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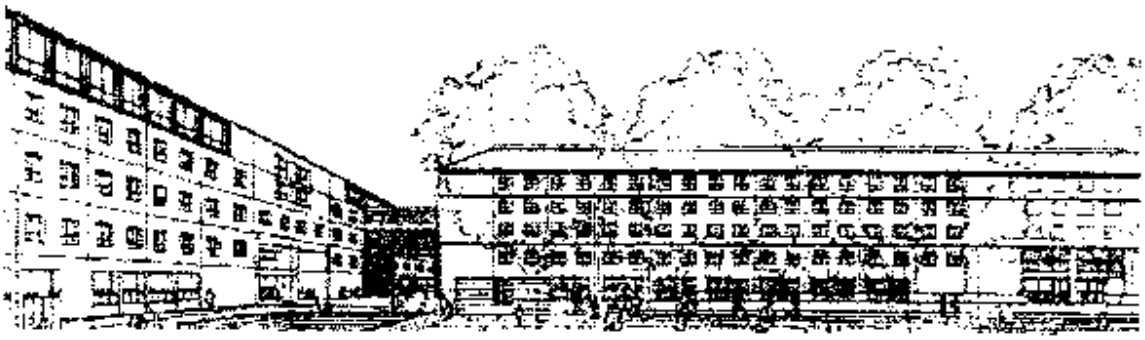

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THE THEORY OF MARKET LEADERS, ANTITRUST POLICY AND THE MICROSOFT CASE

by Federico Etro[1]
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The New Economy, characterized by dynamic, global and innovative markets, requires a new way to approach many economic issues and also a new way to approach policymaking. This work will analyse a new approach toward competition policy based on recent progress in the theory of market leaders and discuss its implications with special reference to the markets in the New Economy, whose distinctive features, namely high fixed costs of R&D, less relevand marginal costs of production and network effects, require a different approach from traditional markets. Close attention will be given to the software market, whose market leader has been (and still is) the subject of the attention of antitrust authorities around the world. For a more extensive discussion see Etro (2007).

The work is organized as follows. In Section1 I will present a brief overview of antitrust policy in US and EU and I will try to motivate the need for a new approach to competition policy, especially for the markets in the New Economy. Section 2 will survey traditional approaches to competition policy, while Section 3 will present the innovations associated with the theory of market leaders. Section 4 will apply the new approach to general issues of abuse of dominance with particular reference to the software market and to the Microsoft case. Section 5 will deal with bundling issues again with reference to the software market. Sections 6 will move to competition for the markets and to interoperability issues which are crucial for the dynamic markets of the New Economy. Section 7 concludes, while the Appendix contains some more technical results on the behaviour of market leaders.

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1 Competition Policy in US and EU

In the United States the main federal antitrust statute is the Sherman Act of 1890, which was developed in reaction to the widespread growth of large scale business trusts. Section 1 prohibits restraints of trade in general, while Section 2 deals with monopolization stating that:

> "Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a felony"

Enforcement is shared by the Antitrust Division of the Department of Justice and by the Federal Trade Commission. The current interpretation of US antitrust law associates abusive conduct with predatory or anticompetitive actions having the specific intent to acquire, preserve or enhance monopoly power distinguished from acquisition through a superior product, business acumen or historical accident. It is generally accepted that an action is anticompetitive when it harms consumers.

In Europe competition policy has a more recent history which is mostly associated with the creation of the European Union and its coordination of policies for the promotion of free competition in the internal market. The main provisions of European Competition Law concerning abuse of dominance are contained in the Article 82 of the Treaty of the European Communities which states that:

> "Any abuse by one or more undertakings of a dominant position within the common market or in a substantial part of it shall be prohibited as incompatible with the common market in so far as it may affect trade between Member States. Such abuse may, in particular, consist in: (a) directly or indirectly imposing unfair purchase or selling prices or other unfair trading conditions; (b) limiting production, markets or technical development to the prejudice of consumers; (c) applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at competitive disadvantage; (d) making the conclusion of contracts subject to acceptance by other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts."

This article (as Article 81 on horizontal and vertical agreements and the Merger Regulation) is part of the law of each member state and is enforced by the European Commission (in particular the Directorate General for Competition) and by all the National Competition Authorities. The application of EU competition law on abuse of dominance involves the finding of a dominance

position and of an abusive behaviour of the dominant firm, usually associated with excessive pricing or with exclusionary practices as predatory pricing, rebates, tying or bundling, exclusive dealing or refusal to supply. However, the analysis of both dominance and abusive behaviour entails complex economic considerations and is the subject of an on going process of revision. A recent document, European Commission (2005), has proposed a new approach to exclusionary abuses under Article 82 which gives an important indication as to how the Commission may approach antitrust cases in the future. The purpose of Article 82 is defined as "the protection of competition on the market as a means of enhancing consumer welfare and of ensuring an efficient allocation of resources". This implies that antitrust should protect competition and not competitors and be based on an economic approach aiming at the maximization of consumer welfare and allocative efficiency rather than based on a legalistic approach, something which appears much more in line with the US approach.

Many economists have pointed out the necessity of a closer focus on consumer welfare in the implementation of competition policy with specific reference to abuses of dominance. While antitrust legislation was written with this objective in mind, its concrete application, especially within the post-Chicago approach, has often been biased against market leaders and in defence of their competitors rather than toward the defence of competition and of the interests of consumers. The two objectives do not necessarily overlap. The development of the New Economy, characterized by very dynamic and innovative markets, has increased the pressure for a new approach, already somewhat developed in the United States, but just in progress in the European Union.

A new approach to competition policy should be based on rigorous economic analysis, from both a theoretical and an empirical point of view. In an important EU Report, Rey *et al.* (2005) emphasize this element in the antitrust procedure: "a natural process would consist of asking the competition authority to first identify a consistent story of competitive harm, identifying the economic theory or theories on which the story is based, as well as the facts which support the theory as opposed to competing theories. Next, the firm should have the opportunity to present its defence, presumably to provide a counter-story indicating that the practice in question is not anticompetitive, but is in fact a legitimate, perhaps even pro-competitive business practice." Moreover, any theory of the market structure able to provide guidance in detecting abuses of dominant positions should: 1) take into account the role and the strategies of dominant firms; 2) describe the equilibrium outcomes taking into account the role of barriers to entry and of fixed costs of entry (which can endogenously determine entry of competitors) and in function of the demand and supply conditions; and 3) provide welfare comparisons under alternative set-ups.

In this paper I will try to argue that, while the Chicago school and the post-Chicago approach failed to provide a unified framework which matches these requirements, the theory of market leaders formalized for instance in Etro (2004, 2006a,b) has provided a possible alternative. The general principle proved

in this new research is that dominant firms may behave in an anti-competitive way, accommodating or predatory, in markets where the number of firms is exogenous, while they always behave in an aggressive way when entry into the market is endogenous, which should be the relevant case in many situations: in these, a large market share of the market leader is a consequence of its aggressive strategies and of the endogenous entry, and not the consequence of its market power. Hence, markets with high concentration due to the presence of a market leadership are perfectly consistent with efficiency. This has major implications for competition policy: while the old approach to abuses of dominant positions needs to verify dominance through structural indicators and the existence of a certain abusive behaviour, we suggest that there is not a well founded reason to associate high levels of concentration with market power and a consistent approach to abuse of dominance would just need to verify the existence of harm to consumers. Finally, notice that what matters is not only welfare of current consumers but also that of future ones (see Rey *et al.*, 2005). What the theory of market leaders suggests on this matter, as shown in Etro (2004), is that the dynamic gains in efficiency due to a leadership position in innovative markets can be quite high as long as entry in the market for innovation is endogenous: the leadership of a firm may persist because of its high incentives to invest in R&D under the threat of entry; nevertheless, this should not be seen as a signal of abusive conduct, but, oddly enough, as the result of competitive pressure.

The recent document of the European Commission (2005) has inspired a wide debate on the proper aims and methods of antitrust policy in Europe. While the aim of this proposal is to enhance consumer welfare and to protect competition and not competitors, we have some concern that these principles are not fully carried through into certain aspects of the analytic framework. As of now, the approach of the European Commission appears partly in line with outdated views, for instance when it stresses an excessive reliance on market shares in determining dominance. The novel part on the efficiency defences for dominant firms appears to be going in the right direction since it allows otherwise abusive strategies if they create a net efficiency gain (which benefits consumers). Nevertheless, the effectiveness of these rules in safeguarding consumer welfare is weakened when it is stated that some firms are virtually excluded from the possibility of an efficiency defence. In particular, a strange concept of market position "approaching that of a monopoly" is introduced and associated with market shares above 75%, something without any justification in economic theory: a firm is a monopoly or is not (in which case, its behaviour is constrained by competitors), but it cannot be an "almost monopoly" or a "near monopoly". From an economic point of view, the real missing concept, which defines firms with high market shares but not monopolizing the all market, is that of a Stackelberg leader with endogenous entry, which is the subject of the analysis of the theory of market leaders (see ICC, 2006, for a more extensive discussion of such an approach).

2 Chicago and post-Chicago Approaches

In this section I am going to review the traditional approaches to antitrust policy on abuse of dominance and start comparing them with the insights of the recent theoretical attempts to build a comprehensive theory of market leadership and competition policy. In our view, a fully fledged model of the behaviour of market leaders is a necessary toolkit for deriving implications for antitrust policy, but it is not necessarily part of the endowment of the traditional theories.

The traditional "pre-Chicago" approach was mostly based on basic models of imperfect competition associating market power, high market shares and abusive conduct with the typical behaviour of monopolists. Such a *naïve* view has been challenged in the 60s and 70s by the "Chicago approach" whose main merit has been to show that, when there are potential entrants in a given sector, aggressive strategies that would be suspect, such as bundling, price discrimination and exclusive dealing, are not necessarily anti-competitive but may instead have a strong efficiency rationale. More recent theories, often associated with the so-called "post-Chicago" approach, have however shown that in the presence of pervasive market imperfections, the above strategies can be anti-competitive because they are aimed at deterring entry in the short run and protect monopolistic rents in the long run. Broadly speaking, US antitrust authorities have been highly influenced by all these approaches over time, while it is hard to claim that the same is true of the EU antitrust authorities. As has recently been pointed out by Ahlborn, Evans and Padilla (2004), "in Europe it has taken longer for new developments in economic theory to affect competition policy. While U.S. antitrust has been influenced by Chicago school and post-Chicago school theories, pre-Chicago school considerations still play a role in Europe, albeit at times dressed up in post-Chicago clothing".

I believe that these traditional approaches gave important insights into many antitrust issues, but they failed to provide a complete understanding of the behaviour of market leaders. The Chicago approach limited most of its analysis to either monopolistic or perfectly competitive markets, and in a few cases, to markets characterized by a monopolist and a competitive fringe of potential entrants. For instance, according to the Chicago school there is not such a thing as predatory pricing, that is reducing prices below costs to induce exit by the competitors so as to compensate the initial losses with future profits: if the incumbent can sustain such initial losses, also any other competitor can do it as long as credit markets are properly working, hence predatory pricing would not be effective to start with. This approach failed to provide results that were robust enough to withstand fully-fledged game-theoretical analysis of dynamic competition between incumbents and entrants. Somewhat related with it are the theory of contestable markets of Baumol, Panzar and Willig (1982) and the initial literature on entry deterrence associated with the socalled Bain-Modigliani-Sylos Labini framework. However, even if the initial theoretical contributions took into consideration the effects of entry on the behaviour

of market leaders, these were not developed in a coherent game theoretic framework and were substantially limited to the case of competition with perfectly substitutable goods and constant or decreasing marginal costs.

In the 80s and 90s, post-Chicago research studied more complex market structures within a solid game-theoretic framework and introduced welfare considerations so as to derive sound normative implications, which represents one of the main contributions of this approach. However, in most cases, this literature studied the behaviour of incumbent monopolists facing a single potential entrant. To cite the most famous works with strong relevance for antitrust issues, this was the case of the Dixit (1980) model of entry deterrence, of the models by Kreps and Wilson (1982) and Milgrom and Roberts (1982) of predatory pricing,[2] of those by Fudenberg and Tirole (1984) and by Bulow *et al.* (1985) of strategic investment, of the Bonanno and Vickers (1988) model of vertical restraints, of the Whinston (1990) model of bundling for entry deterrence purposes, and of many other works, often based on analysis of Stackelberg duopolies (that is, markets with one leader and one follower).[3] Also most of the standard results on the behaviour of incumbents in terms of pricing, R&D investments, quality choices, vertical and horizontal differentiation are derived in models of Stackelberg duopoly, where the incumbent chooses its own strategies in competition with a single entrant. While this analysis simplifies the interaction between incumbents and competitors, it can be highly misleading, since it assumes away the possibility of endogenous entry, and hence limits its relevance to situations where the incumbent has already an exogenous amount of market power.

It is not surprising that the results of the post-Chicago approach are systematically biased toward an anti-competitive role by incumbents: these engage in aggressive pricing, threaten or undertake overinvestments in complementary markets, impose exclusive dealing contracts, or bundle their goods with the sole purpose of deterring competitor entry. Otherwise they engage in accommodating pricing, underinvest in product improvements and differentiation, and stifle innovation. In such a simple world, what antitrust authorities should do is unambiguously to fight against incumbents: punish their aggressive pricing strategies as predatory, and their accommodating pricing strategies as well (but in this case as monopolistic strategies), punish investments in complementary markets as attempts to monopolize them, forbid bundling strategies, and so on. The bottom line is that antitrust authorities should sanction virtually all behaviours of the incumbents which do not conform to those of their competitors.

The fallacy of this line of thought, in my view, derives from a simple fact: it is based on a partial theory which does not take into account that, at least in most cases, entry by competitors is not an exogenous fact, but an endogenous decision.

[2]The post-Chicago school as shown that in presence of asymmetric information between firms, of credit market imperfections and of strategic commitments to undertake preliminary investments the above argument breaks down and predatory pricing can be an equilibrium strategy for the incumbent and deter entry.

[3]See Motta (2004) for a survey.

Whether entry is more or less costly, entry is an endogenous decision by the potential competitors, especially in global markets as most markets in the New Economy. There are two different kinds of constraints on entry. The definition of *barriers to entry* has been quite debated in the literature. Bain associated them with the situation in which established firms can elevate their selling prices above minimal average costs of production without inducing entry in the long run, Stigler with costs of production which must be borne by firms which seek to enter an industry but not borne by incumbents. A similar approach has been prevailing more recently (Baumol, Panzar and Willig, 1982), so that we can talk of barriers to entry as sunk costs of entry for the competitors which are above the corresponding costs of the incumbent (or have been already paid by the incumbent). On the contrary, simple *fixed costs of entry* are equally faced by the incumbent and the followers to produce in the market, but they also constrain entry. Actually, while there is a fundamental difference between the two concepts, their role in constraining entry, and hence in endogenizing it, is basically the same. In our view, only a comprehensive understanding of the behaviour of incumbents when entry is endogenous and when it is not can provide the required tools to judge real world markets.

3 The Theory of Market Leaders

The theory of market leaders clarifies the role of market leaders under more general conditions than the post-Chicago approach. In this section we will discuss its results and compare its implications for antitrust with those of the traditional approach.[4]

Let us start from a general model of Stackelberg competition in which a main difference between the new and the old approach emerges. Consider a market with price competition between firms offering imperfectly substitutable goods, zero marginal costs of production, for simplicity, and a sunk cost of entry S which the market leader does not bear. When a firm sets the price p_i and the other firms set their prices p_j, demand is $D\left[p_i, \sum_{j \neq i} g(p_j)\right]$. We assume that demand is decreasing in the first argument: a higher price by i reduces i's demand. Moreover demand is also decreasing in the second argument while the function $g(p)$ is decreasing in the price, so that a higher price by any firm j increases demand for firm i, as reasonable. This demand function generalizes most common demand functions used by economists, as those derived by isoelastic utilities, Logit demands, constant expenditure demands and the

[4]See Etro (2006a,b, 2007), Wiethaus (2006) and Zigic *et al.* (2006).

Dixit-Stiglitz demand (see the Appendix). Finally, profits for the leader are:

$$\pi_L = p_L D\left[p_L, \sum_{j \neq L} g(p_j)\right]$$

while profits for a follower j are:

$$\pi_i = p_i D\left[p_i, \sum_{j \neq i} g(p_j)\right] - S$$

Consider first the simple case with just a single follower, which was the subject of analysis of most literature in the post-Chicago approach. When the sunk cost S is small enough, the follower is active in equilibrium and chooses its own price, say p_F, as a function of the price of the leader p_L, according to the optimality condition:

$$D_1[p_F, g(p_L)]p_F + D[p_F, g(p_L)] = 0$$

Under standard conditions (strategic complementarity), this implies a price increasing in the price of the leader. Then the leader chooses its own price taking this into account, according to the optimality condition:

$$D_1[p_L, g(p_F)]p_L + D[p_L, g(p_F)] + D_2[p_L, g(p_F)]g'(p_F)\frac{\partial p_F}{\partial p_L} = 0$$

Since the last term is positive, we can conclude that $p_L > p_F$. The intuition of this outcome is quite simple. The leader is aware that the higher will be its own price, the higher will be the price chosen by the follower, and both firms will have larger profits. Hence the leader exploits its first mover advantage to set a high price.

A fundamental contribution by Dixit (1980) and Fudenberg and Tirole (1984), at the origins of the post-Chicago approach, was to show that, when the sunk cost S is high enough, the optimal strategy for the leader may be an entry deterring strategy which requires a low enough price. The policy implication was immediate: any low pricing strategy by a leader must be associated with predatory pricing, otherwise a market leader would prefer to be accomodating, setting high prices.

Unfortunately, this story has a simple but pervasive problem. Let us go back to the hypothetical situation in which the sunk cost S is small enough, so that the follower is active in the duopoly equilibrium. In such a situation it may well be the case that one or more other firms could also find profitable to enter in this market after bearing the small sunk cost. If this is the case, and this must be the case when S is small enough, the right equilibrium concept for this market has to take endogenous entry in consideration. In Etro (2002)

I have solved for this equilibrium, showing that it is characterized by the same optimality condition for each follower as above:

$$D_1(p_F, \cdot)p_F + D(p_F, \cdot) = 0$$

an endogenous entry condition equating gross profits of each follower to the sunk cost of entry:

$$D(p_F, \cdot)p_F = S$$

and the following optimality condition for the leader:[5]

$$D_1(p_L, \cdot)p_L + D(p_L, \cdot) - D_2(p_L, \cdot)g'(p_F)p_L = 0$$

Now the last term is negative, suggesting that $p_L < p_F$. When entry is endogenous, whether just one or many followers end up entering in the market, the leader is always aggressive setting a lower price than each one of the entrant. Hence, a low pricing strategy is associated with a normal strategy of the market leader when entry is endogenous, and not with entry deterrence purposes.

This is the general principle emerging from the theory of market leaders, at the basis of our critique to the post-Chicago approach to antitrust. It actually emerges in more general situations, as shown by Etro (2006a): whenever the leader can engage in preliminary investments, while in duopoly it will bias them strategically to increase its price in the market, under endogenous entry it will bias them in the opposite way, to decrease its price in the market. For instance, if a cost reducing technology exists, Fudenberg and Tirole (1984) have shown that a duopoly leader will underinvest in it, while Etro (2006a) has shown that the same leader will overinvest in it a long as entry in the market is endogenous. This outcome emerges in many other contexts with surprising results with respect to investments in R&D and exploitation of network effects, important factors in markets of the New Economy, in case of bundling of goods and many other situations: some of these are examined in detail in the Appendix. The general point is that in any market where entry is endogenous, the leader always overinvests to gain a strategic advantage and conquer a larger market share; however, this results in a reduction in prices with a net gain for consumers.

Until now we considered a market structure which is quite standard because goods are imperfect substitute. However, our results become even more drammatic with quantity competition and homogenous goods. To see why this

[5]Proof: Equilibrium demand for the followers is $D[p_F, g(p_L)+(n-2)g(p_F)]$ where n is the number of firms active in the market. The equilibrium first order condition and the endogenous entry condition for the followers pin down both arguments p_F and $\beta = g(p_L) + (n-2)g(p_F)$ independently from the leader'strategy p_L: only the number of firms changes with the price of the leader. Hence, the profits of the leader can be written as:

$$\pi_L = p_L D[p_L, (n-1)g(p_F)] = p_L D[p_L, \beta + g(p_F) - g(p_L)]$$

whose maximization provides the equilibrium first order condition in the text.

happens, imagine a market of homogeneous products where production requires again a fixed sunk cost S and a zero marginal cost of production. Moreover, imagine that firms choose their production level and the market price just equates demand and supply. Such a simple structure approximates the situation in many sectors where product differentiation is not very important but there are high costs to start production: this is typical of energy and telecommunication industries and many other high-tech sectors of the New Economy. The assumption of constant (and indeed zero) marginal cost matches the conditions of some markets, as the software one, where variable costs are negligible compared to R&D expenditure.

Imagine that inverse demand is a decreasing function of total production, $p\left(\sum x_j\right)$ where x_j is clearly production for firm j. The profits of the leader are now:

$$\pi_L = x_L p\left(\sum x_j\right)$$

while the profits of each follower are:

$$\pi_i = x_i p\left(\sum x_j\right) - S$$

As well known, a Stackelberg duopoly would imply a division of the market between the leader and the follower. A Stackelberg equilibrium with endogenous entry, however, generates a different result. If the supply of the leader x_L is small enough followers will be active and their supply x will satisfy the first order condition:

$$p(X) + xp'(X) = 0$$

where $X = \sum x_j$ is total production. The endogenous entry condition will be:

$$xp(X) = S$$

It is clear that these two conditions will pin down both the strategy of the followers x, and total production X, and hence the price $p(X)$. Hence the perceived profit of the leader becomes:

$$\pi_L = x_L p(X)$$

which is always trivially increasing in its supply. Hence the leader will always produce as much as possible. No other firm will find convenient to enter in the market, but nevertheless the price will be determined by the free entry condition and hence it will be the same as in absence of the leader. Notice that the same result would emerge with any kind of constant or decreasing marginal cost function.

Etro (2002) also proves that this outcome is better for consumers than the free entry equilibrium without a leadership, but the point here is simpler: under certain technological conditions, it is natural for the leader to conquer a large market share while supplying it at a competitive price determined by a zero

profit condition (but this is referred to the entrants, while the leader earns positive profits). These technological conditions amount to high sunk costs or fixed costs of production (which may be R&D costs as well) and constant marginal costs of production. Of course network effect would even strenghten the result, as shown in the Appendix. On the other side, introducing imperfect substitutability or increasing marginal costs would allow the followers to conquer market shares. Nevertheless, the general principle would always hold: the leader would be aggressive and price below its followers retaining a larger market share because of the competitive pressure.

This discussion implies two main conclusions. First, a leading market position associated with aggressive strategic investments can be the consequence of a competitive market environment and not the result of market power. In other words, the theory of market leaders suggests that it would be better to differentiate market leaders from dominant firms: market leaders have some strategic competitive advantage over their competitors, but only when they can use it to prevent effective competition and harm consumers should they be considered to be dominant and their behaviour potentially abusive. The point is to understand when market leaders can prevent effective competition and when they cannot. Second, whenever firms engage in price competition, the post-Chicago approach associates aggressive pricing or other aggressive strategies with a predatory purpose, while the theory of market leaders shows the conditions under which an aggressive strategy is pro-competitive and without exclusionary purposes.

4 The Software Market and the Microsoft Case

As a case study, consider the software market, one of the markets of the so-called New Economy, developed in the very last decades through progress in the Information & Communication Technology. In the 1960s, the computer industry was dominated by IBM, which manufactured expensive mainframe computers that were used by large enterprise customers; at the time, very few consumers had access to computers. Apart from IBM, mainframes were offered by firms such as Bull, Burroughs, Data General, Fujitsu, ICL, Nixdorf and Sperry-Rand. 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 Nixdorf 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 were not interoperable with one another: early PCs by Tandy, Apple, 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. In mid-1980, IBM announced plans to introduce an IBM personal computer. The first one was offered with a choice of three operating systems: CP/M-86 from Digital Research, UCSD-P System and MS-DOS from Microsoft, a company founded by Bill Gates, a young software architect who dropped his studies at Harvard to develop what was going to become a symbol of market leadership.

To understand the peculiarities of the software market in general it is convenient to focus briefly on the main functions of PC operating systems (OSs). The main one is to serve as a platform on which applications (such as spreadsheets or word processors) 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 systems services are made available through Application Programming Interfaces (APIs). When an application calls a particular API, the OS 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 their applications rely will be present on any given PC. If they did not, then software developers would have to write the software code to provide equivalent functionality in their own applications, generating redundancy, inefficiency and a lack of interoperability.[6] Moreover, modern OSs provide a user interface, the means by which a user interacts with his computer. 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 by Apple with Macintosh. Finally, operating systems enable users to find and use information contained in various storage devices: local ones, such as a floppy diskette, a CD-ROM drive or the hard drive built into a PC, or remote, 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 OSs of Microsoft became the most popular because Microsoft continually added new functionality to the operating system and licensed it to a wide range of computer manufacturers with extremely aggressive pricing strategies. Microsoft recognised 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 operating system that

[6]For instance, the UNIX operating system, developed by Bell Laboratories in the 1970s was not preserved as a common platform but was instead allowed to fragment. IBM, Siemens, Silicon Graphics and many other firms created their own versions of UNIX, which were all different from one another. As a result, applications written for one version of UNIX frequently will not run on other versions.

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 were more easily interoperable because they were relying on the same functionality supplied by the underlying OS. In other words, network effects were created.[7]

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 GUI, enabling users to perform tasks by clicking on icons on the screen using a pointing device called a mouse. 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 and the forthcoming Vista represent furthers evolution of the operating system, with a range of added functionality for both business and home users. Even if official and unanimous data are unavailable, consistent evidence suggests that the market share of Windows on sales of OSs for PCs rapidly increased toward 80% in the first half of the 90s to gradually arrive at 92% in 1996, 94% in 1997, 95% in 1998 and remained basically at this level since then:[8] meanwhile the average consumer price of Windows (calculated as average revenue per licence in OEM channel based on Microsoft sales) was constant (in nominal terms) around 44-45$.

Beyond OSs, Microsoft produces very successful 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 and media player functionalities 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 advanced word processor *Word*, the spreasheet *Excel*, the software for presentations *PowerPoint* and more. The main two applications, Word and Excel, have been successfully competing against alternative products like *WordPerfect*, *WordStar*, *AmiPro* and

[7]Nowadays, 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.

[8]Of course the market share of Windows is lower if we take in consideration Macintosh computers as well.

others on one side and *Lotus*, *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 success (it is important to notice that Microsoft achieved leadership in the Macintosh market, hence without exploiting the presence of its own OS, considerably earlier than in the PC market).[9] In the market for word processing applications, Microsoft's market share was hardly above 10% at the end of the 80s, to gradually increase at 28% in 1990, 40% in 1991, 45% in 1992, 50% in 1993, 65% in 1994, 79% in 1995, 89 in 1996, 94% in 1997 and to arrive at 95% in 1998, meanwhile the average consumer price of Word (calculated as average revenue per license) decreased from 235$ in 1988 to 39$ in 2001.[10] 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, 76% in 1995, 84% in 1996, 91% 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.

The leading position of Microsoft induced large opposition in the industry and the emergence of multiple antitrust cases with importance at a global level. In the main Microsoft vs US case, the software company was accused of monopolizing the PC operating systems market for Intel-compatible computers, tying its Windows operating system with the *Internet Explorer* browser with predatory purposes and to engage in anti-competitive contractual agreeements with computer manufacturers and Internet service providers. After an initial decision which imposed heavy behavioural and structural remedies on Microsoft, including the break up in a operating system and an application company (the socalled "Baby Bills"), the November 2002 ruling of the District of Court decided only to impose behavioural remedies aimed at preventing Microsoft from adopting exclusionary strategies against firms challenging its market power in the market for operating systems.

The Microsoft vs EU case was developed on very similar issues, in particular on the bundling of Windows with mediaplayer functionality and on the level of interoperability with softwares by other companies; at the time of writing, the case is still unresolved. In the March 2004 decision, the European Commission imposed the largest fine in the history of antitrust, 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 and competitor products. Microsoft's Appeal of the decision was heart by the European Court of First Instance in April 2006

[9] Microsoft did not achieve large market shares for other important applications, for instance for personal finance software.

[10] The market for word processing software includes many other niche products. For instance, this paper is written with *Scientific Word*, a software that is particularly useful for scientific writing and academic purposes in general, but which is also largely more expensive than Word.

and a decision is expected by the end of the year.

A common element in both cases has been the substantial involvement of competitors of Microsoft on the side of the antitrust authorities, something that usually can create suspicion on the fact that a firm is really behaving as a monopolist rather than as an aggressive competitor. In a neat article on *Business Week*, Robert Barro (1998) noticed that "[a] sad sidelight in the Microsoft case is the cooperation of its competitors, Netscape, Sun and Oracle Corp., with the government. One might have expected these robust innovators to rise above the category of whiner corporations... The real problem is that whining can sometimes be profitable, because the political process makes it so. The remedy requires a shift in public policies to provide less reward for whining. The bottom line is that the best policy for the government in the computer industry is to stay out of it." Nevertheless in the European case Sun, Oracle, Novell, IBM and the Free Software Movement are active sides against Microsoft.

The technological conditions in the software market are well known. Producing software (whether it is an operating system or a particular application) takes a very high up-front investment and a constant marginal cost which, as well known, is close to zero. The entry conditions in this market are more debated, but there are good reasons to believe that even though entry into the software market may entail large costs, it is substantially open, i.e. endogenous. First of all, there are already many firms producing OSs (as IBM, Red Hat, Oracle, Sun, Apple, HP, Compaq, Data General,...), and 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, the knowledge required to build software is easily accessible worldwide and competition is global. Nevertheless, it has been claimed that in the market for PC (or client) operating systems, the high number of applications developed by many different firms for Windows represents a substantial barrier to entry. Unfortunately, such a claim usually leads to misleading conclusions. It is true that competitors need to offer (and some do offer already) a number of standard and technologically mature applications upon entry to match the high quality of the Windows package, 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 and communications software, which really satisfy the needs of most active computer users (McKenzie, 2001). Second, the competitors of Microsoft should not (and the existing ones do not) even finance the development of all the needed applications: as Microsoft did in most cases, they should just fund and encourage other firms to write applications for their operating system (or have old applications

originally written for other operating systems "ported to" theirs). Finally, it is important to emphasize that if we look at competition in the software market in a dynamic sense, that is competition for the market (as opposed to competition in the market), there is no doubt that the opportunity to invest in innovations for future, better software is widely open not only to large companies in the New Economy, but even to smaller ones.

Summarizing, the software market is characterized by high entry costs, constant marginal costs close to zero and substantially open access by competitors able to create new software. According to the new 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. Notice that network externalities require these prices to be even lower because competitors could (and indeed try to) offer their alternative software at even lower prices to build their own network effects. Notice that low prices in presence of network effects are very common and often extreme: most email services such as *Yahoo* or search engines as *Google* are free because this is the best strategy available for their leading suppliers under the constraint of effective competition. All these market leaders gain from collateral services, and, for sure, their leadership has nothing to do with dominance.

The extremely low price of Windows represents a double proof of our arguments above. 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. 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):[11] it means that a 1% increase in the price of PCs reduces demand by ϵ%. Now, the above relationship tells us that, if the basic price of the hardware is 1000 Euros, which is about the current average price for PCs, the monopolistic price for Windows would be 1000 Euros if $\epsilon = 2$, 500 Euros if $\epsilon = 3$, 333 Euros if $\epsilon = 4$ and so on. It would take really unreasonable values of demand elasticity to even get close to the real price of Windows, which is around 50 Euros. Moreover, this is a very conservative estimate of the monopolistic price. In the real world, we can imagine that the price of hardware is not independent from the price of Windows: if the latter would double tomorrow, hardware producers would be forced to reduce somewhat 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 goes in the direction of increasing further the monopolistic price of Windows, that is, even

[11] See Etro (2006b).

beyond the real price of Windows.[12]

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 it if were to maintain its market position." McKenzie (2001) supports this view: "some firms with high market shares might act more like competitors than other firms in markets where they have much smaller market shares. The reason is that the threat posed by potential competitors in a highly concentrated market can be more constraining than the competitive threat of actual competitors in less-concentrated markets".

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. It has been constantly aggressive, as any firm under the threat of competitive pressure would be. 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 slightly below that of its immediate competitors or just low enough to avoid that they can exploit profitable opportunities increasing their prices. Where other theories cannot, the theory of market leaders can make perfect sense of Microsoft's large market share, large profits and relatively low prices in a global and open market.

5 Bundling

One of the issues where the new theory of market leaders applies and provides new insights for antitrust policy is bundling, that is, the combination of two separate products in a single one sold alone. Notice that tying refers to selling

[12]It has been claimed that low Windows pricing may be explained with the 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 operating systems. Finally, as Economides (2001) 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."

one product (the tying product) conditional on the purchase of another one (the tied product), but there will not be any substantial difference between bundling and tying for our purposes. Virtually any product is a bundle since it combines multiple basic products which could be or are sold separately: a car bundles many separate components, shoes bundle shoes without laces and shoelaces, a computer bundles hardware, a operating system and basic software applications of general interest. In some cases bundling is just a contractual restriction used to force customers to purchase an ancillary product in an aftermarket for goods or services, while in other cases bundling improves a finished product by integrating new components or features into it: of course, only the first situation should be subject to antitrust investigation.

The Chicago school has advanced efficiency rationales in favour of bundling with positive, or at worst ambiguous, consequences on welfare, including production or distribution cost savings, reduction in transaction costs for customers, protection of intellectual property, product improvements, quality assurance and legitimate price responses. Moreover, according to the so-called "single monopoly profit theorem", as long as the secondary market is competitive, a monopolist in a separate market cannot increase its profits in the former by tying the two products. Actually, in the presence of complementarities, it can only gain from having competition and high sales in the secondary market to enhance demand in its monopolistic market. A similar theory has been advanced by Economides (2001) to explain the tying strategies of Microsoft. With particular reference to the US case, Economides (2001) notes that Microsoft could not have been interested in the browser market when this was perfectly competitive, but only when this market became dominated by Netscape for two main reasons. "First, Netscape had a dominant position in the browser market, thereby taking away from Microsoft's operating system profits to the extent that Windows was used together with the Navigator. Second, as the markets for Internet applications and electronic commerce exploded, the potential loss to Microsoft from not having a top browser increased significantly... Clearly, Microsoft had a pro-competitive incentive to freely distribute IE since that would stimulate demand for the Windows platform." The very same point could be made for the free distribution of Media Player with Windows, the subject of the tying part of the EU case.

However, the post-Chicago approach, starting with Whinston (1990), has shown that, when the bundling firm has some market power, bundles can have a predatory purpose, that is, they can deter entry in the tied product market to expand monopolistic power and reduce consumer welfare, at least in the long run. Summarizing the past economic research in the field, Tirole (2005) has concluded that tying should be submitted to a rule-of-reason standard, since it can have both efficiency and anti-competitive purposes. As formally shown in the Appendix, the theory of market leaders emphasizes that bundling by the incumbent is just an aggressive (pro-competitive) strategy of the incumbent for a competitive tied product market, may not have a specific entry deterrence

purpose, and may increase welfare even without taking efficiency reasons into account.

Here, to derive the intuitions of these results, let us adopt the strongest bias against the bundling firm, imagining that this is a monopolist in a primary market which is also active in a secondary market, and that there are no technological efficiencies emerging from bundling goods in the two markets. The Chicago school has studied such a situation when the secondary market is perfectly competitive, that is, firms price at marginal cost and earn no extra profits: in such a case, the monopolist has no incentives to bundle because this could only reduce demand in the primary market. The post-Chicago approach has studied the same situation when the secondary market is not perfectly competitive and there is actually one single firm active strategically and no possibility for other firms to enter: then, the only reason why the monopolist would adopt a bundling strategy is to induce exit of the rival in the secondary market. The new theory of market leaders has studied again the same situation but with an imperfectly competitive secondary market, where firms decide "endogenously" whether to enter or not. In this case, the purpose of bundling has nothing to do with entry deterrence, it is just an aggressive strategy (but not a predatory one) which has pro-competitive effects: it reduces the combined price level and increases welfare. Technically, the market leader can exploit a larger scale of production for the bundle to offer it at a competitive price: bundling the two products works as a commitment device to be aggressive, that is to produce more for the secondary market and hence to be able to adopt a lower price. As a consequence, the leader can exploit larger scale economies, reduce the average price level for consumers and hence increase welfare.

Summarizing, when approaching a bundling case we need to verify the entry conditions of the secondary market. If there is a dominant firm in this market as well, the main problem is not the bundling strategy, but the lack of competition in the secondary market, and it should be addressed within that market: punishing the bundling strategy would just guarantee the monopolistic (or duopolistic) rents of the dominant firm in the secondary market. However, things are different when the secondary market is not monopolized but open to endogenous entry (even if it is not perfectly competitive, in the sense that firms do not price at marginal cost). In such a case bundling is a pro-competitive strategy and punishing it would hurt consumers.[13]

[13]Looking at the approach of the European Commission (2005), it appears that its positive principles are not fully carried through into the discussion on bundling. For instance, the standard of proof the Commission is required to meet to establish harmful foreclosure effects is too low, particularly in light of the fact that the analysis of foreclosure effects can be speculative in nature. In the case of bundling, actual market foreclosure effects are not required by the Discussion Paper: it is enough that such effects are "likely" to occur. In other words, the mere risk of foreclosure can result in a finding against a dominant company. A standard of proof that requires convincing evidence will help ensure that companies will not be deterred from bringing new products to market as a result of concerns about remote, potential foreclosure effects.

In the case of Microsoft, we have the impression that in both bundling cases, that of Windows with Internet Explorer and that of Windows with Media Player, the tied market was and still is characterized by endogenous entry: just think of new successfull browsers as Mozilla or Firefox and media player software as RealPlayer, Quick or, more recently, Macromedia Flash. 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 with endogenous entry.[14]

6 Innovation and Interoperability

Competition in high-tech markets is dynamic in the Schumpeterian sense that it takes place as competition for the market in a so-called winner-takes-all-race, and such an element requires an even deeper rethinking of antitrust policy than suggested in the analysis of the previous sections, which were mostly focused on a static concept of competition in the market.

Economic research has emphasized the positive relationship linking patents to investments in innovation and these investments to technological progress and growth. In the New Economy and high-tech sectors in general firms compete mainly by innovating. This is possible as long as there are well defined IPRs, and especially patents, protecting their innovations and investments, which is ultimately what leads to technological progress in our economies. Moreover, even if most economists are used to thinking about market leaders as firms with weaker incentives to invest in R&D, recent theoretical and empirical research has also found that market leaders play a crucial role in the innovative activity. The recent theories of market leadership have clarified the mechanics of these results. In a sense, patents drive competition through innovation in these markets and induce technological progress led by market leaders. For instance, in Etro (2004) and in a simpler model in the Appendix, I have shown that dominant firms have more incentives to invest in innovation than the outsiders when the patent race is characterized by endogenous entry, as long as the dominant firms have a leadership. The crucial thing here is that dominant firms often remain dominant thanks to their investments, but this should not be seen as evidence of inefficiency or of monopolistic power, but rather as a proof of the opposite: the competitive environment spurs investment by leaders and consequently induces a chance that their dominance persists. Clearly, this has strong implications for industrial policy. What the above theory suggests is that dominant firms in high-tech sectors investing a lot in innovation may create an efficient situation.[15]

[14]Notice that the defensive strategy of Microsoft in the EU case appears to be unrelated with this point, but based on the fact that a modern OS must include mediaplayer functionalities and hence there should not even be an issue about bundling.

[15]The EU approach to antitrust deals with issues concerning innovation and IPRs in the discipline on refusals to supply, that is, situations where a dominant company denies a buyer

New ideas are often protected with patents, but these are not the only form of protection for innovations. 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 which are the result of multiple innovations. Defending (intellectual or material) property rights is one of the fundamental conditions for a proper functioning of the market economy: defending trade secrets has not a minor role in this context. Things get even more complicated in high-tech sectors of the New Economy. In these sectors trade secrets often cover fundamental innovations and protecting them amounts to promote new fundamental innovations, which 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, which is, broadly speaking, the ability to exchange and use information and data, especially in networks. For instance, take in consideration the leading on line

access to an input in order to exclude that buyer from participating in an economic activity. Four conditions have to be fulfilled in order to find a termination of such a supply relationship to be abusive: i) the behaviour must be properly characterised as a termination of the supply arrangement; ii) the refusing undertaking must be dominant; iii) the refusal must be likely to have a negative effect on competition; and iv) the refusal must not be justified objectively or by efficiencies. Only when the dominant supplier has not previously supplied the input to a potential buyer, as for IPRs, an additional criterion is added: the input must be "indispensable" to carry on normal economic activity in the downstream market (a so-called "essential facility"). Nevertheless, the European Commission (2005) correctly pointed out that "to maintain incentives to invest and innovate, the dominant firm must not be unduly restricted in the exploitation of valuable results of the investment. For these reasons the dominant firm should normally be free to seek compensation for successful projects that is sufficient to maintain investment incentives, taking the risk of failed projects into account. To achieve such compensation, it may be necessary for the dominant firm to exclude others from access to the input for a certain period of time. The risks facing the parties and the sunk investment that must be committed may thus mean that a dominant firm should be allowed to exclude others for a certain period of time in order to ensure an adequate return on such investment, even when this entails eliminating effective competition during this period".

The proposal clearly states the priority of IPR protection, saying that "[i]mposing on the holder of the rights the obligation to grant to third parties a licence for the supply of products incorporating the IPR, even in return for a reasonable royalty, would lead to the holder being deprived of the substance of the exclusive right". Hence, another more restrictive criterion is added in the case of a refusal to license IPRs: the undertaking which requests the licence should intend to produce new goods or services not offered by the owner of the IPRs and for which there is a potential consumer demand. This additional criterion is in line with established case-law, but the Commission introduces an exception to this criterion. It states that a refusal to license IPR-protected technology which is indispensable for follow-on innovation may be abusive even if the license is not sought to directly incorporate the technology in clearly identifiable new goods and services, since the refusal to license an IPR-protected technology "should not impair consumers' ability to benefit from innovation brought about by the dominant undertaking's competitors". However, this exception is not motivated by economic analysis and is inconsistent with mainstream theories. There are no serious economic arguments supporting the view that weakening IPRs would strengthen innovation in the long run: such an approach on this matter may have negative consequences for EU innovation in the long run.

search engine in the world, Google. We may look at its patented innovations, but after that, we would need to know its trade secrets to fully discover the mechanism of its precious algorithms. This would help many software companies and websites to interoperate with Google even better than they already do, as it would allow other search engines to improve their performances compared to that of the leading search engine. But after that, we can bet, few companies would invest huge resources and take substantial risks to create a leading search engine or other brilliant ideas like Google when they can just free ride on others' ideas. The same argument would apply for the trade secrets of Microsoft on the source codes of its successful operating system Windows and to many other trade secrets of innovative leading companies. 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 to the precious role of trade secrets, or other 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. Coase (1960) has clarified that whenever there is social value to generate, the market will properly allocate all property rights, including intellectual ones, insuring the accessibility of the information that fuels interoperability and acknowledging legitimate ownership rights of the innovators, and hence enhancing R&D investments. Finally, in 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. In a famous book, Liebowitz and Margolis (1999) have shown that this was the case in many episodes. For instance, in the adoption of the QWERTY keybord (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 out that all the 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 the consumers better than policymakers: promote innovation, enable an efficient degree of interoperability and select the best standards.[16]

[16]The approach of the European Commission (2005) on this subject in the proposed guidelines for the application of Art. 82 is quite ambiguous. In the section on refusals to supply, they state that although "there is no general obligation even for dominant companies to ensure interoperability, leveraging market power from one market to another by refusing interoperability information may be an abuse of a dominant position". It is added that even if such information may be considered a trade secret "it may not be appropriate to apply to such refusals to supply information the same high standards for intervention" as those regarding IPRs. However, there is no guidance on the lower standards that the Commission should apply and on the definition of "information needed for interoperability" and this statement appears to open doors to a systematic possibility that innovative firms are forced to reveal

To go back once again to our case study of the software market and the Microsoft case, a lot of the residual contrast between Microsoft and the European Commission depends on the approach to interoperability. The Commission's March 2004 antitrust decision mandated the licensing of intellectual property to enable interoperability between Windows PCs and work group servers and competitor products. This point has turned out to be the most problematic in the case. In reality, as we have suggested earlier, the degree of interoperability in the computer industry is uncomparably high compared to just a few years ago. At the time of writing, Microsoft's offer of access to Windows source code, including for technologies that are covered by patents and trade secrets, seems to have not convinced the European Commission. Nevertheless, its case appears weaker than in 2004: Microsoft was also forced to licence more than a hundred technologies and in Europe not one of its competitors has taken out a license, a sign that the existing level of interoperability was not as low as it was depicted.

7 Conclusion

In conclusion I would like to briefly point out the main message of this paper. Recent progress in the theory of market leaders suggests that the post-Chicago approach to abuse of dominance can be problematic for markets characterized by endogenous entry conditions. In particular when investments in R&D represent a large portion of the costs of production and constrain entry, marginal costs are approximately constant and small, and network effects are present, equilibrium market structures are naturally characterized by large marker shares for the leaders. These are the results of their aggressive pricing and investments strategies which are forced by competitive pressure in the market and for the market. Hence, antitrust authorities should be more careful in associating large market shares and aggressive strategies with abuse of dominance in the dynamic markets of the New Economy. Hopefully, these results may contribute to the current debate on the reform of the EU approach to competition policy.

References

Ahlborn, Christian., David Evans and Jorge Padilla, 2004, The Antitrust Economics of Tying: a Farewell to per se Illegality, *The Antitrust Bulletin*, Spring-Summer, 287-341

Barro, Robert, 1998, Why the Antitrust Cops should Lay off Hight Tech, *Business Week*, August 17, 20

Baumol, William, John Panzar and Robert Willig, 1982, *Contestable Markets and the Theory of Industry Structure*, San Diego, Harcourt Brace Jovanovich

trade secret. In my own view, even the uncertainty induced by this ambiguous wording is likely to jeopardize the incentives to invest in R&D with dangerous consequences for (future) consumer welfare.

Bonanno, Giacomo and John Vickers, 1988, Vertical Separation, *Journal of Industrial Economics*, 36, 257-265

Bulow, Jeremy, John Geanakoplos and Paul Klemperer, 1985, Multimarket Oligopoly: Strategic Substitutes and Complements, *Journal of Political Economy*, 93 (3) 488-511

Coase, Ronald, 1960, The Problem of Social Cost, *Journal of Law and Economics*, 3, 1-44

Dixit, Avinash, 1980, The Role of Investment in Entry-Deterrence, *The Economic Journal*, 90, 95-106

Economides, Nicholas, 2001, The Microsoft Anti-trust Case, *Journal of Industry, Competition and Trade*, 1, 7-39

Economist, The, 2004, *Slackers or Pace-setters? Monopolies may have more incentives to innovate than economists have thought*, Economic Focus, 22nd-28th May, 84

Etro, Federico, 2002, Stackelberg Competition with Endogenous Entry, mimeo, Harvard University

Etro, Federico, 2004, Innovation by Leaders, *The Economic Journal*, 114 (April), 495, 281-303

Etro, Federico, 2006a, Aggressive Leaders, *The Rand Journal of Economics*, Vol. 37 (Spring), 146-54

Etro, Federico, 2006b, Competition Policy: Toward a New Approach, *European Competition Journal*, Vol. 2 (March), 29-55

Etro, Federico, 2007, *Competition, Innovation and Antitrust*, Springer-Verlag, forthcoming

European Commission, 2005, *DG Competition Discussion Paper on the Application of Article 82 of the Treaty to Exclusionary Abuses*, Bruxelles

Fudenberg, Drew and Jean Tirole, 1984, The Fat Cat Effect, the Puppy Dog Ploy and the Lean and Hungry Look, *The American Economic Review, Papers and Procedeengs*, 74 (2), 361-68

ICC, 2006, *ICC Comments on the European Commission Discussion Paper on the Application of Article 82 of the Treaty to Exclusionary Abuses*, International Chamber of Commerce, Paris

Kreps, David and Wilson, Robert, 1982, Reputation and Imperfect Information, *Journal of Economic Theory*, 7, pp. 253-79

Liebowitz, Stan and Stephen Margolis, 1999, *Winners, Losers & Microsoft: Competition and Antitrust in High Technology*, The Independent Institute

McKenzie, Richard, 2001, *Trust on Trial: How the Microsoft Case is Reframing the Rules of Competition*, Cambridge, Perseus Publishing

Milgrom, Paul and Roberts, John, 1982, Predation, Reputation and Entry Deterrence, *Journal of Economic Theory*, 27, 280-312

Motta, Massimo, 2004, *Competition Policy. Theory and Practice*, Cambridge, Cambridge University Press

Rey, Patrick, Jordi Gual, Martin Hellwig, Anne Perrot, Michele Polo, Klaus Schmidt and Rune Stenbacka, 2005, *An Economic Analysis to Article 82, Report*

of the Economic Advisory Group for Competition Policy, European Union

Tirole, Jean, 2005, The Analysis of Tying Cases: A Primer, mimeo, University of Toulouse

Whinston, Michael, 1990, Tying, Foreclosure and Exclusion, *The American Economic Review*, 80, 837-59

Wiethaus, Lars, 2006, Excess Absorptive Capacity and the Persistence of Monopoly, mimeo, University of Hamburg

Zigic, Kresimir, Viatcheslav Vinogradov and Eugen Kovac, 2006, Persistence of Monopoly, Innovation, and R&D Spillovers: Static versus Dynamic Analysis, mimeo, CERGE-EI, Prague

Appendix

In this appendix I will present a general model of strategic investment and Nash competition based on Etro (2006a). Consider n firms choosing a strategic variable $x_i > 0$ with $i = 1, 2, ..., n$. They all compete in Nash strategies, that is taking as given the strategies of each other. These strategies deliver for each firm i the net profit function:

$$\pi_i = \Pi(x_i, \beta_i, k) - F \tag{1}$$

where $F > 0$ is a fixed cost of production. The first argument is the strategy of firm i and I assume that gross profits are quasiconcave in x_i.

The second argument represents the effects (or spillovers) induced by the strategies of the other firms on firm i's profits, summarized by $\beta_i = \sum_{k=1,k\neq i}^{n} h(x_k)$ for some function $h(x)$ which is assumed positive, differentiable and increasing. These spillovers exert a negative effect on profits, $\Pi_2 < 0$. In general, the cross effect Π_{12} could be positive, so that we have strategic complementarity (SC), or negative so that we have strategic substitutability (SS). I will define strategy x_i as aggressive compared to strategy x_j when $x_i > x_j$ and accommodating when the opposite holds. Notice that a more aggressive strategy by one firm reduces the profits of the other firms.

The last argument of the profit function is a profit enhancing factor ($\Pi_3 > 0$) which for all firms except the leader is constant at a level $\bar{k}$. Only the leader is able to make a strategic precommitment on k in a preliminary stage. The cost of its strategic investment is given by the function $f(k)$ with $f'(k) > 0$ and $f''(k) > 0$. Our focus will be exactly on the incentives for this firm to undertake such an investment so as to maximize its total profits:[17]

$$\pi_L(k) = \Pi^L(x_L, \beta_L, k) - f(k) - F \tag{2}$$

where x_L is the strategy of the leader and $\beta_L = \sum_{j\neq L} h(x_j)$. We will say that the investment makes the leader tough when $\Pi^L_{13} > 0$, that is an increase in k increases the marginal profitability of its strategy, while the investment makes the leader soft in the opposite case ($\Pi^L_{13} < 0$).

Most of the commonly used models of oligopolistic competition in quantities and in prices are nested in our general specification.[18] For instance, consider a market with quantity competition so that the strategy x_i represents the quantity produced by firm i. The corresponding inverse demand for firm i is $p_i = p\left[x_i, \sum_{j\neq i} h(x_j)\right]$ which is decreasing in both arguments (goods are substitutes). The cost function is $c(x_i)$ with $c'(\cdot) > 0$. It follows that gross profits for firm i are:

$$\Pi(x_i, \beta_i) = x_i p(x_i, \beta_i) - c(x_i) \tag{3}$$

[17] To avoid confusion, I will add the label L to denote the profit function, the strategy and the spillovers of the leader.

[18] Other models of oligopolistic interaction such as patent races and contests are also nested in my general framework, but I have discussed them elsewhere (Etro, 2002; 2004). In the following examples I omit the variable k for simplicity.

Examples include linear and isoelastic demands and other common cases. This set up satisfies our general assumptions under weak conditions and can locally imply SS (as in most cases) or SC.

Consider now models of price competition where p_i is the price of firm i. Any model with direct demand:

$$D_i = D\left[p_i, \sum_{j=1, j\neq i}^{n} g(p_j)\right] \quad \text{where } D_1 < 0,\ D_2 < 0,\ g'(p) < 0$$

is nested in our general framework after setting $x_i \equiv 1/p_i$ and $h(x_i) = g(1/x_i)$. This specification guarantees that goods are substitutes in a standard way since $\partial D_i/\partial p_j = D_2 g'(p_j) > 0$. Examples include models of price competition with isoelastic demand, Logit demand, constant expenditure demand[19] and other demand functions as in the general class due too Dixit and Stiglitz. Adopting, just for simplicity, a constant marginal cost c, we obtain the gross profits for firm i:

$$\Pi(x_i, \beta_i) = \left(\frac{1}{x_i} - c\right) D\left(\frac{1}{x_i}, \beta_i\right) = (p_i - c)\, D(p_i, \beta_i) \tag{4}$$

which is nested in our general model and, under weak conditions assumed through the paper, implies SC.

We can now note that a more aggressive strategy corresponds to a larger production level in models of quantity competition and a lower price under price competition. In these models, we can introduce many kinds of preliminary investments, as we will see later on.

Strategic investment by the leader

We will now solve for the equilibrium in the two-stage model where the leader chooses its preliminary investment in the first stage and all firms compete in Nash strategies in the second stage.

For a given preliminary investment k by the leader, the second stage where firms compete in Nash strategies is characterized by a system of n optimality conditions.

[19] For instance, consider a isoelastic utility like $u = \left[\sum_{j=1}^{n} C_j^{\theta}\right]^{\gamma}$, where $\theta \in (0, 1]$ and $\gamma \in (0, 1/\theta)$. Demand for good i can be derived as:

$$D_i \propto \frac{p_i^{-\frac{1}{1-\theta}}}{\left[\sum_{j=1}^{n} p_j^{-\frac{\theta}{1-\theta}}\right]^{\frac{1-\gamma}{1-\gamma\theta}}}$$

which is nested in our framework after setting $g(p) = p^{-\theta/(1-\theta)}$. The Logit demand is

$$D_i = \frac{e^{-\lambda p_i}}{\sum_{j=1}^{n} e^{-\lambda p_j}}$$

which requires $g(p) = e^{-\lambda p}$. Notice that linear demands are not nested in our model.

For the sake of simplicity, I follow Fudenberg and Tirole (1984) by assuming that a unique symmetric equilibrium exists and that there is entry of some followers for any possible preliminary investment. Given the symmetry of the model, in equilibrium each follower chooses a common strategy x and the leader chooses a strategy x_L satisfying the optimality conditions:

$$\Pi_1 \left[x, (n-2)h(x) + h(x_L), \bar{k}\right] = 0 \tag{5}$$

$$\Pi_1^L \left[x_L, (n-1)h(x), k\right] = 0 \tag{6}$$

where I use the fact that in equilibrium the spillovers of each follower is $\beta = (n-2)h(x) + h(x_L)$ and of the leader is $\beta_L = (n-1)h(x)$.

Before analyzing the model with free entry, it is convenient to briefly summarize the results in the presence of barriers to entry. The system above provides the equilibrium values of the strategies as functions of the preliminary investment, $x(k)$ and $x_L(k)$, whose comparative statics can be easily derived. In the first stage the leader chooses its investment k to maximize:

$$\pi_L(k) = \Pi^L \left\{x_L(k), (n-1)h\left[x(k)\right], k\right\} - f(k) - F$$

and it is immediate to obtain the optimality condition:

$$\Pi_3^L + \frac{h'(x_L)\Pi_{13}^L \Pi_2^L \Pi_{12}}{\Omega} = f'(k) \tag{7}$$

where the second term on the left hand side represents the strategic incentive to commit to k.[20] The sign of this incentive is the opposite of the sign of $\Pi_{12}\Pi_{13}^L$. Hence, we have the following traditional result: under barriers to entry: 1) when the leader is tough ($\Pi_{13}^L > 0$), strategic over (under)-investment occurs under SS (SC), inducing a "top dog" ("puppy dog") strategy; 2) when the leader is soft ($\Pi_{13}^L < 0$), strategic under (over)-investment occurs under SS (SC), inducing a "lean and hungry" ("fat cat") strategy.

The intuition behind this result is important for what follows. Basically, under SS the leader gains from committing to an aggressive behaviour in the market and can accomplish such a task by overinvesting or underinvesting strategically when the investment promotes aggressive or accommodating behaviour. Otherwise, under SC the leader tries to commit to accommodating behaviour in the market and can achieve this by adopting the opposite kind of strategy. The ultimate behaviour of the leader in the market depends on whether strategies are substitutes or complements.

I will now consider the case of endogenous entry assuming that the number of potential entrants is great enough that a zero profit condition pins down the number

[20] Here

$$\Omega = \frac{\Pi_{11}^L}{(n-1)h'(x)}\left[\Pi_{11} + (n-2)\,h'(x)\Pi_{12}\right] + \Pi_{12}^L \Pi_{12}$$

is positive by the assumption of the stability of the system.

of active firms, n.[21] The equilibrium conditions in the second stage for a given preliminary investment k are the optimality conditions derived before and the zero profit condition for the followers:

$$\Pi\left[x, (n-2)h(x) + h(x_L), \bar{k}\right] = F \tag{8}$$

We can now prove that a change in the strategic commitment by the leader does not affect the equilibrium strategies of the other firms, but it reduces their equilibrium number. Let us use the fact that $\beta_L = \beta + h(x) - h(x_L)$ to rewrite the three equilibrium equations in terms of x, β and x_L:

$$\Pi\left(x, \beta, \bar{k}\right) = F, \quad \Pi_1\left(x, \beta, \bar{k}\right) = 0, \quad \Pi_1^L\left[x_L, \beta + h(x) - h(x_L), k\right] = 0$$

This system is block recursive and stable under the condition $\Pi_{11}^L - h'(x_L)\Pi_{12}^L < 0$. The first two equations provide the equilibrium values for the strategy of the followers and their spillovers, x and β, which are independent of k, while the last equation provides the equilibrium strategy of the leader $x_L(k)$ as a function of k with $x_L(\bar{k}) = x$ and:

$$x_L'(k) = -\frac{\Pi_{13}^L}{\Pi_{11}^L - h'(x_L)\Pi_{12}^L} \gtreqless 0 \quad \text{for } \Pi_{13}^L \gtreqless 0 \tag{9}$$

In the first stage the optimal choice of investment k for the leader maximizes:

$$\pi_L(k) = \Pi^L\left\{x_L(k), \beta + h(x) - h\left[x_L(k)\right], k\right\} - f(k) - F$$

and hence it satisfies the optimality condition:

$$\Pi_3^L + \frac{h'(x_L)\Pi_2^L\Pi_{13}^L}{\Pi_{11}^L - h'(x_L)\Pi_{12}^L} = f'(k) \tag{10}$$

where the sign of the second term is just the sign of Π_{13}^L. This implies that the leader has a positive strategic incentive to invest when it is tough ($\Pi_{13}^L > 0$) and a negative one when it is soft.

Since our focus is on the strategic incentive to invest, I will normalize the profit functions in such a way that, in absence of strategic motivations, the leader would choose $k = \bar{k}$ resulting in a symmetric situation with the other firms.[22] Consequently we can conclude that a tough leader overinvests compared to the other firms, in the sense that $k > \bar{k}$, while a soft leader underinvests. We also noticed that a tough leader is made more aggressive by overinvesting and a soft leader is made more aggressive by underinvesting. Finally, the strategy of the other firms is independent of the investment of the leader. Hence, we can conclude that the leader will be always more aggressive in the market than any other firm. Summarizing, we have:

[21] As customary in the literature, I will assume n is a real number.

[22] This requires $\Pi_3^L\left(x, \beta, \bar{k}\right) = f'(\bar{k})$. Such a normalization does not affect qualitatively the incentives to adopt strategic investments and has a realistic motivation. We can imagine that all firms choose k but only the leader can do it before the others and commit to it, hence only a strategic motivation can induce the leader to choose a different investment.

Under Nash competition with endogenous entry, when the strategic investment makes the leader tough (soft), over (under)-investment occurs, but the leader is always more aggressive than the other firms.

Basically, under free entry, the taxonomy of Fudenberg and Tirole (1984) boils down to two simple kinds of investment and an unambiguous aggressive behaviour in the market: whenever $\Pi_{13}^L > 0$, it is always optimal to adopt a "top dog" strategy with overinvestment in the first stage so as to be aggressive in the second stage; while when $\Pi_{13}^L < 0$ we always have a "lean and hungry" look with underinvestment, but the behaviour in the second stage is still aggressive. Strategic investment is always used as a commitment to be more aggressive in a market with free entry, and this does not depend on the kind of competition or strategic interaction between the firms. As we will see in the applications of the next section, the result is particularly drastic for markets with price competition. In these markets, leaders are accommodating in the presence of entry barriers (choosing higher prices than their competitors), but they are aggressive under free entry (choosing lower prices). This difference may be useful for empirical research on barriers to entry and may have crucial implications for anti-trust policy.

Applications

We will now apply the above results to a number of basic industrial organization situations, with particular reference to specific features of markets of the New Economy: R&D investments, network externalities and bundling issues.

R&D Investments

Our first application is to a standard situation where a firm can adopt preliminary R&D investments to improve its production technology and hence reduce its cost function. Traditional results on the opportunity of these investments for market leaders are ambiguous when the number of firms is exogenous, but, as I will show, they are not when entry is endogenous. From now on, I will assume for simplicity that marginal costs are constant. Here, the leader can invest k and reduce its marginal cost to $c(k) > 0$ with $c'(k) < 0$, while the marginal cost is constant for all the other firms.

Consider first a model of quantity competition. The gross profit of the leader becomes:

$$\Pi^L(x_L, \beta_L, k) = x_L p(x_L, \beta_L) - c(k)x_L \tag{11}$$

Notice that in such a model, Π_{12}^L has an ambiguous sign, but $\Pi_{13}^L = -c'(k) > 0$, hence the leader may overinvest or underinvest in R&D under barriers to entry, but, will always overinvest in R&D and produce more than the other firms when entry is free. For instance assuming inverse demand $p = a - \sum x_i$ with $c(k) = c - dk$ and $f(k) = k^2/2$, for d small enough the leader invests:

$$k = \frac{2d\sqrt{F}}{1 - 2d^2}$$

in cost reductions and produces:

$$x_L = \frac{\sqrt{F}}{1-2d^2}$$

while all entrants produce $x = \sqrt{F}$ (while for a large enough d the leader would invest more to deter entry and to remain alone in the market).

Consider now the model of price competition where the leader can invest to reduce its marginal costs in the same way and its profit function becomes:

$$\Pi^L(x_L, \beta_L, k) = \left[\frac{1}{x_L} - c(k)\right] D\left(\frac{1}{x_L}, \beta_L\right) \tag{12}$$

where $\Pi^L_{13} = c'(k)D_1/x_L^2 > 0$. Hence, underinvestment in R&D emerges when there are barriers to entry, but overinvestment is optimal when there is free entry. Whenever entry is endogenous, the leader wants to improve its cost function to be more aggressive in the market by selling its good at a lower price. Summarizing, we have:[23]

Under both quantity and price competition with endogenous entry, a firm has always an incentive to overinvest in R&D to reduce costs and to be more aggressive than the others in the market.

Network externalities and learning by doing

Consider now dynamic models where profitability depends on past strategies. For instance, learning by doing implies that the cost function is decreasing in past production. This is the typical case of the aircraft industry (Boeing, Airbus), the production of chips (Intel) and many other sectors with a fast technological progress. Network externalities imply that demand is enhanced by past production and the consequent diffusion of the product across customers. This may be the case of the markets for operatying systems and general softwares (Microsoft), computers (IBM, Hewlett Packard) or wireless and broadband communications (Nokia, Motorola).

In these contexts it is natural to think in terms of quantity competition and, for simplicity, following Bulow et al. (1985), I will focus on two period models with the leader alone in the market in the first period and facing free entry in the second period. In case of learning by doing the leader will always overproduce initially to exploit the learning curve. In case of demand externalities the leader will overproduce initially to create network effects, which broadly matches pricing strategies by leaders in high tech sectors characterized by network externalities.

To formalize these results in the simplest setting, assume perfectly substitute goods. Imagine that in the first period the leader produces k facing the inverse demand $p(k)$ and a marginal cost c. In the second period other firms compete in quantities

[23] Welfare analysis is beyond the scope of this paper, but in this case one can show that a leadership improves the allocation of resources. This is not due only to the cost reduction but also to the reduction in the number of firms since, as well known, Cournot and Bertrand equilibria with free entry are characterized by excessive entry.

and the leader faces the inverse demand $p(x_L + \beta_L)\phi(k)$ where $\phi(k)$ is some increasing function of past production, which is a measure of the diffusion of the product across consumers (and induces the network externality), while the marginal cost $c(k)$ is decreasing in past production (because of learning by doing). The profit function for the leader becomes:

$$\Pi^L(x_L, \beta_L, k) = kp(k) - ck + \delta\left[p(x_L + \beta_L)\phi(k) - c(k)\right]x_L \tag{13}$$

where $\delta < 1$ is the discount factor. In this case in equilibrium we have $\Pi^L_{13} = \delta\left[\phi'(k)/c(k)\phi(k) - c'(k)\right] > 0$ which already suggests that the initial monopolist will overproduce to be more aggressive when the market opens up. Moreover, the choice of initial production will satisfy:

$$p(k) + kp'(k) = c - \delta x_L\left[p\phi'(k) - c'(k)\right] - \delta x_L c(k)\left[\phi'(k)/\phi(k) - c'(k)/c(k)\right]$$

which equates marginal revenue to effective marginal cost. The latter includes the myopic marginal cost c, a second term which represents the direct benefit due to the network effects on future demand and costs and a last term representing the indirect (strategic) benefits due to the commitment to adopt a more aggressive strategy in the future. Summarizing:

Under learning by doing and network externalities a firm has always an incentive to overproduce initially so as to be more aggressive when endogenous entry takes place in the future.

Notice that the leader may engage in dumping (pricing below marginal cost) in the first period (if the discount factor is large enough), but this may well be beneficial to consumers in both periods (see Economides, 2001, for a related analysis of the software market).

Bundling

There has been a lot of attention in the economic literature on the rationale for bundling products rather than selling them separately. A fundamental reason for this is that many antitrust cases have focused on such a practice as an anti-competitive device. This paper tries to derive some general results on why firms bundle their products and some welfare implications.

According to the traditional leverage theory of tied good sales, monopolists would bundle their products with others for competitive or partially competitive markets to extend their monopolistic power. Such a view as been criticized by the Chicago school because it would erroneously claim that a firm can artificially increase monopolistic profits from a competitive market. Bundling should have different motivations, as price discrimination or creation of joint economies, whose welfare consequences are ambiguous and sometimes even positive.

Whinston (1990) has changed the terms of the discussion trying to verify how a monopolist can affect strategic interaction with competitors in another market by bundling. His main finding is that the only reason why a monopolist could bundle

is to deter entry (as in Dixit, 1980), which has typically negative effects on welfare. His analysis is based on price competition between two firms, hence strategic complementarity holds, and it can be extended in many directions, especially including complementarities between products.

We depart from this analysis and consider a more general model where there may be more firms and alternative market structures. In particular, under free entry, bundling may become the optimal aggressive strategy. In this case, bundling does not need to have an exclusionary purpose as assumed by the leverage theory, and the reduction in the price of the two bundled goods together can also benefit consumers. Such an analysis may apply to the bundling of Windows with Internet Explorer and Media Player at no extra price (see Economides, 2001), which, nevertheless, has been harshly treated by the US and EU antitrust authorities.

To make our point in a neat way, let us follow the example by Whinston (1990), who has shown that a monopolist in one market does not have incentives to bundle its product with another one sold in a duopolistic market (unless this deters entry in the latter), and that this corresponds to a "puppy dog" (accomodating) strategy (see Fudenberg and Tirole, 1984). However, under free entry, bundling may become the optimal "top dog" (aggressive) strategy.

Imagine that a monopolistic market is characterized by zero costs of production and unitary demand at price v, which corresponds to the valuation of the good. For simplicity, there are no complementarities with a good produced in another market which is characterized by standard price competition, a fixed cost F and a constant marginal cost c.

Gross profits for the monopolist without bundling are:

$$\Pi^M (p_M, \beta_M) = v + (p_M - c) D (p_M, \beta_M) - F \tag{14}$$

while profits for the other firms are $\Pi^i (p_i, \beta_i) = (p_i - c) D (p_i, \beta_i) - F$. In Bertrand equilibrium with free entry the monopolist enjoys just the profits $\Pi^M = v$.

Under bundling, demand for the monopolist is constrained by demand for the other good, which is assumed less than unitary. Given a bundle price corresponding to $P_M = v + p_M$, profits for the monopolist become $\Pi^{MB} = (P_M - c) D(P_M - v, \beta_M) = (p_M + v - c) D (p_M, \beta_M)$, while the other firms have the same objective function as before. In Bertrand equilibrium the monopolist chooses the price P_M satisfying:

$$(p_M + v - c) D_1 [p_M, (n-1) g(p)] + D [p_M, (n-1) g(p)] = 0 \tag{15}$$

while each one of the other firms chooses p satisfying:

$$(p - c) D_1 [p, g(p_M) + (n-2) g(p)] + D [p, g(p_M) + (n-2) g(p)] = 0 \tag{16}$$

If endogenous entry holds, the number of firms satisfies also:

$$(p - c) D [p, g(p_M) + (n-2) g(p)] = F \tag{17}$$

so that the profit of the monopolist becomes:

$$\Pi^{MB} = (p_M + v - c)\, D\left[p_M, (n-1)g(p)\right]$$

Notice that if we define $\beta = g(p_M) + (n-2)g(p)$ the equilibrium spillovers received by the entrants as a consequence of the price chosen by their competitors, the equilibrium conditions jointly determine the price of the entrants p and β independently from the price of the monopolist. Hence, using $\beta_M = \beta + g(p) - g(p_M)$ we can rewrite the equilibrium first order condition of the monopolist as an implicit expression for $p_M = p_M(v)$, and it is immediate to derive that the equilibrium price of the secondary good decided by the monopolist has to be decreasing in v.[24] As well known from the theory of market leaders (Etro, 2006a), even under price competition, any strategic commitment is undertaken with the aim of being aggressive on the market. Nevertheless, when v is small enough, the equilibrium does not imply exclusion of other firms. Clearly, if the profit in the primary market is large enough, the monopolist may find convenient to offer such a large discount on the bundle that all its competitors will have to exit the market, but this only happens under retrictive conditions.

Clearly bundling is optimal if $\Pi^{MB} > \Pi^{M}$, and we need to verify under which conditions this happens. The first element to take in consideration is the way in which bundling changes the strategy of the monopolist. Since $\Pi_1^{MB} - \Pi_1^{M} = vD_1 < 0$, bundling makes the monopolist tough. This implies that the monopolist is led to reduce the effective price in the other market by choosing a low price of the bundle. Since strategic complementarity holds, a price decrease by the monopolist induces the other firms to decrease their prices. Under barriers to entry, as in the Whinston (1990) model with two firms, this reduces profits of all firms in the other market, hence bundling is never optimal unless it manages to deter entry.

Under free entry, however, result can change: bundling can now be an effective device to outplace some of the other firms without deterring entry but creating some profits for the monopolist in the other market through an aggressive strategy. In particular, bundling is optimal if the low price of the bundle increases profits in the competitive market more than it reduces them in the monopolistic one. It is easy to verify that bundling is optimal if:

$$(p_M - c)D\left[p_M, (n-1)g(p)\right] - F > v\left\{1 - D\left[p_M, (n-1)g(p)\right]\right\}$$

whose left hand side is the gain in profits in the competitive market and whose right hand side is the loss in profits in the monopolistic market.

[24] In particular we have:

$$\frac{dp_M}{dv} = \frac{-D_1\left[p_M, \beta + g(p) - g(p_M)\right]}{\Delta} < 0$$

where $\Delta \equiv 2D_1 + (p_M + v - c)[D_{11} - g'(p_M)D_{12}] - g'(p_M)D_2 < 0$ by the stability of the equilibrium system. In other words, the price of the bundle increases less than proportionally with v or the monopolist offers the bundle with a discount on the secondary good compared to its competitors.

Moreover, in this case, bundling does not need to have an exclusionary purpose as assumed by the leverage theory of tied good sales. The reduction in the price of the two bundled goods together can also benefit consumers. This is even more likely when they are complements.