of bundling, since the competitors in the secondary market, notably RealNetworks, do not represent a threat for Windows, the primary product of Microsoft.

In the famous antitrust decision of March 24, 2004, Competition Commissioner Mario Monti imposed on Microsoft the largest fine in the history of antitrust (€ 497 million), required Microsoft to issue a version of its Windows operating system without Media Player, and mandated the licensing of intellectual property to enable interoperability between Windows PCs and work group servers on one side, and competitor products on the other side. After this decision, Microsoft paid the fine, developed and released a version of Windows without Media Player, and entered into extensive discussions with the Commission about the implementation of the remedies concerning interoperability. In the original decision this required to prepare a complete and accurate interface documentation describing portions of Microsoft server operating system software and to license innovations created by Microsoft under "reasonable and non discriminatory" (so-called RAND) terms to competitors. These imply that the royalties should be set at levels that enable use by other developers in a commercially practicable way with reference to standard valuation techniques, to an assessment of whether the protocols are innovative, and with reference to market rates for comparable technologies.

Over time, the new Competition Commissioner Neelie Kroes has continued to extend the scope of the information required, from information that would enable interoperability with Windows PCs and servers for the purpose of creating new products for which there is unmet consumer demand, to information that would allow a competitor to produce clones or "drop-in replacements" of the Windows server OS. Even more controversially, the Commission's Competition Directorate-General has sought to loosen the terms under which Microsoft would be able to licence its information, so as to allow products implementing its technical specifications to be released under so-called Open Source licences (DG Competition was prepared to make an exception for technologies that involved an inventive step and were considered novel by comparison with the prior

art, thus meeting the criteria for patentability). Such release, by revealing to the world Microsoft's own implementations of its technical specifications, would irreparably undermine the trade secret protection to which these technologies, some of which are not patented, are subject. In a further shift, the Commission made clear in Spring of 2007 that it expected Microsoft to forego royalty payments on any technologies that were not covered by patents. With the compliance process made more difficult on both sides by the technical complexity of the material and key policy differences (e.g. over the intellectual property issues), DG Competition challenged Microsoft to comply with the interoperability remedy by 15 December 2005, on pain of massive penalty payments for non-compliance. In early 2006, Microsoft provided further information needed for interoperability purposes, and even made available to its competitors selective access to the source code of Windows. Nevertheless, in July 2006 the Commission levied fines of € 1.5 million a day from the December hearing onwards (for a total of other € 280.5 million), and threatened to double the fine if the company did not comply.

On September 17, 2007 the Court of First Instance concluded the Appeal of the Microsoft vs EU case and essentially upheld the 2004 Commission decision, finding that Microsoft abused its dominant position both for bundling the operating system Windows with Windows Media Player (WMP) and for the refusal to supply interoperability information in the work group server operating system market. The fine was also confirmed, while the Court annulled parts of the 2004 decision relating to the appointment of a monitoring trustee, which had no legal basis in the Community Law.

3 The role of Microsoft in the software sector

While a comprehensive analysis on the PC operating system market and of the role of Microsoft is beyond our scope, we can try to provide a basic interpretation of a few features of this market through the simple ideas developed in the theoretical part of this book. The technological conditions in the software market are relatively simple. Production of an operating system, as any other software, takes a very high up-front investment and a roughly constant and low (close to zero) marginal cost. Demand conditions are more complex. What drives demand is not the traditional concept of product differentiation, which is of course present, but the development of network externalities: network effects are crucial in the development of a market for an OS and the pricing structure is fundamental to get on board both end users and application developers. Beyond this, a firm producing OSs faces competitors: the entry conditions in the market for OSs are quite debated, but there are good reasons to believe that even though entry into the software market may entail large costs, it is substantially endogenous. First of all, there are already many companies distributing OSs (for instance Solaris by Sun Microsystems, many versions of Unix and Linux,

those by Red Hat and Novell), there are many firms producing OSs for related industries (smart phones, PDAs and videogames) which could be scaled-up to run on desktop computers (especially on low cost PCs), and there are even more potential entrants (think of the giants in adjacent sectors of the New Economy, hardware and telecommunications in particular). Second, it is hard to think of a market which is more "global" than the software market: demand comes from all over the world, transport costs are virtually zero, and the knowledge required to build software is accessible worldwide.

Nevertheless, it has been claimed that in the market for OSs, the high number of applications developed by many different firms for Windows represents a substantial barrier to entry. It is probably true that high quality products make life harder to the competing products, but this should not lead to the conclusion that quality is a barrier to entry, especially in sectors where innovation should drive competition. Moreover, it is true that competitors need to offer a number of standard and technologically mature applications upon entry to match the high quality of the Windows package and create network effects (and some do offer many already), but the cost of offering these applications is unlikely to be prohibitive compared to the global size of this market. There are at least two reasons for this. First, notice that the alleged "applications barrier to entry" is often erroneously associated with thousands of applications written for Windows, while it is actually limited to a handful of applications such as word processing, spreadsheet, graphics, internet access and media player software, which really satisfy the needs of most active computer users. Second, the competitors of Microsoft should not (and the existing ones do not) even finance the development of all the needed applications: they should just fund and encourage other firms to write applications for their OSs, or have old applications originally written for other OSs "ported to" theirs, which is what already happens since multi-homing is common practice on the side of software developers.

In essence, the software market is characterized by network effects, high fixed costs of R&D, constant marginal costs of production close to zero and substantially open access by competitors able to create new software. According to the theory of market leaders, these are the ideal conditions under which we should expect a leader to produce for the whole market with very aggressive (low) prices. Hence, it should not be surprising that, at least in the market for operating systems, a single firm, Microsoft, has such a large market share. We can see the same fact from a different perspective: since entry into the software market is endogenous, the leader has to keep prices low enough to expand its market share to almost the whole market.

3.1 Competition in the software market

Many economists agree on the fact that Microsoft sells Windows at an extremely low price. For instance, Fudenberg and Tirole (2000) notice that both sides in

the US Microsoft case admit that "Microsoft's pricing of Windows does not correspond to short run profit maximization by a monopolist. Schmalensee's direct testimony argues that Microsoft's low prices are due at least in part to its concern that higher prices would encourage other firms to develop competing operating systems" even if, they add, "neither side has proposed a formal model where such 'limit pricing' would make sense."

To verify in the simplest way that the price of Windows does not correspond to the monopolistic price for the OS market, assume for simplicity that the marginal cost of producing Windows is zero, and that the price of hardware is constant and independent from the price of Windows. Demand for Windows is clearly a derived demand, in the sense that it depends on the demand for PCs and on the total price of PCs in particular. Standard economic theory implies that the monopolistic price for an operating system should be the price of the hardware divided by $\epsilon - 1$, where ϵ is the elasticity of demand for PCs (including both hardware and software): it means that a 1% increase in the price of PCs reduces demand by ϵ %.[3] Now, this relationship tells us that, if the basic price of the hardware is € 1000, which is about the current average price for a PC, the monopolistic price for Windows would be other € 1000 if $\epsilon = 2$, it would be € 500 if $\epsilon = 3$, it would be € 333 if $\epsilon = 4$ and so on. Foncel and Ivaldi (2005) estimate this elasticity on the basis of a panel data of all PC brands sold in the G7 countries over the period 1995-1999 and derive a value between $\epsilon = 1.5$ and $\epsilon = 3$ with a best guess slightly above two. The moral is that it would take really unreasonable values of demand elasticity to even get close to the real price of Windows, which is around € 50. Moreover, the above estimate of the monopolistic price is very conservative. In the real world, we can imagine that the price of hardware is not completely independent from the price of Windows: if the latter would double tomorrow, hardware producers would be forced to somewhat reduce their prices (eventually switching to lower cost techniques and/or lower quality products). Even if this effect may be limited by the high level of competition in the hardware sector, it works in the direction of further increasing the hypothetical monopolistic price, that is, even beyond the actual price of Windows. Finally, let us remember what we pointed out in our previous discussion on the software platforms: a two-sided platform like Windows earns its revenue entirely from end-users, and not from software developers, which are typically subsidized by Microsoft to develop new and better applications to strengthen network externalities. Hence, the low price of Windows appears

[3] Formally, let us assume that the price of the hardware is fixed and independent from that of the software. Given a demand $D(h+w)$ decreasing in the price of the hardware h plus the price of Windows w, the gross profit of a monopolist in the OS market would be $wD(h+w)$ and would be maximized by a price of Windows w^* such that $D(h+w^*) + w^* D'(h+w^*) = 0$ or:

$$w^* = \frac{h}{\epsilon - 1}$$

with ϵ elasticity of demand.

further away from what should be the hypothetical monopolistic price.

Hall and Hall (2000) developed similar calculations to the one above assuming Nash competition in quantities in the hardware market and suggested that Microsoft has to adopt a low price for Windows as a rational strategy in front of endogenous entry in the PC market. Their conclusion is consistent with the results of the theory of market leaders and endogenous entry: "not only is the price of Windows brought down to a small fraction of its monopoly price, but the social waste of duplicative investment in operating systems is avoided as well."

It has been claimed that low Windows pricing may be explained with higher pricing of the complementary applications, as the Microsoft Office suite. However, the combined price of Windows and the average application package sold with it is still below the monopolistic price. Moreover, these applications are not sold at lower prices for other OSs. As Nicholas Economides pointed out "Windows has the ability to collect surplus from the whole assortment of applications that run on top of it. Keeping Windows' price artificially low would subsidize not only MS-Office, but also the whole array of tens of thousands of Windows applications that are *not* produced by Microsoft. Therefore, even if Microsoft had a monopoly power in the Office market, keeping the price of Windows low is definitely not the optimal way to collect surplus" (Economides, 2001).

What does all this tell us? Simply that Microsoft is not an unconstrained price-setter, while its prices are limited well below the monopolistic price to compete aggressively with the other firms active in the operating system market and with the potential entrants in it. Economides (2001) concludes in a similar fashion: "Microsoft priced low because of the threat of competition. This means that Microsoft believed that it could not price higher if it were to maintain its market position." The empirical work of Foncel and Ivaldi (2005) supports the same conjecture: "Microsoft seems to behave as if it fears that charging monopoly prices today would cause it to lose substantial profits to competitors in the future."

Indeed, we can say more than just that Microsoft is not a monopoly. What the post-Chicago approach suggested about leaders in markets with price competition was that they should be accommodating and exploit their market power, setting higher prices than competitors, or otherwise engage in predatory pricing and, after having conquered the whole market, increase prices. But in the last 10-15 years of global leadership, Microsoft has done neither of these things. Microsoft has been constantly aggressive, which, according to the theory of market leaders developed in this book, is exactly what a leader under the threat of competitive pressure would do.

The theory of market leaders has shown that a market leader in these conditions would price above marginal cost in such a way to compensate for the fixed costs of investment and obtain a profit margin (over the average costs of production) thanks to the economies of scale derived from the large (worldwide in the case of Microsoft) scale of production. Its (quality adjusted) price should be

below that of its immediate competitors, or just low enough to avoid that they can exploit profitable opportunities in the market. The low price of Windows induced by competitive pressure and network effects explains its large market share. As Posner (2001, p. 278) has pointed out acutely, in such a market "a firm may have a monopoly market share only because it is not charging a monopoly price."

The significant preference that customers attribute to Windows even in the presence of good alternative products, some of which are supplied at no charge (!), suggests that Microsoft is still providing the package with the best quality-price ratio in the software market, at least if we believe in the rationality of consumers.

3.2 Competition for the software market

It is also important to look at competition in the software market in a dynamic sense, that is competition for the market, as opposed to the competition in the market examined until now. As we have emphasized many times, high-tech sectors can be seen as races to develop new products before others and conquer large market shares with the new products. On the basis of the so-called Arrow effect, we know that incumbent monopolists that do not face endogenous pressure in the competition for the market have small incentives to invest in R&D because, by innovating, they only obtain the difference between the value of the next technology and that of their current technology, while outsiders obtain the full value of replacing the incumbents. However, the theory of market leaders developed in Etro (2007) has shown that, when leaders face competitive pressure, they are induced to invest more in R&D than any other competitor, with the incentive of defending their leadership from a rapid replacement.

Let us look at the incentives to invest in the software market. Of course, the overall expected value of Windows Vista for Microsoft can be quite high, but the net value of replacing Windows XP with Vista has been only a small percentage of that value, especially if we take into account that the real price is not likely to increase and that the introduction of Vista is only gradual (and associated to the change of hardware for most customers). At the same time, the value of developing a successful OS for a competitor of Microsoft is incomparably higher. The Arrow effect would suggest that Microsoft has lower incentives to invest in R&D than the other active firms if further entry in the competition for the OS market is not possible. However, the theory of market leaders replies that this is not the case when entry is endogenous. Accordingly, this supports the idea that only strong pressure in the competition for the market could have led Microsoft to undertake an unprecedented investment to rewrite from scratch, develop and release a brand new OS as Windows Vista. This pressure, we conjecture, comes mainly from the new actors in the software market, the open source community and the commercial companies that are active around this community. At the same time, it is reasonable to conjecture that the wide

and fast growing open source community and the commercial companies behind it are investing so much in R&D exactly because they envision the possibility of replacing the leadership of Microsoft. In light of this, the software market appears as a dynamic sector characterized by strong competition for the market and by a leader that is both a source and a cause of innovation, quite the opposite of how it is sometimes depicted.

Similar ideas appear behind the words of the leading scholar of the Chicago school on the software industry "We have seen all manner of firms rise and fall in this industry—falling sometimes from what had seemed a secure monopoly position. The gale of creative destruction that Schumpeter described, in which a sequence of temporary monopolies operates to maximize innovation that confers social benefits far in excess of the social costs of the short-lived monopoly prices that the process also gives rise to, may be the reality of the new economy. This is especially likely because quality competition tends to dominate price competition in the software market industry. The quality-adjusted price of software has fallen steadily simply because quality improvements have vastly outrun price increases" (Posner, 2001, pp 249-50).

4 Tying

On September 17, 2007 the Court of First Instance concluded the Appeal of the Microsoft vs EU Commission case and essentially upheld the 2004 Commission decision, finding that Microsoft abused its dominant position for bundling the operating system Windows with Windows Media Player (WMP). Here, I will comment on this ruling and its consequences from an economic point of view.

The reasoning of the Commission on the bundling part of the case, substantially adopted by the CFI ruling is based on the following points:

1) media players would be separate products from OSs, therefore OSs and media players would characterize two distinct markets: a primary market for OSs and a secondary one for media players;

2) Microsoft is the leader of the primary market with an extremely large market share, therefore Microsoft is a dominant firm; Microsoft has engaged in pure (not mixed) bundling, therefore consumers would have no choice to obtain their optimal bundle;

3) the bundling strategy of the dominant firm may foreclose competition in the secondary market, therefore it would represent an abuse of a dominant position. In particular, potential foreclosure would occur through an indirect network mechanism:

3.1) content providers would choose to encode in a single media format and software developers would develop their technologies to be used on a single media format to save in costs;

3.2) the ubiquity of WMP obtained through bundling would lead content providers and software producers to limit their applications to WMP to reach

the maximum percentage of consumers;

3.3) all consumers would use exclusively WMP since this would allow most of the content to be available.

Each one of these points is problematic. Contrary to the claim in point 1), the fact that virtually all PCs (including those with other OSs than Windows) are sold with media player functionalities shows that there is not consumer demand for OSs without media player software, therefore there is not a distinct market for OSs without media players. Focusing on the existence of consumer demand for media players and emphasizing the existence of a separate market for media players (with the notable feature that its equilibrium price is zero), the Commission has ignored the recent evolution of the software market establishing a distinction that does not exist anymore. Whether or not consumer demand exists for the tied product is the wrong question to determine whether there are two distinct markets; the correct question is whether there is any significant consumer demand for the tying product without the tied product. Unless the analysis focuses on this question, there is a danger that the mere existence of consumer demand for the tied product may prevent the emergence of efficient tying arrangements and end up protecting suppliers of tied products at the expense of consumers and innovation. To exemplify our doubts, notice that, while there is clearly consumer demand for shoelaces, this should not mean that shoes and shoelaces are distinct products for the purposes of tying analysis. This issue can only be addressed by asking whether there is consumer demand for shoes without shoelaces.

Moreover, in the case of technical integration of two products that were previously distinct, the distinct products test itself may not be helpful for understanding market dynamics because, by definition, this test is backward-looking. A better approach in these cases would be simply to ask whether the company integrating the previously distinct products can make a plausible showing of efficiency gains in the interest of consumers: since technical tying is normally efficient, market leaders would be able to continue producing innovative products benefiting consumers without running systematic risk of incurring in the prohibitions on tying. None of this has been taken in consideration in the Microsoft case. Finally, since tying usually enhances price competition, it should never be abusive when it is standard commercial practice, which is also indirect evidence that such tying generates efficiencies, or that there is no demand for the unbundled product.

Ignoring altogether the efficiency rationale of bundling in an innovative and rapidly evolving sector, the Commission has clearly rejected the traditional approach to bundling associated with the so-called Chicago School. On the contrary, the points 2) and 3) show that the Commission has entirely adopted one of the thesis of the so-called post-Chicago approach to antitrust (Whinston, 1990, 2001): this theory suggests that bundling is used by a dominant firm to foreclose competition by a rival in the tied product market. The defense of Microsoft has been largely based on stressing the technological nature of the integration of

Windows and WMP and the speculative nature of the indirect network theory. In reality, the reasoning of the Commission has other major problems that have emerged only indirectly in the case, and that brings us straight to the interests of consumers, which should be always the priority.

The economic rationale of the Commission is based on the idea that a monopolist in a primary market would bundle the primary good with a secondary good to strengthen price competition and to induce the exit of a rival which is exclusively active in the secondary market; the ultimate purpose of the monopolist would be to extend its monopoly power to both the primary and the secondary market. This idea is associated with the post-Chicago approach to antitrust, and in particular with the work of Whinston (1990): bundling for predatory purposes is indeed a realistic possibility and in theory it may induce harm to consumers. Nevertheless, it is also well known between economists that this theory does not work when (Etro, 2007):

a) the secondary market is characterized by rapid and endogenous entry and evolving technological conditions;

b) product differentiation which allows multiple secondary goods to be consumed with the primary good.

Under these conditions, bundling has the usual role of strengthening price competition, but the constant competitive pressure (both effective and potential) in the secondary market does not allow the bundling firm to increase the prices, and the level of product differentiation allows the rivals to maintain large market shares. As a consequence, the only reason for which bundling occurs is a normal form of healthy competition, which induces a reduction in the price level for both the bundle and the secondary goods, does not deter entry, and increases consumer welfare.

In other words, while the Commission would be correct in endorsing the post-Chicago theory to bundling cases in which a monopolist in a primary market faces a single competitor in a secondary market and induces the exit of the latter through bundling, the Commission is erroneously applying the same theory when the secondary market satisfies conditions a) and b) above. I will now point out the reasons for which these conditions are indeed satisfied in the software sector.

First of all, the last decade has witnessed a rapidly evolving composition of the market for media players, with constant introduction of new and better products by multiple firms. Currently the most used media player is not even WMP, but Flash by Adobe, which is the media player commonly used to watch videos on YouTube. Competition is quite strong, to the point that the price of all the most used media players corresponds to the marginal cost, which in this market is zero, and the buying costs for consumers are also close to zero since these products can be freely downloaded in a few seconds online.

Second, the supply of media players is characterized by a substantial product differentiation, with some media players that are developed for audio content, some that are better for video contents, others for music content, and still others

that are ideal for storing music files, and so on. Not by chance, most consumers have multiple media players and use different media players for different purposes and for different contents. Also for these reasons, content providers and software developers provide content and applications that interoperate with all the most used media players: this is what allows the maximum percentage of customers to be reached.

Consequently the bundling strategy of Microsoft could be simply seen as an aggressive and competitive strategy of a market leader active in a secondary market where entry is indeed endogenous. Moreover, in these markets the standard strategy is to provide free software to enhance network effects and earn from externalities associated with the use of the software (a typical strategy in multisided markets). For instance, in the case of digital media platforms, Microsoft looks for network effects on licenses of its OS, Real earns from content subscriptions, Apple from sales of digital audio and video devices (the iPod and, in perspective, the iPhone) and Adobe from Flash server sales. This implies different levels of platform integration and interoperability with different platforms. As Evans *et al.* (2006) noticed: "At one extreme is Apple. Its iPod/iTunes platform is integrated into the hardware and content-provider sides of the media platform, and its doesn't interoperate with any other platform. At the other extreme is Microsoft, whose media platform is integrated into neither hardware nor content and which interoperates with all other media platforms that allow it to do so. In the middle are vendors like RealNetworks, which limit interoperability - but not completely - and integrate - but only partially - into the content provider side." Even if these companies adopt very different business models, competition is quite intense because multi-homing is common practice: end users typically use multiple media players, and also PC manufacturers typically install multiple competing media players at their will (while this is not the case for digital music devices and mobile phones).

5 Software innovations and interoperability

In Etro (2007, Ch. 4) I have discussed the role of market leaders in innovative markets and the importance of the protection of IPRs in stimulating investment in R&D and technological progress. Both aspects are quite relevant in the understanding of the dynamics of the software market and the Microsoft case.

The software market is a major example of an industry where competition is mainly for the market, and in such a case, as we have seen, large market shares by single firms are a typical outcome. The counterpart of this, of course, is that these industries can exhibit catastrophic entry where innovators can replace current leaders quite quickly. As we noticed in Chapter 4, in such an environment, it is exactly when competition is open that leaders have incentives to invest deeply to retain their leadership. On the contrary, when competition for the market is limited, technological leaders are able to have a quiet life,

invest less in R&D and accept the risk that someone will come up with a better product. When competition for the market is open, this same risk is too high and incumbents prefer to accept the challenge and try to innovate first: this leads to a more persistent leadership.

When entry is endogenous, innovation by leaders creates a virtuous circle that also has important implications for the way we can evaluate such a market. The endogenous persistence of the technological leadership has a value that creates incentives for all firms to invest even more, which in turn strengthens the same incentives of the leader to invest and retain its leadership, and so on. In other words, persistence of leadership is a source of strong competition for the market (through investments in R&D to replace the current leader), and, given that leaders have higher incentives to invest as long as the race to innovate is open, we can also conclude that strong competition for the market is a source of persistence of leadership. This circular argument may appear paradoxical, but is the fruit of a radical distinction between static and dynamic competition: once again, there is no consistent correlation between market shares and market power in dynamic markets.

The endogenous multiplicative effect of the value of leadership that we have just summarized implies that in dynamic markets the rents of a leader may be spectacularly larger than those of its competitors, and the market value of a leadership may be extremely large even if the market is perfectly competitive in a dynamic sense. In our view, this is something not too far from what we can see in the software market and in the leadership of Microsoft, but also in many other high-tech sectors.

The source of the value of innovation, the starting point of the chain of value that we just described, must be a fundamental rent associated with innovations and protected through IPRs. Hence, all forms of IPRs are the ultimate source of leadership, innovation and technological progress. As we already noticed, the role of patent legislation is exactly to trade off the benefits of patents in terms of incentives to innovate with the costs related to temporary monopolistic pricing. In our opinion, there is no reason why antitrust authorities should interfere with this legislation when patent protection appears inconsistent with other goals. And even if these goals are legitimate and relevant, introducing a discretionary evaluation of IPRs would create uncertainty and jeopardize the investment, which, after all, goes against the ultimate objective of the same antitrust authorities.

Nevertheless, in the Microsoft case the EU Commission and, in its recent judgement, the CFI have taken this dangerous direction, asking Microsoft to disclose a wide amount of technologies. In the Statement of Objections of March 1, 2007 the Commission has arrived to the point of asking to make them available royalty free unless they have an innovative nature (meaning that they involve an inventive and novel step compared to the prior art). Finally, it has started questioning the same innovative nature (and with it the license pricing) of most technologies that Microsoft was forced to disclose, technologies which are also

covered by many patents approved by US and EU patent offices. This creates an even stronger contradiction between patent law and antitrust policy in the EU, and also a substantial divergence between the US approach to IPRs and the EU approach, with the former much more careful in protecting IPRs and promoting R&D.

It is important to add that new ideas, including those underlying Microsoft software, are not protected only with patents. Not all inventive and innovative activities fall under the scope of patentability and it is not always in the interest of a firm to patent every single innovation. In most high-tech sectors, firms adopt a combination of patents and trade secrets to protect products that are the result of multiple innovations. Defending (intellectual or material) property rights is one of the fundamental conditions for proper functioning of the market economy: defending trade secrets should not play a minor role in this context.

Some of the most famous trade secrets are the formulas of Coca-Cola, Chanel No. 5 and Campari. Consider the first example and imagine that Coca-Cola was required to disclose its secret formula: anyone could reproduce the very same drink, "clone" it under a different name if you like, but it is hard to believe that this would create large gains for consumers. Close substitutes to Coke already exist and there are small margins to substantially reduce prices. However, the incentives for any other firm in the same industry to invest and create new products could be drastically reduced if trade secrets were not protected.

High-tech sectors are more complicated. In these sectors, patents and trade secrets often cover fundamental inventions and protecting those inventions amounts to promoting innovations that today are the main engine of growth. In some fields, however, there maybe, at least apparently, a trade-off between trade secret protection and "interoperability" between products - broadly speaking, this is the ability of heterogeneous information technology systems, components and services to exchange and use information and data, especially in networks. Interoperability is important in the PC industry and, as shown above, the level of interoperability has strongly increased in the last decades. Problems arise, however, when interoperability is confused with "interchangeability" or with a right to clone the innovations of the competitors. Any forced disclosure of similar trade secrets represents an expropriation of legitimate investments and establishes inappropriate legal standards with perverse effects on the incentives to innovate.

Fortunately, giving up the precious role of IPRs in promoting innovations is not the only way to solve interoperability challenges. The market can do it much better: valuable ideas can be selectively commercialized on a voluntary basis through licenses, for instance under RAND (reasonable and non discriminatory) terms, a type of licensing typically used during standardization processes to promote the rapid adoption of standards and new technologies and to encourage entry. The RAND terms include a definition of reasonable royalties, and can include further restrictions as field-of-use clauses (that allow licensees to utilize a patented technology in a use that is directly related to the implementation of

the standard), reciprocity clauses, or limits to sublicensing.

Coase (1960) has clarified that whenever there is social value to generate, the market will properly allocate all the property rights. This is also true for the intellectual property rights: market mechanism can allocate them efficiently, insure the accessibility of the information that fuels interoperability and acknowledge legitimate ownership rights of the innovators, so as to enhance R&D investments. But in the presence of network effects dynamic market forces can do even more: as long as IPRs are well protected and firms can invest with the safe confidence that successful innovations will be rewarded, market forces can select the best standard when multiple standards are available and interoperability is only partial. Liebowitz and Margolis (1999) have shown that this is the case in many episodes. For instance, in the adoption of the common QWERTY keyboard for PCs (so-called from the first five letters on the top left): for years it has been claimed that the allocation of letters of this keyboard was an inefficient standard, while these researchers found that evidence suggests that the Qwerty keyboard, somehow selected by the market, is not worse than any other alternative.

In conclusion, also in this field, markets can properly balance the short run and long run interests of consumers better than policymakers: promote innovation, enable an efficient degree of interoperability and select the best standards. It would have been better to leave the ruling of intellectual property protection and of its limits to the legislative level rather than creating an important precedent, as the on of the Microsoft case, for which antitrust authorities could force firms to reveal their IPRs.

6 Conclusions

In this article we have focused our attention on the New Economy, which was developed in the last decades around the PC industry and the Internet. The New Economy has spread rapidly all over the world thanks to what we are used to call globalization. Markets in the New Economy work in a radically different way from markets in the Old Economy, both on the supply and demand side. On the supply side, while traditional sectors are often characterized by competition *in* the market with substantial product differentiation and U-shaped cost functions, many markets of the New Economy are often driven by competition *for* the market taking place through high fixed costs of investment in R&D, and production is typically characterized by small and constant marginal costs. Beyond this, looking at the demand side, many markets of the New Economy exhibit network effects and are often multi-sided, in the sense that firms act as platforms for different types of customers with complex network effects between them.

These strong differences require a new approach to the analysis of markets and of the behavior of their leaders. In the absence of such a new approach,

it is not surprising that in the last years the attention of antitrust authorities around the world has been often biased against market leaders in the sectors of the New Economy. These dynamic sectors are certainly not less competitive than others, but are often characterized by large market shares for their leaders and aggressive strategies which are the symptom of heavy competition. Leaders might enjoy high market shares yet be subject to massive competitive pressure to constantly create better products and sell them at lower prices, due to threats from innovative competitors and potential entrants.

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