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# Endogenous market structures and antitrust policy

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**Abstract** I revisit the post-Chicago approach to antitrust issues examining markets whose structure is endogenous. The usual analysis of oligopolies with strategic interactions and an exogenous number of firms is extended to the case of endogenous entry, which determines the degree of market power. The role of predation is evaluated within a generalization of the contestability theory to strategic interactions. Endogenous entry requires a revision of our understanding of the role of incumbents in pricing, producing in the presence of network externalities, bundling products, price discriminating, and delegating to retailers through vertical restraints: when entry is endogenous, leaders adopt aggressive strategies typically without exclusionary purposes and without reducing welfare. Endogenous entry has also implications for the analysis of mergers, that take place only if they create enough cost efficiencies and do not harm consumers, beneficial concentration, technology transfers, and cartels. The spirit of the policy recommendations of the Chicago school is broadly supported by our analysis.

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The recent literature on the endogeneity of market structures has been useful to revisit a number of descriptive results of industrial organization concerning markets

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with strategic interactions and endogenous entry,[1] and a number of normative results concerning competition, innovation, trade, and macroeconomic policy.[2] In this article, I will apply the theoretical apparatus of the endogenous market structures approach to discuss antitrust policy issues. In particular, I will advance a critical view of the post-Chicago approach, emphasizing that this has often disregarded the consequences of the endogeneity of the market structure: extending this approach to cases in which the number of competitors is endogenously determined, one can obtain a more complete view of its antitrust implications. Notice that the hypothesis of endogenous entry should not be interpeted as pure free entry in perfectly competitive markets, but as a condition determining the endogenous size of the market power of the active firms as a consequence of profit-maximizing decisions on entry. Taking this into account, standard results of the post-Chicago literature can be radically modified. The main implications concern the behavior of market leaders, that is the first-movers of a market, and consequently the antitrust approach to abuse of dominance (or monopolization) issues, but I will also derive implications on mergers and collusion.

The theory of endogenous entry and market leadership has shown that whether entry in a market is exogenous or endogenous makes a lot of difference for the way leaders behave (Etro 2006). In markets where entry is independent from the profitability conditions, market leaders can adopt accommodating strategies to increase prices or aggressive ones to exclude rivals, and their strategies can harm consumers. When entry is endogenously dependent on the profitability conditions in the market, the leaders always adopt aggressive strategies, which typically do not harm consumers. A few examples should clarify the point.

Consider a merger between two firms in a market with price competition: if the number of firms is fixed (for instance because they have an exclusive and superior technology), this stimulates an accommodating behavior of the merged entities, which tends to increase prices and profits, but when entry is endogenous (for instance because the production technology is publically available) this attracts entry and defeats the same strategic purpose of the merger. The conditions under which such a merger can hurt consumers have been investigated only recently (starting with Werden and Froeb 1998; Davidson and Mukherjee 2007; Etro 2007). Consider unilateral conducts now. A firm competing with a single rival could engage in accommodating pricing to increase mark ups, or in predatory pricing to induce the exit of the rival, but a firm facing endogenous entry of competitors will ordinarily adopt aggressive pricing strategies without exclusionary purposes (Etro 2008). As a last example, consider a monopolist in a primary market competing also in a secondary market: when the latter is characterized by a single rival, the monopolist may bundle its goods to monopolize also the secondary market inducing

[1] See Sutton (1998) and Etro (2007) for wide reviews. For some of the most recent applications of the endogenous market structures approach to strategic commitments, see Tesoriere (2008), Ino and Matsumura (2008, 2009), Matsumura and Okamura (2009), Creane and Konishi (2009), Kesternich and Schumacher (2009), Kato and Oki (2009), and Kováč et al. (forthcoming).

[2] See Etro (2009) for wide review. For some of the most recent applications, see Boone et al. (2006), Davidson and Mukherjee (2007), Kiedaisch (2009), Amable et al. (2009), and Etro (2010).

the exit of the rival, but when the secondary market is characterized by endogenous entry the purpose of bundling can be simply to strengthen price competition in the secondary market (as we will show in this article).

Of course, notice that efficiency reasons can still motivate mergers, aggressive pricing or the adoption of bundling (or vertical restraints, price discrimination, and other strategies). Therefore, the overall flavor of our approach is reminiscent of the Chicago school, but the analysis is based on game theoretic foundations consistent with the post-Chicago tradition (and can be seen as complementary to it).

It is clear that the relevance of these results depends on the relevance of the hypothesis that entry is endogenous in a specific market. One may argue that entry can be usually regarded as endogenous in the medium and long run, but not in the short run. If this is the case, and if antitrust policy is aimed at correcting distortions in the medium and long run, as opposed to short run distortions, which self-correct through market mechanisms, then these results are potentially relevant for policymakers. However, if antitrust policy is also aimed at correcting short run distortions emerging in the absence of entry pressure, the traditional post-Chicago analysis based on exogenous entry applies.[3]

The rest of the article is organized as follows. In Sect. 1, I will review the traditional approaches to antitrust, and in Sect. 2, I will describe the endogenous market structures approach. Section 3 summarizes the basic theoretical results. Section 4 applies them to abuse of dominance (monopolization) issues. Section 5 is about mergers and price-fixing agreements. Section 6 compares the U.S. and E.U. approaches to antitrust on the basis of our investigation. Section 7 concludes.

## 1 Chicago and post-Chicago approaches

During the 1950s and 1960s, the school associated with the University of Chicago has introduced a systematic economic approach to antitrust (see Bork 1993; Posner 2001). Most scholars in this tradition have a *laissez-faire* view on mergers and exclusionary practices: when there are potential entrants in a given sector, mergers are mostly aimed at creating beneficial cost efficiencies, while aggressive strategies as bundling, price discrimination, and exclusive dealing are not necessarily anti-competitive, but usually have an efficiency rationale. For instance, bundling is typically used for price discrimination purposes and not for exclusionary purposes. Actually, according to the so-called *single-monopoly profit theorem* a monopolist in one market cannot use tying or any other practice to leverage market power in another market where entry is free. Moreover, according to a widespread view in the Chicago school, there is not such a thing as predatory pricing: the main reason is that, if the predator can sustain the initial losses needed to induce the exit of a rival, also the rival can sustain the induced losses as long as credit markets are properly

[3] The distinction between markets where entry can be regarded as endogenous or not in the relevant timing for welfare considerations remains an empirical issue to be address case by case. I am grateful to a referee on this point.

working, therefore, predatory pricing would not be effective to start with (McGee 1958).[4]

The Chicago school provided fundamental insights into many antitrust issues, but it failed to provide a complete understanding of the behavior of market leaders. In particular, it limited most of its analysis to the understanding of how monopolistic and perfectly competitive markets work, and in a few cases it focused on markets characterized by a monopolist facing a competitive fringe of potential entrants.[5] Dismissing the useful progress in the applications of game theory, the Chicago school ignored the important role of the strategic interactions between incumbents and entrants. The consequence was that its approach to exclusionary practices has been often biased toward a competitive role of the incumbents without an updated theoretical support, and it has been neglected in practice whenever markets were characterized by imperfect competition.

In the 1980s, while the Chicago school was succeeding in reducing the enforcement attitudes of US antitrust law, a (later called) post-Chicago approach started to expand its influence between economists and, in the following decade, also between antitrust scholars. This approach introduced new game theoretic tools to study complex market structures and derive sound normative implications. For instance, with reference to exclusionary practices, the post-Chicago approach has shown that in the presence of strategic commitments to undertake preliminary investments, of asymmetric information between firms (as in the celebrated model of Milgrom and Roberts 1982) or in the presence of limited forms of irrationality or credit market imperfections, then predatory pricing can be an equilibrium strategy for the incumbent, can deter entry and it can harm consumers. Similarly, it has shown that bundling can be used to strengthen price competition and exclude a rival from a secondary market (Whinston 1990). Analogously, many other strategies can have an exclusionary purpose, while mergers have typically an accommodating purpose which again hurts consumers.

One should keep in mind that many of the results of the post-Chicago approach (see Tirole 1988) largely depend on a number of restrictive assumptions. For example, predatory pricing has been shown to be exclusionary under extreme circumstances, including forms of irrational behavior (in reputation models) or pervasive market imperfections, and, even when exclusion emerges under more plausible conditions, it is not necessarily associated with a pricing below cost or even with reductions in consumer welfare (in signaling models), which is what should matter for the antitrust implications.

[4] More recently, Posner (2001) has taken a less extreme position, proposing a moderate standard for judging practices claimed to be exclusionary: "in every case in which such a practice is alleged, the plaintiff must prove first that the defendant has monopoly power and second that the challenged practice is likely in the circumstances to exclude from the defendant's market an equally or more efficient competitor. The defendant can rebut by proving that although it is a monopolist and the challenged practice exclusionary, the practice is, on balance, efficient" (*ibidem*, pp. 194–195). This efficiency defense is at the basis of the *rule of reason* approach, for which a business practice is not per se illegal, but can be justified if it does not harm consumers or creates efficiencies.

[5] Somewhat related with this literature are the dominant firm literature (see recently Tasnadi 2009) and the theory of contestable markets by Baumol et al. (1982).

Our critique of the post-Chicago approach is not centered on its game theoretic foundation or on its specific results, but on the general applicability of these results for policy purposes. In most cases, the modern game theoretic literature in industrial organization has studied the behavior of incumbent monopolists facing a single potential entrant. To cite the most known theoretical 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, by Fudenberg and Tirole (1984) on strategic investment, by Rey and Stiglitz (1988) and Bonanno and Vickers (1988) on vertical restraints, by Whinston (1990) on bundling for entry deterrence purposes, and many other subsequent works based on analysis of duopolies with an incumbent and an entrant.[6] Also most of the standard results on the behavior of incumbents in terms of pricing, R&D investments, mergers, quality choices, and vertical and horizontal differentiation are derived in simple oligopolistic models, where the incumbent chooses its own strategies in competition with a fixed number of competitors (see Salant et al. 1983, Bulow et al. 1985, Deneckere and Davidson 1985). 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 therefore, limits its relevance to situations where the incumbent already has an exogenous amount of market power.[7]

## 2 Endogenous entry and antitrust

The industrial organization literature has emphasized different kinds of constraints on entry. The definition of *barriers to entry* has been quite debated in the literature.[8] Bain (1956) 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. Broadly speaking, such a situation corresponds to what we define as competition between an exogenous number of firms: even if positive profits can be obtained by a new firm in the market, entry is not possible. Stigler (1968) has proposed a different definition of barriers to entry, associating them with costs of production which must be borne by firms seeking to enter an industry but not borne by the incumbents; a similar approach has been prevailing more recently (Baumol et al. 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). According to this definition, sunk costs can be binding on the entry decision of the followers, therefore, they can be a crucial determinant of the endogeneity of entry in a market. A final category is that of the simple *fixed costs of entry*: these are equally faced by

[6] See Motta (2004) and Whinston (2006) on the post-Chicago approach.

[7] Of course, entry can be regarded as an exogenous phenomenon in the case of a natural monopoly or when there are legal barriers to entry, but these cases should not be the subject of antitrust analysis, but of regulatory analysis.

[8] See Martin (2002) and Mosca (2009).

the incumbent and the followers to produce in the market, but they can also represent a binding constraint on entry. While there is a fundamental difference in the concepts of sunk costs and fixed costs of entry, their role in endogenizing entry is virtually the same, and we will not stress the difference in what follows.[9] In conclusion, entry should be regarded as endogenous not when it is free, as in the perfectly competitive paradigma, but when sunk or fixed costs of entry constraint endogenously the number of firms that interact strategically in a market and therefore their market power.

In the rest of this section, I will introduce verbally the main applications of our approach on the behavior of market leaders, defined as first-movers, in models of competition in quantities, and in prices where entry is endogenous, and I will extend these results to evaluate the role of strategic commitments adopted by dominant firms and the role of mergers and cartels. The reader interested in the theoretical results can skip to the next section.

### 2.1 Competition in quantities

A main point emerging from the analysis of the behavior of market leaders facing or not facing endogenous entry is that standard measures of the concentration of a market have no relation with the dominance or market power of the leaders and may lead to misleading welfare comparisons. This point emerges quite clearly in the simplest environment, that of competition in quantities with homogenous goods and firms using the same technology with constant marginal costs and a fixed cost of production. Such a simple structure approximates the situation of many sectors where product differentiation is not very important, but there are high costs to start production (as in many high-tech sectors). In such markets, the characterization of the equilibrium structure is drastically different when entry conditions change. First of all, as long as the number of firms is exogenously given and the fixed costs of production are not too high, the leader is aggressive but leaves space for the followers to be active in the market. As external observers, we would look at this as a market characterized by an incumbent with a market share typically larger than its rivals, but with a certain number of competitors whose supply of goods reduces the equilibrium market price. The higher the number of these competitors, the lower the price will be: in such a case, higher concentration would be correctly associated with lower welfare.

Radical changes occur when entry in the market is endogenous, and is determined by the existence of profitable opportunities in the same market (Etro 2008). In such a case, the leader would expand production until no one of the potential entrants has

[9] Another important aspect is about the source of these barriers and costs. They can constitute a source of antitrust examination if they have been artificially created or enlarged by the incumbent; they cannot if their source is purely technological. Nevertheless, according to the Chicago approach, it is hard to imagine how artificial barriers could be erected under normal circumstances, as we can conclude from the following position of Bork (1993): "If everything that makes entry more difficult is viewed as a barrier, and if barriers are bad, then efficiency is evil. That conclusion is inconsistent with consumer-oriented policy. What must be proved to exist, therefore, is a class of barriers that do not reflect superior efficiency and can be erected by firms to inhibit rivals. I think it clear that no such class of artificial barriers exists."

incentives to supply its goods in the market. The intuition for this extremely aggressive behavior of the market leader is simple. When entry is endogenous, the leader understands that a low production creates a large space for entry in the market while a high production reduces entry opportunities. More precisely, knowing how technological constraints govern the incentives to enter in the industry, the leader is aware that its output exactly crowds out the output of the competitors leaving unchanged the aggregate supply and hence the equilibrium price. However, taking this equilibrium price as given, the leader can increase its profits by increasing its output and reducing the average costs of production. Here the fixed costs of production (associated with constant marginal costs) are crucial: on one side, they constrain the profitability of entry, while on the other side they create scale economies in the production process that can be exploited by the leader through an expansion of its output. Actually, it is always optimal for the leader to produce enough to crowd out all the output of the competitors: exploiting the economies of scale over the entire market allows the leader to enjoy positive profits even if there is not an (equally efficient) competitor that could obtain positive profits from entering in the market. As external observers, in this case, we would simply see a single firm obtaining positive profits in a market where no one else enters, and we may erroneously associate this situation with a monopolistic environment. In reality, it is the competitive pressure of the potential entrants that induces the leader to produce so much to drive down the equilibrium price until no other (as-efficient) firm can enter. One can even show that this equilibrium with only the leader in the market generates a higher welfare than the endogenous entry equilibrium without a leadership, which would involve (too) many firms active in the market and earning zero profits.

Let us consider now a related situation with a different cost pattern for the firms: the marginal costs are substantially increasing in the production level or, more generally, the average costs have a U-shape. In such a case, a market leader facing endogenous entry of competitors may not have incentives to produce enough to be alone in the market, but would still behave in an aggressive way. Notice that, given the strategy of the leader, all the entrants maximize their own profits and therefore they price above the marginal cost. However, endogenous entry reduces the equilibrium price at a level that is just high enough to cover the fixed costs of production. This equilibrium generates a production below the efficient scale (which should equate marginal and average costs). Also in this case, the leader takes into account these elements and, in particular, takes as given the equilibrium price emerging from the endogenous entry of the competitors. Accordingly, the leader finds it optimal to produce enough to equate its marginal cost to the price, which requires a production above the efficient scale. Since marginal costs are increasing for such a high production level, the leader is pricing above its average cost, and hence obtains positive profits. In this case, the strategy of the leader does not even affect the market price, which is fully determined by endogenous entry of firms. Nevertheless, the leader obtains a larger market share than its rivals and positive profits. Moreover, one can show that the aggressive behavior of the leader, that adopts a price equal to the marginal cost, improves the allocation of resources compared to the same market with free entry and no leadership. A similar situation emerges when goods are not homogeneous, but they differ in quality.

The crucial lesson from this analysis is that we should be careful in drawing any conclusion on dominance and market power from indexes of concentration or from the market shares. Of course, an abusive behavior can be still associated with aggressive strategies aimed at foreclosing rivals and with negative consequences on consumers. However, this can be the case under two circumstances: (1) when these strategies are implemented by leaders with genuine market power, which is not constrained by effective entry, or (2) when the same leader has built barriers to artificially constraint entry and without efficiency reasons.[10,11]

Of course, a complete analysis of the consequences of entry deterrence would require a dynamic model taking into account the behavior of the leader before and after deterrence (as the one developed by Kováč et al. forthcoming, within the endogenous market structures approach), but simpler models are often able to say a lot. Our point here is just to warn against the risk of directly associating aggressive strategies that reduce prices and entry with strategies that harm consumers.

## 2.2 Competition in prices

Another important implication of the endogenous market structures approach emerges quite clearly when goods differ in quality and firms compete in prices. In this typical situation, the traditional analysis of Stackelberg oligopolies with a fixed number of competitors shows that dominant firms are either accommodating (setting high prices) or trying to exclude rivals by setting low enough prices: the first case happens when the fixed costs of entry are small (and predation would be too costly), the second when they are high enough.[12] However, this outcome, which has been largely emphasized by the post-Chicago approach, implies the risk of erroneously associating an aggressive price strategy with an entry deterring strategy in a systematic fashion.

When we endogenize entry in the market, leaders never adopt accommodating pricing strategies while they are always aggressive. In equilibrium with endogenous entry, the leaders increase their market shares and obtain positive profits through an aggressive pricing strategy: this reduces entry, but without excluding all the rivals (as long as product differentiation is substantial). Therefore, we must be extremely careful in associating aggressive pricing with predatory purposes. The original reason for which predatory strategies are considered anti-competitive is that they exclude competition in the future allowing the dominant firm to behave in a monopolistic fashion once competitors are out of the market. Clearly, if a strategy is aimed at excluding some but not all competitors, the monopolistic threat is absent or, at least, more limited.

[10] The last case emerges often in regulated sectors with the incumbent facing endogenous entry but determining the fixed or variable cost of the entrants (for instance with access pricing: see Armstrong et al. 1996).

[11] Of related interest is also the relation (see Etro 2007, Chap. 3.7, and Matsumura and Okamura 2009).

[12] Accommodating high prices are chosen by the leader when fixed costs of entry are small. The problem is that this is exactly when there are incentives for other firms to enter, hence the duopolistic equilibrium is quite weak, and the study of endogenous entry becomes crucial.

### 2.3 Strategic commitments by dominant firms

In general, the spirit of the results on the aggressive behavior of leaders goes through when they cannot commit to output or price strategies, but can undertake preliminary investments that change their incentives in the market (Etro 2006). For instance, a market leader facing an exogenous number of competitors may want to underinvest or overinvest strategically in cost reducing R&D according to the kind of competition (in prices or in quantities), because it may want to commit through these investments to adopt an accommodating or an aggressive strategy in the market: in particular, underinvesting is optimal before price competition, while overinvesting is optimal before quantity competition. However, this ambiguity collapses if the leader is facing endogenous entry of competitors. In such a case, strategic overinvestment in cost reducing R&D is optimal independently from the form of competition, because it allows one to be aggressive against the competitors.[13] A similar role is attached to investment in production capacity, to the adoption of debt financing, and to many other strategic commitments.

An interesting situation for antitrust purposes emerges when demand is characterized by network effects. In such a case, market leaders tend to underprice their products initially to attract customers in the future. As known, these strategies may induce pricing below marginal cost without entry deterrence purposes. Moreover, leaders facing endogenous entry may have further strategic incentives to reduce initial prices (or expand initial production): by doing so, they enhance network externalities and are able to reduce their prices also in the future. Therefore, antitrust authorities should be careful in evaluating aggressive pricing in the presence of network effects.[14]

The same care in judging aggressive strategies is needed in cases of complementary strategies that virtually induce aggressive behavior. One of these is bundling. In an influential article, Whinston (1990) has studied bundling in a market with two goods. The primary good is monopolized by one firm, which competes with a single rival in the market for the secondary good. Under price competition in the secondary market, the monopolist becomes more aggressive in its price choice in case of bundling of its two goods. As a more aggressive strategy leads to lower prices for both firms as long as they are both producing, the only reason why the monopolist may want to bundle its two goods is to deter entry of the rival in the secondary market. This conclusion can be highly misleading because it neglects the possibility of further entry in the market. If the secondary market is characterized by endogenous entry, the monopolist would always like to be

[13] Both effective and potential competition are crucial here. On this point, we are close to early informal insights of the Chicago school. For instance, Posner (2001, p. 145) notices that "notions of potential competition cannot and should not be banished entirely from antitrust law... a monopolist who creates excess capacity in order to reduce his marginal cost, so that entrants (who have to be able to cover their average total cost if they are to make a go of entry) are deterred, is reacting to potential competition."

[14] This point applies in particular to multi-sided markets, where network effects take place between different kinds of customers, and firms can charge differently their different customers. In such an environment market leaders tend to price quite aggressively one of the sides, but again without exclusionary purposes.

aggressive in this market and bundling may be the right way to commit to an aggressive strategy. Bundling would not necessarily deter entry in this case, especially if there is a high degree of product differentiation in the secondary market, but may increase competition in this market and reduce prices with positive effects on the consumers.

Another application of the theory of endogenous market structures concerns vertical restraints affecting inter-brand competition (Bonanno and Vickers 1988; Rey and Stiglitz 1988). Also in this case, the behavior of the market leader can be anticompetitive depending on the entry conditions. In particular, under price competition, a contract delegating distribution to a downstream firm tends to soften price competition when entry in the market is exogenous, because the upstream firm imposes high prices through direct or indirect contractual restraints. However, the same contract strengthens price competition when entry is endogenous, in which case the upstream firm can only gain by inducing an aggressive behavior of the downstream firm. The consequences on consumers tend to be negative in the former case and positive in the latter case.

### 2.4 Mergers and cartels

The theory of endogenous market structures delivers related results on horizontal mergers. As well known, even in the absence of cost efficiencies, these mergers are often profitable when entry is exogenous because they allow the merged entities to increase prices or restrict production so as to enhance profitability. These effects are counterproductive when entry is endogenous because any accommodating strategy attracts entry. Therefore, the only rationale for mergers in markets with endogenous entry must be a cost efficiency large enough to (more than) compensate the strategic disadvantages associated with the merger (Davidson and Mukherjee 2007; Etro 2007). In these cases, mergers are welfare improving. Similar principles have been applied to examine related issues as the consequences of joint production through technology transfers (Creane and Konishi 2009), the welfare consequence of higher concentration associated with new leaders in the market (Ino and Matsumura 2008) or the effectiveness of cartels (Etro 2007).

## 3 Market leaders and endogenous entry

In this section, I review the results derived in Etro (2006, 2008) on the characterization of equilibria with endogenous entry. Consider $n$ firms choosing a strategic variable $x_i$. 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:

$$\pi_i = \Pi^i(x_i, X_{-i}) - F, \tag{1}$$

which is assumed an inverted U curve in the first argument and decreasing in the second one, with $X_{-i} = \sum_{k=1,k\neq i}^{n} h(x_k)$ for some positive increasing function $h(x)$. Here, $F > 0$ represents the sunk or fixed cost of production, which can constraint

endogenous entry in the market. Most of the commonly used models of oligopolistic competition are nested in our general specification, including models of competition in quantities with homogeneous or differentiated goods and models of competition in prices with a demand for firm $i$ given by $D(p_i, X_{-i})$ decreasing in $p_i$ and in the price aggregator $X_{-i} = \sum_{k=1,k\neq i}^{n} h(1/p_k)$ for any increasing function $h(\cdot)$[15]—common demand functions as the Dixit–Stiglitz one, the Logit one or others satisfy the general model with the transformation of variables $p_i = 1/x_i$.

Our interest will be on the behavior of leaders (first movers) in these markets. Two situations are usually studied in the literature. The simplest one requires a leader choosing its own strategy before the other followers that simultaneoulsy choose their strategies, and corresponds to Stackelberg competition. As well known, when the number of firms $n$ is exogenous and all firms obtain positive profits in the Stackelberg equilibrium, we obtain that the leader is accommodating compared to the followers under strategic complementarity ($\Pi_{12} > 0$) and aggressive under strategic substitutability ($\Pi_{12} < 0$), with a first mover advantage emerging only in the second case. However, when entry is endogenous, we obtain the following result:

**Theorem 1** (Etro 2008) *A Stackelberg equilibrium with endogenous entry always implies that the leader is aggressive compared to each follower, and each follower either does not enter or chooses the same strategy as in the Nash equilibrium with endogenous entry.*

The equilibrium is characterized by the first-order condition for the followers $\Pi_1(x, X) = 0$ and by their endogenous entry condition $\Pi(x, X) = F$, which jointly determine the strategies of the followers $x$ and $X = h(x)(n - 2) + h(x_L)$. Notice that both $x$ and $X$ are independent from the leader'strategy $x_L$ and therefore $X_{-L} = (n - 1)h(x) = X + h(x) - h(x_L)$. The equilibrium interior optimal condition for the leader is:

$$\Pi_1(x_L, X_{-L}) = \Pi_2(x_L, X_{-L})h'(x_L), \tag{2}$$

which confirms that $x_L > x$ and that the leader has a first mover advantage. Finally, in models of quantity competition and under standard specifications of models of price competition, the aggressive strategy of the leaders always enhances total welfare.

The second situation studied in the literature (since Fudenberg and Tirole 1984) involves a preliminary commitment by the leader on a variable that affects its own profits. Imagine that the leader has the profit function $\pi_L = \Pi^L(x_L, X_{-L}, k) - F$, where the last argument, $k$ is a profit enhancing factor ($\Pi^L_3 > 0$). 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 ($\Pi^L_{13} < 0$).

As well known, when $n$ is exogenous, we have the following traditional result due to Fudenberg and Tirole (1984). With an exogenous number of firms: when the leader is tough, strategic over (under)-investment occurs under SS (SC), inducing a "top dog" ("puppy dog") strategy; and, when the leader is soft, strategic under

[15] Notice that demand for firm $i$ is therefore increasing in the price of each other firm.

(over)-investment occurs under SS (SC), inducing a "lean and hungry" ("fat cat") strategy. Etro (2006) considers the case of endogenous entry assuming that the number of potential entrants is great enough that a zero profit condition pins down the number of active firms, $n$. Comparing the optimality conditions of the leader and the followers, we have:

**Theorem 2** (Etro, 2006) *Under Nash competition with endogenous entry, when the strategic investment makes the leader tough (soft), that is* $\Pi_{13}^{L} > (<)0$, *over (under)-investment occurs, but the leader is always more aggressive than the other firms.*

Basically, under endogenous entry, the taxonomy of Fudenberg and Tirole (1984) boils down to two simple kinds of investment and an unambiguous aggressive behavior 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;[16] while when $\Pi_{13}^{L} < 0$ we always have a "lean and hungry" look with underinvestment, but the behavior in the second stage is still aggressive. Strategic investment is always used as a commitment to be more aggressive in a market with endogenous entry, and this does not depend on the kind of competition or strategic interaction between the firms. Also in this case, the aggressive strategy of the leaders tends to enhance total welfare.[17]

It is worth mentioning two different situations that can emerge under endogenous entry. First, entry may occur before the leader chooses its strategy, something which may characterize markets where a firm (the leader) is faster than others in choosing its production level or its price. In such a case, once entry occurs we have the usual game between a leader and an exogenous number of firms: under strategic substitutability the leader is still aggressive, but under strategic complementarity the second mover advantage eliminates any positive gains from the leadership.

Finally, one may consider preliminary strategies by a leader which affect (negatively) the profits of the followers: for instance, it may choose the fixed cost of entry, increase the marginal cost of production of the entrants or an access price for an essential facility of its own property (think of access to physical infrastructures or IPRs licensing). In such a case, the leader can use these strategies to limit entry and increase its profits, generating a different source of abuse of market power from those considered below.[18]

In the rest of the article, I will apply the above results to particular commitments or strategies with relevance for antitrust analysis. I will start with issues related to abuse of dominance, and then I will comment on applications to mergers and cartes.

[16] A typical case analyzed in the literature on innovation is that of investments in cost reductions. For recent applications to the interaction between industrial policy and innovation by leaders see Ledezma (2009), Damsgaard (2009) and Azevedo and Paxson (2009).

[17] Kato and Oki (2009) have extended this framework to the general case of a fixed number of incumbent firms already active in the market, one of which can adopt a preliminary investment. The incumbents can face different demand or technology conditions (i.e.: have different profit functions), but neither these or their number affect the strategic choices of the leader as long as there is endogenous entry of other firms.

[18] I am thankful to Antonio Nicita and John Vickers for useful discussions on this point.

## 4 Abuse of dominance

In this section, I will address a number of issues related with abuse of dominance (monopolization) by market leaders. First, I will study the behavior of leaders in simple situations when entry is endogenous to point out under which conditions the strategies of the leaders are abusive. The discussion will extend to markets with network externalities and to multisided markets, which are quite important for high-tech sectors of the New Economy. This will allow us to derive some conclusions on the proper approach to predatory pricing. Afterward, I will analyze more specific issues as tying, price discrimination, and vertical restraints.

The core issues of the endogenous entry approach to the behavior of market leaders can be shown within a simple model of competition in quantities. Consider a market with homogenous goods and an inverse demand $p(\mathbf{X})$, which is decreasing in the total production $\mathbf{X}$. For a general cost function, gross profits of firm $i$ are $\pi_i = x_i p(\mathbf{X}) - c(x_i) - F$, which is clearly nested in our general formulation. Consider a Stackelberg equilibrium in quantities with endogenous entry. If we focus on a case in which marginal costs are increasing, the usual mark up rule for the optimal strategy of the followers is:

$$p(\mathbf{X}) = \frac{c'(x)}{1 - 1/\epsilon}, \tag{3}$$

where $\varepsilon$ is the elasticity of demand and $x$ is the equilibrium production of the followers. The endogenous entry condition is:

$$p(\mathbf{X}) = \frac{c(x) + F}{x} \tag{4}$$

and these two conditions pin down the market price and the production of each follower. Their number depends on the strategy of the leader, but now the leader is aware that its output level will not affect the market price. Therefore, the output that maximizes profits $\pi_L = x_L p(\mathbf{X}) - c(x_L) - F$ must satisfy the simple condition:

$$p(\mathbf{X}) = c'(x_L), \tag{5}$$

which completes the characterization of the equilibrium. Notice that the followers are producing below the optimal scale of production—which satisfies $c'(x) = (c(x) + F)/x$, while the leader is producing above it: according to Theorem 1, the leader is always aggressive (independently from the shape of the demand and cost functions). In this basic framework, it is normal for the leader to price at marginal cost; nevertheless, such a choice guarantees positive profits.

Notice that when the marginal cost is not increasing enough, for instance when it is constant, the equilibrium requires entry deterrence with a limit price that is low enough to make entry unprofitable. For instance, with marginal cost $c$ and inverse demand $p = a - \mathbf{X}$, the equilibrium price is $p = c + 2\sqrt{F}$. The only difference between this equilibrium and the one predicted by the contestable market theory (Baumol et al. 1982) is that the latter corresponds to a Stackelberg equilibrium in prices with endogenous entry, while here we focused on the Stackelberg equilibrium in quantities with endogenous entry—of course, our theory has the advantage that it

applies beyond the case of homogenous goods. Summing up, *market leaders facing endogenous entry choose to price at marginal cost when they face a steep cost function, while they set a limit price above the marginal cost when the latter is constant; in both cases, they obtain positive profits that are increasing in the sunk or fixed cost of production*.

While this was a simple application, similar results can be obtained when the leader does not decide its strategy before the followers, but can simply commit to a preliminary strategic investment. This more realistic situation will be the focus of the following sections.

### 4.1 Predatory pricing as a cost-signaling device

Our first application of the results on strategic commitments is about market pricing in standard markets and has implications for the main post-Chicago approach to predatory pricing, due to Milgrom and Roberts (1982) and based on limit-pricing as a signal of low costs. Before addressing this issue, I will consider a situation where a firm can adopt preliminary investments to improve its production technology and hence reduce its costs. Traditional results on the opportunity of these investments for market leaders are ambiguous when the number of firms is exogenous, but, as we will show, they are not when entry is endogenous.

From now on, let us assume that the marginal costs are constant. Suppose that the leader can invest $k$ and reduce its marginal cost to $c(k) > 0$ with $c'(k) < 0$, while the marginal cost cannot be changed for all the other firms. Consider first a model of quantity competition. The gross profit of the leader becomes $\Pi^L(x_L, X_{-L}, k) = x_L p(x_L, X_{-L}) - c(k)x_L$. Notice that:

$$\Pi^L_{13} = -c'(k) > 0. \tag{6}$$

Consequently, according to Theorem 2, the leader overinvests in cost reductions when facing a fixed number of competitors, as long as strategic substitutability holds, and overinvests always producing more than the other firms when entry is endogenous.

Consider now a model of price competition with demand for firm $i$ given by $D(p_i, X_{-i})$ decreasing in $p_i$ and in the price aggregator $X_{-i} = \sum_{k=1, k\neq i}^{n} h(1/p_k)$, which implies imperfect susbtitutability between goods. The leader can invest to reduce its constant marginal costs in the same way and its profit function becomes $\Pi^L(x_L, X_{-L}, k) = [p_L - c(k)]D(p_L, X_{-L})$, with $p_L = 1/x_L$. Now we have:

$$\Pi^L_{13} = c'(k)D_1 p_L^2 > 0. \tag{7}$$

Accordingly, assuming as usual that strategic complementarity holds, underinvestment in cost reductions emerges when entry is exogenous, but overinvestment is optimal when there is endogenous entry. Whenever this is the case, the leader wants to improve its cost function to be more aggressive in the market and sell its good at a lower price. Summarizing, under both quantity and price competition with endogenous entry, a firm always has an incentive to overinvest in cost reductions and to be more aggressive than the others in the market. This simple example shows that in the presence of endogenous entry, market leaders always adopt aggressive

pricing strategies without having necessarily exclusionary purposes (which would be the only reason to adopt aggressive price strategies in case of competition in prices).

This result can be used to re-interpret models of predatory pricing through cost signaling. In a classic work of the modern industrial organization (and of the post-Chicago approach to antitrust), Milgrom and Roberts (1982) have studied the entry decision of an entrant in a duopoly with an incumbent that is already active in the market, and have introduced incomplete information. Imagine that the entrant does not know the cost of the leader, which can be a high cost or a low cost, but would like to enter only when facing a high cost leader. Milgrom and Roberts study under which conditions preliminary strategies of the leader induce entry deterrence. For instance, a low cost leader can signal its own efficiency through initial over-production or under-pricing (associated with a sacrifice of profits) as long as this is relatively cheaper for the low cost leader compared to the high cost one.

This sorting or *single crossing condition* is respected here exactly because the marginal profitability of production decreases with the marginal cost. In our terminology, this corresponds to the same condition $\Pi_{13}^{L} > 0$ that we used in Theorem 2: when the marginal cost is lower ($c(k)$ is lower because the investment $k$ is higher), the marginal benefits of an aggressive strategy is higher. This means that the marginal cost of an aggressive strategy is lower for a low cost firm. Then, in a separating equilibrium, a low cost leader is initially aggressive and overproduces enough to signal its efficiency and induce the follower not to enter, while a high cost leader does not imitate such a strategy because it is more profitable to behave monopolistically initially and accommodate entry subsequently. This result shows that cost reductions can have a strategic role also in the presence of incomplete information about costs. Notice that even without exclusionary purposes, a leader may like to signal its own type to affect post-entry competition with incomplete information on costs. Under competition in quantities, a low cost leader may signal its efficiency to reduce the equilibrium output of the entrant and increase its own, but under price competition it is a high cost leader that wants to signal its inefficiency to induce high prices by the entrant and obtain high profits for both, a point first made by Fudenberg and Tirole (1984).

Without developing the argument in technical details, it is important to point out that when entry is endogenous there can only be a gain from signaling efficiency for a low cost incumbent. The reason is that signaling a high cost would soften price competition with the only consequence of attracting further entry, while signaling a low cost would strengthen price competition and guarantee a larger market share for the incumbent. Summing up, *also under incomplete information about costs, there is a role for a positive strategic investment in cost reductions (for signaling purposes) whenever entry in the market is endogenous, and this does not necessarily imply exclusionary aims*.

### 4.2 Pricing in markets with network externalities

Many markets are characterized by network externalities, in the sense that demand is enhanced by past production and the consequent diffusion of the products across

customers. This may happen for cultural or social reasons, for instance because goods become fashionable when they have been already chosen by other customers, or because of technological reasons, for instance because the willingness to pay for a good by each consumer depends on how many other consumers have the same good. The classic study of competition in this kind of markets is due to Katz and Shapiro (1985). Here, I will focus on a more stylized model of the behavior of market leaders in the presence of network externalities.

I will adopt a model of quantity competition with homogeneous goods and introduce a time dimension. Imagine that in a first period the leader is alone in the market and produces $k$ facing the inverse demand $p(k)$ and a marginal cost $c$. In the second period other firms compete in quantities and the leader faces the inverse demand $p(\mathbf{X})\phi(k)$, where $\mathbf{X}$ is total production and $\phi(k)$ is some increasing function of past production, which is a measure of the diffusion of the good between consumers, and induces network externalities. The gross profit function for the leader becomes:

$$\Pi^L(x_L, X_{-L}, k) = kp(k) - ck + \delta[p(\mathbf{X})\phi(k)x_L - cx_L], \tag{8}$$

where $\delta \leq 1$ is the discount factor, while the net profit of the other firms is simply $\pi_i = x_i p(\mathbf{X}) - cx_i - F$. As the other firms do not enjoy network effects, one can easily show that under endogenous entry the future production of the leader $x_L(k)$ will be increasing in its initial production, with $\partial x_L/\partial k = -c\phi'(k)/\phi(k)^2 p'(\mathbf{X}) > 0$. Moreover, in equilibrium we have the cross effect:

$$\Pi^L_{13} = \frac{\delta c \phi'(k)}{\phi(k)} > 0 \tag{9}$$

which, according to Theorem 2, shows that the leader will be always engaged in initial overproduction to be more aggressive when the market opens up to endogenous entry. We can also derive a simple expression for the optimal initial production:

$$p(k) + kp'(k) = c - \delta p(\mathbf{X})\phi'(k)x_L(k) - \delta\frac{c\phi'(k)x_L(k)}{\phi(k)}. \tag{10}$$

This rule equates the marginal revenue of initial production to its effective marginal cost, which includes the myopic marginal cost $c$, a second term that represents the direct benefit due to the network effects on future demand (determining what is sometimes called a penetration price), and a last term representing the indirect (strategic) benefits due to the commitment to the adoption of a more aggressive strategy in the future. Notice that in the presence of network externalities, an incumbent expecting strong competition in the market may want to price well below marginal cost not with the purpose of excluding any other firm to enter in the market, but to be able to compete aggressively in the future: this is more likely when the marginal costs of production are low and the discount factor is high. Summarizing, *in markets with network externalities an incumbent has an incentive to overproduce and decrease the price initially so as to be more aggressive when endogenous entry takes place in the future*.

Notice that the same result occurs in case of price competition, but only if the future market structure is characterized by endogenous entry.

### 4.3 Pricing in multi-sided markets

The model of the previous section can be re-interpreted in an interesting way when we assume that the externality function is simply $\phi(k) = k$. This implies that net profits in the competitive market are proportional to $kx_L$. To fix ideas, imagine that the firms under consideration produce local newspapers. The leader decides a capacity production for $k$ copies of its local newspaper, but also sells advertising space on the newspaper in quantity $x_L$ and in competition with other newspapers (located elsewhere and with their own local readers). Of course, advertising is more valuable when a newspaper has more readers, and more precisely what matters is exactly the number of interactions between readers and advertisement, which is simply $k{\cdot}x_L$. This is the simplest example of a two-sided market because newspapers sell two products (news and advertising) to different customers, and there are network effects between them (actually only in one direction in this example, since we assumed that readers are indifferent to the size of advertisement space on the newspapers).

As first pointed out by Rochet and Tirole (2003), in such a two-sided market firms charge the different sides in different ways with the aim of enhancing network effects: in general, the aim is to get on board as many agents as possible from the side whose size creates more value for the other side. In our example, for instance, the direct effect of the sales of newspapers (and maybe related bundled gadgets) on the profits from advertising induces a production beyond the myopic monopolistic output level. However, here I want to point out a new strategic element: a leader facing competition on one side (advertising), will have an additional indirect incentive to overproduce on the other side (newspapers), to enhance the value of the platform and to be aggressive in the competition with other firms (for advertising).

One can verify that the same happens under price competition, which is the usual assumption in models of two-sided markets. However, under strategic complementarity, overproduction by the leader is strictly related with the endogeneity of entry. When the number of competitors is exogenous, a leader would like to commit to (relatively) high prices for the newspapers so as to be accommodating in the competition for advertising space against other newspapers: only when entry is endogenous the need of being aggressive in the advertising market induces to price newspapers at a (relatively) low price.

Similar situations emerge in many multi-sided markets where platforms compete on the volume of transactions between different groups of buyers and sellers (think of credit cards, operating systems) and multiple factors can induce different strategic behavior toward different sides. For instance, consider a variant of the previous example where both sides are now charged for each interaction, and $c$ is the marginal cost of an interaction, so that:

$$\Pi^L(x_L, X_{-L}, k) = [p(k) + p(\mathbf{X}) - c] \cdot k \cdot x_L.$$

In case the leader is just a monopolist, $k$ and $x$ would be chosen to satisfy the Rochet–Tirole (2003) optimality condition:

$$p(k)+p(x)-c=\frac{p(k)+p(x)}{\epsilon(k)+\epsilon(x)}=\frac{p(k)}{\epsilon(k)}=\frac{p(x)}{\epsilon(x)}$$

where $\varepsilon(x) = -p(x)/xp'(x)$ is the elasticity of demand: the side whose demand is more elastic should be charged relatively more because this keeps demand on both sides balanced and maximizes the volume of interactions for a given total price (of course, in case of a corner solution with supply such that one side is not charged, the optimal mark up on the other side follows the standard inverse elasticity rule). Now, imagine that the leading platform competes on one side, but can commit to output $k$ on the other side. As $\Pi_{13}^{L}=p'(k)k<0$, according to Theorem 2 there is a strategic incentive to commit to underproduction to be more aggressive on the competitive side.

More generally, leaders may alter the Rochet–Tirole rule leading to charge more one side to create strategic effects on the competitors on the other side. Market relations easily become complex when network effects act in both directions (in the case of informative advertising, readers may have positive externalities from more advertising in the newspapers), and especially when one or both sides engage in multi-homing (in case of national newspapers, readers may read more than one of them). As well known, in dynamic and multi-sided markets where demand is characterized by network effects, market leaders may want to price low without entry deterrence purposes but just to develop network externalities and to be more aggressive in parallel or future competition.

### 4.4 A rule on predatory pricing

The standard antitrust approach uses a number of cost benchmarks in order to assess whether "predatory pricing" by a dominant undertaking has actually taken place, and in particular it sets a cut-off such that pricing below this cut-off gives rise to a rebuttable presumption that pricing is predatory. This strategy is supported by the traditional idea that pricing below marginal cost should have an exclusionary purpose in standard markets, while pricing above marginal cost should not.

The theory of endogenous market structures emphasizes some limits of this way of thinking: pricing at or below marginal cost by the market leader does not need to exclude as efficient competitors, and it does not even need to induce short run losses for the same leader. To see why, let us remember that a leader in a standard market with quantity competition and endogenous entry can generally choose between two alternative strategies. The first one is to price below the rivals and allow their entry with a price equal to their average cost but above the marginal cost. The second strategy is to choose a limit price such that entry is not profitable for any firm. The former strategy is optimal when marginal costs are increasing enough in the production level and/or products are differentiated, while the latter strategy is optimal in the case of decreasing or constant marginal costs and/or homogenous goods.

Let us focus on the first situation. When goods are homogenous, the equilibrium strategy of the leader is simply to price at marginal cost, and its profits are positive because production is in the region where average total costs are increasing. When goods are differentiated, the equilibrium price of the leader is above its marginal

cost, and profits are again positive. As we have seen, in this equilibrium entry occurs, and is not deterred. Moreover, if the leader can obtain positive profits in equilibrium by pricing at marginal cost, positive profits could be preserved even by pricing slightly below marginal cost as long as the scale of production is large enough.

Let us focus on the second situation now. The leader can deter entry when marginal costs are constant or decreasing and/or goods are homogenous, and this happens with a price of the leader above the marginal cost. Nevertheless, when entry is endogenous this is a normal competitive strategy of a firm able to exploit scale economies and reduce average costs of production.

Finally, we saw that in dynamic (and multi-sided) markets where demand is characterized by network externalities, leaders may want to price below the marginal cost without entry deterrence purposes. The purpose of pricing below marginal cost would be to develop network effects or decrease costs for the future and to be more aggressive in the future competition. In conclusion, it is questionable that the marginal cost should be the right theoretical cut-off below which predation can be presumed, and we do believe that a rule of reason should be applied also in this case, because different sectors and different cost and demand structures require different approaches to the definition of predatory pricing.

On the basis of our theoretical discussion, we can now try to draw our conclusions on the proper approach to predatory pricing. As we have noticed, one cannot judge the pricing behavior of a market leader in a correct way without taking the entry conditions into account. When entry is endogenous, in the practical sense that entry is driven by profitable opportunities and it is rapid, no firm can manipulate the market at its will.[19] Only when entry is not feasible (even when it could be profitable), a leader can hope to exclude the current rivals and monopolize the market.

On the basis of these considerations, we propose the following modification of the Areeda–Turner (1974) rule based on two steps:

1. the Antitrust Authority should evaluate whether the undertaking is effectively constrained by endogenous entry of competitors in his strategic choices: if entry is endogenous dismiss the case, otherwise proceed;
2. the Antitrust Authority should evaluate the relation between price, average total cost (ATC) and average variable cost (AVC):
   (a) a price above ATC should be lawful without exceptions;
   (b) a price below ATC but above AVC should be presumed lawful with the burden of proving the contrary on the Antitrust Authority, and on the basis of the consequences on consumers and allocative efficiency;

[19] As McGee (1958) noticed in his pioneering work on predatory pricing, a necessary condition for the success, and therefore the viability, of a predatory strategy is that entry must be exogenously blocked: "Obstacles to entry are necessary conditions for success. Entry is the nemesis of monopoly. It is foolish to monopolize an area or market into which entry is quick and easy. Moreover, monopolization that produces a firm of greater than optimum size is in for trouble if entry can occur even over a longer period. In general, monopolization will not pay if there is no special qualification for entry, or no relatively long gestation period for the facilities that must be committed for successful entry."

(c) a price below AVC should be presumed unlawful with the burden of proving the contrary on the undertaking, through an efficiency defense or proving that demand or technological conditions (as the presence of network effects or multi-sided demand) reduce the relevant cut-off below the AVC.

Notice that the first step we propose is different from the traditional one, which simply evaluates whether there is a dominant position in the relevant market. The traditional step is based on the idea that after excluding the rivals, a dominant firm can monopolize the market and recoup its initial losses with higher prices. But, this is impossible when entry in the competition in the market is endogenous (there is no way to recoup losses by increasing future prices if a price increase attracts entry).[20] The traditional definition of dominance (associated with the market share and the related indexes of concentration) should not be the relevant element to establish the likelihood of recoupment. The focus should not be on the market leader in the first step of an antitrust investigation for abuse of dominance, but on the followers and on two main aspects: (1) the chances that these followers have to exploit profitable opportunities in the market, and (2) the independence of the entry barriers from the activity of the incumbent.[21]

### 4.5 Tying

There has been a lot of attention in the antitrust literature on the rationale for tying (or bundling) products rather than selling them separately. 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; this is impossible according to the *single-monopoly profit theorem* of the Chicago school. 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 bundling tends to strengthen price competition against these competitors, hence the only reason why a monopolist could bundle is to deter entry in the secondary market. However, his results (and those of the subsequent literature based on the analysis of bundling for duopolistic secondary

[20] Such recoupment is also extremely unlikely when entry in the competition for the market is endogenous (there is a low probability to recoup losses by increasing future prices of goods that may be soon replaced by innovations of other firms).

[21] An important case of abuse of dominance of this kind emerges in regulated markets in which the incumbent can affect the cost of the rivals, for instance increasing their fixed costs of entry or choosing the price to an essential facility. The brilliant analysis of access pricing for network facilities by Armstrong et al. (1996), based on a model of a dominant firm facing a competitive fringe, can be reworked with the endogenous entry approach with analogous results. On this basis, Vickers (2009) has forcefully claimed that regulated markets should not be less under the scrutiny of antitrust law, but more.

markets) largely rely on the existence of exogenous market power in the secondary market.[22] Here I will show that, when entry is endogenous, bundling may serve a different and not abusive purpose.

Imagine that a monopolistic market is characterized by zero costs of production and constant demand $D_M$ at price $v$, which corresponds to the valuation of the good alone. Another market is characterized by standard price competition with demand functions $D(p_i, X_{-i})$ decreasing in the price and in the index $X_{-i} = \sum_{k=1,k\neq i}^{n} h(1/p_k)$ characterized by an increasing function $h(\cdot)$. Production in this secondary market requires a fixed cost $F$ and a constant marginal cost $c$. Gross profits for the monopolist without bundling are $\pi_M = vD_M + (p_M - c)D(p_M, X_{-M}) - F$, while profits for the other firms are $\pi_i = (p_i - c)D(p_i, X_{-i}) - F$. In a Bertrand equilibrium without tying and with endogenous entry the monopolist enjoys the profits $\pi_M = vD_M$.

Under tying, demand for the monopolist is constrained by demand for the other good, which is assumed less than $D_M$. The bundle price corresponds to $P_M = v' + p_M$, where $v' \geq v$ is the valuation of the primary good when bundled with a secondary good of the same firm: this maybe higher for efficiency reasons, complementarities or network externalities of different kind. In such a case, the profits for the monopolist become:

$$\pi_{MB} = (p_M + v' - c)D^{MB}(p_M, X_{-M}) - F \tag{11}$$

while the other firms have the same objective function as before. In a Bertrand equilibrium the monopolist chooses the price $P_M = p_M + v'$ satisfying the first order condition $(p_M + v' - c)D_1^{MB} + D^{MB} = 0$, while each one of the other firms chooses $p$ satisfying a first-order condition $(p - c)D_1 + D = 0$. If endogenous entry holds, the number of firms satisfies also the endogenous entry condition $(p - c)D = F$. Together, the last two conditions jointly determine $p$ and $X$ independently from the price of the monopolist. Using this we can verify that the equilibrium price of the secondary good $p_M(v')$ decided by the monopolist has to be decreasing in $v'$.

Here, Theorem 2 does not apply directly because there is a discrete commitment, but its principle applies again. As $\partial\pi_{MB}/\partial p_M - \partial\pi_M/\partial p_M = v'D_1^{MB} < 0$, 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. As strategic complementarity holds, a price decrease by the monopolist induces the other firms to reduce their prices. Under exogenous entry, as in the Whinston (1990) model with two firms, this reduces profits of all firms in the secondary market, hence bundling is never optimal unless it manages to deter entry. Under endogenous entry, however, this result can change: bundling can now be an effective device to outplace some of the other firms without fully deterring entry in the secondary market, but creating some profits for the monopolist in this market through an aggressive strategy.

Clearly, bundling is optimal if $\pi_{MB} > \pi_M$, that is if:

$$[p_M(v') - c]D^{MB}[p_M(v'), X_{-M}] - F > vD_M - v'D^{MB}[p_M(v'), X_{-M}] \tag{12}$$

[22] For a recent development always in a duopolistic set up, see Nalebuff (2004).

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: as long as the demand in the primary market, given by the exogenous parameter $D_M$, is close enough to the demand for the bundled good $D^{MB}[p_M(v'), X_{-M}]$, this inequality is automatically satisfied.[23] Summing up, *when a monopolist in a primary market is active in a secondary market under competition in prices with endogenous entry, the monopolist gains from tying its two goods (without fully deterring entry) as long as the demand for the bundle is close enough to the demand of the monopolistic product*.

In other words, what is impossible in case of market power in the secondary market (Whinston, 1990) becomes possible when entry is free in this market: when (1) the secondary market is characterized by differentiated goods and an endogenous market structure and (2) demand for the bundled good is close enough to the demand of the primary product, tying is a profitable device to reduce prices without fully deterring entry in the secondary market. It is important to remark that, in this case, tying does not have an exclusionary purpose as assumed by the leverage theory of tied good sales, even if it tends to strengthen competition and to reduce the number of competitors in the secondary market. Moreover, our result rejects also the single-monopoly profit theorem of the Chicago school, for which a monopolist in one market cannot use tying to leverage market power in another market where entry is free: as we have seen, a monopolist can do that, because tying can create larger gains in the secondary market than losses in the primary one.[24] This is possible because of the inefficient pricing emerging in the free entry equilibrium, which allows the monopolist to reduce its price for the bundled good and still be able to gain market shares and profits.[25]

Notice that our result applies to one of the most famous antitrust cases of tying, the investigation of the European Commission on the tie of Windows with a software application as Internet Explorer: in this case, the secondary market for browsers is characterized by product differentiation (with many users downloading and trying different browsers) and endogenous entry (with the recent entry of Google's Chrome and the rapid increase in market shares of Firefox-Mozilla, which stole something between 20% and 30% of the European market from IE), and by a demand for the primary good, which is close to that for a bundle (everyone needs a browser with the PC, though trying and using other browsers takes only a few

[23] For instance, consider the case of isoelastic Dixit-Stiglitz demand $D(p_i, X_{-i}) = Ep_i^{-\theta} / \sum_{j=1}^{n} p_j^{1-\theta}$ with $E$ demand size and $\theta$ elasticity of substitution. The equilibrium price of the other firms is $p = c\theta E/(\theta-1)(E-F)$ and the equilibrium price of the bundle satisfies $p_M(v) < p$ and $p_M(v) > (c - v)\theta E/(\theta-1)(E-F)$. The condition for the profitability of tying without complementarities or network externalities ($v = v'$) can be solved for $p_M(v) > (c-v)\theta E/(\theta-1)(E-F-vD_M)$ , which is always satisfied for $D_M$ small enough.

[24] Notice that this model has the traditional outcomes as particular cases. When $F$ goes to zero, the secondary market becomes close to a perfectly competitive market and the single monopoly profit theorem tends to hold. When $F$ is large enough, full entry deterrence occurs, as in the Whinston model.

[25] The reduction in the price of the bundled goods can also benefit consumers. This is even more likely when they are complements, when there are network externalities between products, or when bundling creates efficiency effects.

seconds of free download). For this reason, we fail to see any economic rationale behind the investigation of the European Commission on the browser market.[26]

### 4.6 Third degree price discrimination

Our results have also implications for price discrimination, and in particular third degree price discrimination (on the basis of observable characteristics), a crucial issue in antitrust policy. When firms sell the same good at different prices for different consumers, they are adopting a policy of price discrimination. Typically this increases profitability, but requires a certain commitment, because similar goods must be sold not only at different prices for different consumers, but also in different packages and with different advertising.

For simplicity, imagine that all firms compete simultaneously for a common set of consumers, whose demand is $D^A(p_i, X_{-i})$ for each firm $i$, and the leader also serves a local market with demand $\tilde{D}^B(p_i)$ (we assume that the leader has to serve both markets simultaneously). The leader can commit to a policy of price discrimination, and then choose two separate prices $p_L^A$ and $p_L^B$ for the same good sold at different kinds of customers. The marginal cost of production is $c$ for all firms. The profits of the leader are then:

$$\pi_L = p_L^A D^A(p_L^A, X_{-L}) + p_L^B D^B(p_L^B) - c[D^B(p_L^B) + D^A(p_L^A, X_{-L})] - F \qquad (13)$$

while the profits of the other firms are simply:

$$\pi_i = \left(p_i^A - c\right) D^A(p_i^A, X_{-i}) - F$$

Otherwise the leader can adopt a uniform pricing policy and choose a unique price $p_L$ for both kinds of customers, with the same profit function as above. The idea behind the commitment to discriminate is that price discrimination requires a small preliminary investment in package diversification and separate advertising for the products sold for the different kind of customers.

Consider the case of an exogenous number of firms. Choosing price discrimination, the leader sets the two prices, say $p_L^A > p_L^B$, and obtains monopolistic profits in the local market and (given symmetry) the same profits as the other firms in the symmetric Bertrand equilibrium for the common market. Choosing uniform pricing, the leader chooses an intermediate price $p_L \in (p_L^B, p_L^A)$ in Bertrand equilibrium, and strategic complementarity implies that also the other firms will reduce their equilibrium prices. Ultimately, the leader reduces its profits in the local market and strengthens competition in the common market. Clearly, in this case, price discrimination is the optimal choice, since it allows the leader to maximize profits in the local market and to soften competition in the common one.

Consider endogenous entry now. Under price discrimination, all firms choose the same price $p_L^A$ in the common market and entry drives profits to zero in this market, while the leader enjoys only its monopolistic profits in the local market setting the optimal price $p_L^B$. Assume again that the demand conditions are such that $p_L^A > p_L^B$. In this case, by adopting uniform pricing, the leader will choose an intermediate

[26] See "A Chance to Move on from EU vs. Microsoft" by F. Etro (Vox, October 8, 2009).

price between $p_L^B$ and $p_L^A$, and will obtain two results: on one side, profits in the local market will decrease because pricing is above monopolistic pricing, on the other side, profits in the common market will increase because the leader is endogenously committed to aggressive pricing, which is always optimal in a market where entry is endogenous. If the former loss is smaller than the latter gain, it is optimal to adopt uniform pricing rather than committing to price discrimination.[27]

This simple example is just aimed a suggesting that price discrimination can have a role in softening price competition (compared to uniform pricing) inducing negative consequences for consumers: this effect, however, is less likely to emerge in markets where entry is endogenous, since in these markets an aggressive uniform pricing strategy can be optimal. In conclusion, we may have a possible new case for the association of price discrimination by market leaders with anti-competitive purposes.

A different situation emerges if the demand conditions are such that under price discrimination we have $p_L^A < p_L^B$. Then, with exogenous entry, a uniform price by the leader increases prices and profits in market $A$ and reduces them in market $B$, with ambiguous consequences, while with endogenous entry price discrimination is always optimal (and if it is not allowed, the leader is better off not serving market $A$).

### 4.7 Interbrand competition

Vertical restraints are agreements or contracts between vertically related firms. When these restraints improve the coordination of a vertical chain, they are typically welfare improving, however, when they affect *interbrand competition*, that is competition between different products and different vertical chains, they can induce adverse consequences on consumers: namely, they can be used to keep prices high. This is the standard result of the theory of strategic vertical restraints in interbrand competition (Bonanno and Vickers 1988; Rey and Stiglitz 1988), which suggests that, as long as firms compete in prices, a firm has incentives to choose vertical separation and charge his retailer a francise fee together with a wholesale price above marginal cost to induce an accommodating behavior.

Consider an upstream firm that produces a good at marginal cost $c$ and fixed cost $F$, and delegates its distribution on the market to a single downstream firm[28] through a contract implying a fixed fee $\Upsilon$ and a wholesale price $w$ for the good. The downstream firm sells this same good at the price $p_D$ to maximize net profits:

$$\pi_D = (p_D - w)D(p_D, X_{-D}) - \Upsilon \tag{14}$$

while the other firms, that are vertically integrated and face the same cost structure, have the standard profit function $\pi_i = (p_i - c)D(p_i, X_{-i}) - F$, where $X_{-i} = \sum_{k=1,k\neq i}^{n} h(1/p_k)$. The upstream firm can preliminarily choose the optimal contract, meaning the wholesale price $w$ and the fee $\Upsilon$ that maximize profits $\pi_U = (w - c)D(p_D, X_{-D}) + \Upsilon - F$. It is always optimal to choose $w$ such that the profits

[27] Notice that this can happen because the loss from a small deviation from monopolistic pricing is a second order loss, while the gain in the common market is a first order gain.

[28] Notice that the combination of one producer and one distributor is exogenously set.

of the downstream firm are maximized, and the fee that fully expropriates these profits. Of course, a choice $w = c$ would be neutral for the market outcome. However, Bonanno and Vickers (1988) have shown that, if competition is between an exogenous number of firms, it is optimal to choose a high wholesale price $w > c$ to soften price competition, and increase prices compared to the outcome in which the firm is vertically integrated. This is the classic example of an anti-competitive vertical restraints adopted by a market leader through strategic delegation of accommodating pricing.

When entry in the market is endogenous, the market leader cannot operate as above, because high wholesale prices would put the downstream firm out of the market. A market leader can still gain from delegating pricing decisions, but the optimal contract is now radically different and implies a wholesale price below marginal cost. To verify that Theorem 2 applies, define $k = c - w$ as the wholesale discount, and $\Pi(x_D, X_{-D}, k) = (p_D - c + k)D(p_D, X_{-D})$ as the gross profit of the delegated firm. Then, we have:

$$\Pi_{13}(x_D, X_{-D}, k) = -D_1/D^2 > 0 \tag{15}$$

In particular, competition in prices with endogenous entry between the downstream firm and the other firms would lead to a price $p_D(w)$ increasing in the wholesale price for the downstream firm, a price for the other firms $p = p_D(c)$ and an endogenous value for $X$ that are both independent from $w$. One can verify that the optimal contract requires a wholesale price for the retailer smaller than the marginal cost and implicitly given by:[29]

$$w^* = c - \frac{(p_D - c)D_2 h'(1/p_D)}{D_1 p_D^2} < c. \tag{16}$$

This wholesale price generates a lower equilibrium price and higher output for the downstream retailer than for the other firms, but generates positive profits. Summing up: *under price competition with endogenous entry, it is optimal to delegate distribution to a downstream retailer with a francise fee contract involving a wholesale price below marginal cost so as to induce an aggressive pricing*.

In such a case, the vertical restraint leads to a lower price for the consumers and there is no ground for conjecturing any anti-competitive behavior.[30] Therefore, also in the case of vertical restraints affecting interbrand competition, entry conditions are crucial to derive proper conclusions.

[29] The optimal contract solves the problem:

$$\max_{\{w,\Upsilon\}} \pi_U = (w - c)D[p_D(w), X_{-D}(w)] + \Upsilon - F$$
$$s.v. : \pi_D = [p_D(w) - w]D[p_D(w), X_{-D}(w)] - \Upsilon \geq 0$$

where $X_{-D}(w) = X + h(1/p) - h(1/p_D)$. It is easy to verify that the constraint must be binding and determine the optimal $\Upsilon$.

[30] A similar result emerges also in models of competition in quantities, but this is less surprising since it confirms the outcome of delegation games with an exogenous number of competitors. Finally, notice that in case of limited product differentiation and high fixed cost, entry deterrence is still possible. I am thankful to Ryoko Oki for comments on this part.

## 5 Concentrations and price-fixing agreements

We have seen that even when they face endogenous entry of competitors, market leaders can obtain positive profits by adopting certain strategic commitments. One may think that a horizontal merger with another firm and a subsequent cooperation in the strategic decisions may serve a similar purpose. When the number of firms in the market is given, this is typically the case. Moreover, a merger increases concentration and induces a more accommodating behavior which exerts an indirect effect on the other firms. When strategic substitutability holds the other firms become more aggressive (Salant et al. 1983), when strategic complementarity holds they become more accommodating as well (Deneckere and Davidson 1985): for this reason, loosely speaking, mergers tend to be more profitable under competition in prices. However, once again, the situation changes when entry is endogenous. In such a case the merger can affect entry, which creates a new effect, often taken into account in antitrust policy considerations, but not in the formal theory of mergers until recently (see Davidson and Mukherjee 2007; Erkal and Piccinin 2007a; Etro 2007; Kato and Oki 2009). In our framework, a merger induces accommodation by the merged firm, which attracts entry and reduces the profits of the merged firm: consequently, there is no any strategic rationale for mergers when entry in the market is endogenous.[31]

### 5.1 Merger analysis

Consider a merger between two firms, say firms $k$ and $j$. The net profits of the merged firms become:

$$\pi^{\text{Merger}} = \Pi(x_k, X_{-k}) + \Pi\left(x_j, X_{-j}\right) - \tilde{F}$$

where $\tilde{F} \in [F, 2F]$ is the new fixed cost of production. Using the fact that $X_{-j} = X_{-k} + h(x_k) - h(x_j)$ for $k, j = 1, 2$, we have the first-order conditions:

$$\Pi_1(x_k, X_{-k}) + \Pi_2(x_j, X_{-j})h'(x_k) = 0 \quad k, j = 1, 2, \tag{17}$$

which clearly shows an accommodating behavior for both strategies. As we know, such a behavior creates a strategic disadvantage when entry in the market is endogenous. The equilibrium after the merger is characterized by two identical strategies for the merged firm, $x_k = x_j = x_M$, a strategy for the followers $x$, and respective spillovers $X_M$ and $X$ such that:

$$\Pi_1(x_M, X_{-M}) + \Pi_2(x_M, X_{-M})h'(x_M) = \Pi_1(x, X) = 0, \quad \Pi(x, X) = F.$$

This implies $x_M < x$ and $X_{-M} > X$: the equilibrium strategy of the other firms is always the same after the merger, but the accommodating behavior of the merged entity induces further entry so as to decrease its gross profits below those of each

[31] See Motta (Ch. 5) for a survey of the literature on horizontal mergers. He points out that "the firms' ability to raise prices after a merger is also limited by the existence of potential entrants. Firms which would find it unprofitable to enter the industry at pre-merger prices might decide to enter if the merger brings about higher prices or lower quantities. By anticipating this effect, post-merger prices might not rise at all" (p. 236). See also the important work by Werden and Froeb (1998).

independent firm. Nevertheless, the merger can still be profitable if $\pi^{Merger} > 0$, which requires $\tilde{F} < 2\Pi(x_M, X_{-M})$. In a market where entry is endogenous, the only way a merger can be profitable is by creating cost efficiencies. The above conclusion exactly matches the informal insights of the Chicago school on horizontal mergers, and can be summarized as follows: *in a market with endogenous entry, a horizontal merger induces accommodating behavior of the merged firm and attracts entry of other firms: the merger is profitable if and only if it creates enough cost efficiencies to compensate for the strategic disadvantage of the merged firm.*

Notice that in our class of models of competition in quantities and homogenous goods or competition in prices with standard demand functions (as the Dixit-Stiglitz one or the Logit one), as long as the merged firm does not deter entry, the equilibrium after the merger implies the same total production or the same price indexes as before. Therefore, consumer surplus is not affected by the merger. As the latter takes place only when there are significant cost efficiencies, it follows that horizontal mergers in markets where entry is endogenous are welfare improving (Etro 2007, Prop. 2.10). For instance, in the linear model of competition in quantities, the merged firm would produce the same as the two separate firms, therefore the merger could be profitable only if $F > \tilde{F}$.

These results generalize those independently reached by Davidson and Mukherjee (2007): under quantity competition with homogeneous goods and constant marginal costs, if the initial equilibrium is symmetric, then with endogenous entry, (1) a horizontal merger has no impact on the equilibrium price and (2) a privately beneficial merger is socially beneficial as well.[32]

The welfare consequences of a merger become more complex when the firms produce heterogenous goods. Consider a simple model of quantity competition with imperfect substitutability, where the inverse demand function for firm $i$ is derived from a quadratic utility function as $p_i = a - (1 - b)x_i - b\mathbf{X}$. A merger between two firms would lead them to produce $2 - b$ times as before and to reach the joint profits:

$$\pi^{\text{Merger}} = \frac{(2-b)(2+b-b^2)F}{2} - \tilde{F} \tag{18}$$

which are positive if product differentiation is strong enough ($b$ small) or $\tilde{F}$ is low enough.

The model by Erkal and Piccinin (2007a) extends this analysis to the case of competition in prices (derived from the same quadratic utility function). They show that a merger increases the prices of the merged firms and reduces the prices of the other firms while increasing entry (nevertheless, in the absence of cost efficiencies, the impact on consumer surplus is typically negative).

[32] Kato and Oki (2009) have analyzed a related model with a fixed number of incumbent firms, one of which can adopt a preliminary investment, and a competitive fringe of potential entrants. They show that a horizontal merger between incumbents does not affect the strategic investment of the leader as long as there is endogenous entry, and that a privately beneficial merger is socially beneficial as well.

### 5.2 Beneficial concentration

Another source of concentration that often leads to antitrust concern is associated with a new leadership position by one or more competitors. A firm that becomes able to precommit to a certain production decision before its rivals tends to increase its market share and the concentration of the market (even a merger may turn the merged entities into a stronger leader in the sector). The important work by Daughety (1990) has examined the consequences of increasing the number of leaders in a simple model of competition in quantities with a fixed total number of firms and linear demand and cost functions: the result was that welfare follows an inverted U relation with the number of leaders. Since an increase in the number of leaders is associated with an increase of concentration, measured for instance with the Herfindahl-Hirschman Index, this means that beneficial concentration can occur. The intuition relies on the balance of two effects: the introduction of a leader induces a competition acceleration effect due to the increase in total production, which improves welfare, and an inefficiency effect due to the production asymmetries, which decrease welfare.

Ino and Matsumura (2008) have extended the model with general demand and convex cost functions,[33] and with endogenous entry after the production choice of the leaders. They show that the equilibrium strategies of the followers, total production and the equilibrium price do not change with the number of leaders. While this eliminates the competition acceleration effect and leaves unchanged the consumer surplus, the increase in the number of leaders reduces the waste in fixed costs of entry and leads to an increase in both total profits and total welfare.[34] More interestingly, the Ino–Matsumura model can be easily extended to the case in which endogenous entry occurs before the production choice of the leaders, which generates the same equilibrium price, though associated with a lower production of the leaders and a higher number of followers. Nevertheless, in this case total welfare follows an inverted U relation with the number of leaders. In conclusion, when entry is endogenous we can always have a positive relation between concentration and welfare.

### 5.3 Joint production with technology transfers

Another brilliant application of the endogenous market structures approach is due to Creane and Konishi (2009), who have investigated the rationale for free technology transfers from a cost leader to a rival in the presence of endogenous entry. Assuming that these transfers do not lead to collusive behavior, but simply to a more efficient joint production, one may wonder how the cost leader could gain from them and what would be their welfare consequences.

[33] With a fixed number of firms they show that, when the marginal cost is increasing enough, welfare may initially decrease with the introduction of a leader, but it always increases for intermediate numbers of leaders.

[34] See also Etro (2007, Prop. 3.8). However, Ino and Matsumura (2008) also show that the welfare conclusion is not robust when taking in consideration the integer constraint on the number of firms.

Consider the simplest case where the cost leader has a constant marginal cost which is lower than the marginal cost of all the other firms due to a superior technology. Under competition in quantities between a fixed number of firms, the technology transfer would increase the production of the rival receiving the superior technology, which would reduce the equilibrium price, leaving no rationale for this strategy. However, when entry is endogenous, the number of firms may decrease enough to increase the equilibrium price and the profits of the cost leader. The Creane–Konishi model shows that these transfers are typically profitable and further it may be optimal to predate every firm so that a market with many inefficient firms becomes a duopoly with two efficient firms. Most important, even if the price increases as a consequence of this, the increase of the profits of the efficient firms more than compensates the reduction of consumer surplus, which leads to higher welfare. Once again, the reduction of the waste in fixed costs creates efficiency gains that associate more concentration with higher welfare.

The same principle can be applied to the case of technology licensing for a payment, which makes the transfer more profitable for the technology leader.[35] Of course, a negative aspect of joint production between two competitors is that it may facilitate collusive practices, a topic on which we dedicate the next section.

### 5.4 Cartels

One of the main objectives of antitrust policy is the elimination of forms of collusion between firms aimed at increasing prices. As well known, a collusive cartel for the choice of prices or quantities between an exogenous number of firms ends up increasing prices and harming consumers. When a restricted number of firms collude, they can still implement accommodating strategies and increase their equilibrium prices and profits (especially if they act as leaders). The reaction of the other firms to their collusive strategies can be either aggressive under strategic substitutability or accommodating under strategic complementarity, but the outcome is qualitatively similar to the previous one: when it takes place, collusion in a market with an exogenous number of firms tends to harm consumers. In this section we will examine a different, but related, issue: the impact of collusion between a restricted number of firms in a market where entry is endogenous. In such a case, collusion has unusual effects.

More formally, let us consider a collusive cartel between $m$ firms, where their strategies $x_k$ for $k = 1, 2, ..., m$, are chosen to maximize the joint profits:

$$\pi^{\text{Cartel}} = \sum_{k=1}^{m} \Pi(x_k, X_{-k}) - mF \tag{19}$$

while the other firms $i = m + 1, ..., n$, maximize their simple profits $\pi_i = \Pi(x_i, X_{-i}) - F$ and enter until these net profits are zero.

In a hypothetical Nash equilibrium between the cartel and the outsider firms, each member of the cartel would implement an accommodating strategy according to the optimality conditions:

[35] On the issue of adoption of complementary technologies see Azevedo and Paxson (2009).

$$\Pi_1(x_k, X_{-k}) + \sum_{q=1, q\neq k}^{m} \Pi_2(x_q, X_{-q}) h'(x_k) = 0 \text{ for } k = 1, 2, \ldots, m \tag{20}$$

while the outsiders would stick to the usual optimality conditions $\Pi_1(x_i, X_{-i}) = 0$. Notice that the accommodating strategies of the members of the cartel would attract entry until the cartel becomes a lossmaker: in a symmetric equilibrium, a simple commitment to collusion is not profitable when entry is endogenous (this is another application of our results in Theorem 2, since the collusive commitment makes the members of the cartel more accommodating).[36]

However, a commitment to join in a cartel can be profitable when the members of the cartel act as leaders in the competition with the other firms. More formally, consider a game in which the cartel plays first, then the followers enter, and finally the followers play simultaneously. In this case, the optimality condition of the followers and their zero profit condition pin down their strategy $x$ and their spillovers $X$ independently from the strategies of the cartel.[37] Therefore, taking into account that the expected spillover of a member of the cartel is $X_{-k} = \sum_{j\neq k} h(x_j) = X + h(x) - h(x_k)$, the optimal strategies of the cartel solve the problem:

$$\max_{x_1,\ldots,x_m} \pi^{\text{Cartel}} = \sum_{k=1}^{m} \Pi[x_k, X + h(x) - h(x_k)] - mF. \tag{21}$$

The corresponding optimality conditions are:

$$\Pi_1(x_k, X_{-k}) = \Pi_2(x_k, X_{-k}) h'(x_k) \text{ for} k = 1, 2, \ldots, m. \tag{22}$$

However, these conditions exactly correspond to the condition (2) defining the equilibrium strategy of a leader (or more leaders) in the Stackelberg equilibrium with endogenous entry of Theorem 1. On this basis, we can apply all the results derived in the rest of this chapter. In the case of competition in quantities, a collusive cartel in a market where entry is endogenous would coordinate an increase in the output of its members so as to increase their market shares and improve the allocation of resources. In the case of competition in prices, the cartel would coordinate a reduction of the prices of its members to increase their market shares, and this would lead to an improvement in the allocation of resources.[38]

Partial collusion, that is *collusion between a limited number of firms, is always ineffective under endogenous entry; however, when it is associated with a commitment over the competitors, is can become profitable, sustainable*[39] *and also pro-competitive*. The last result should not be overemphasized from a policy point of view. Most of the time, collusive cartels involve all the firms of an oligopolistic

[36] For a related result see Erkal and Piccinin (2007b) who show that R&D cartels are not profitable under free entry.

[37] We focus on the case in which the number of members of the cartel is small and entry takes place in equilibrium. If this is not the case, the cartel deters entry.

[38] Under competition for the market an R&D cartel acting as a leader under endogenous entry would enhance investments in R&D for its members.

[39] Since the cartel with $m$ members implements the same strategies as in the Stackelberg equilibrium with $m$ leaders and endogenous entry, collusion is always sustainable.

market or are aimed at blocking entry, and they are harmful to consumers: their avoidance should be the main focus of antitrust authorities.

## 6 An evaluation of U.S. versus E.U. antitrust policy

One of the main points emerging from the endogenous market structures approach to antitrust issues is that anti-competitive and welfare-reducing behavior tends to emerge only when entry is not endogenous but it is exogenously limited to a fixed number of firms.

Antitrust policy plays a fundamental role to correct distortions in markets where entry is not possible, especially with its action to deter collusive behavior aimed at increasing mark ups and to stop mergers involving a dominant firm than can be detrimental to future competition. On this front both the American and European antitrust authorities have adopted a similar and wise approach, focusing on markets characterized by barriers to entry and not on markets where endogenous entry forces can neutralize attempts to exercise market power. Nevertheless some differences remain, with the U.S. approach sometimes excessively neutral in front of mergers between firms that do not face a fully endogenous entry threat and that may engage in accommodating strategies post-merger. For instance, at the time of writing, the European Commission has just issued a formal S.O. against the merger between Oracle and Sun Microsystems, a merger which was previously cleared by U.S. regulators. This delicate initiative shows the maturity reached by the European antitrust authorities in the field of merger regulation, because the deal, or at least part of it, creates substantial concern for the future of competition and innovation, especially in the market for enterprise database software, where Sun's MySQL is the closest competitor of Oracle.[40] Notice that, a few months earlier, similar concerns in the related field of search advertising, led the dominant firm Google to drop its deal with Yahoo!, its closest competitor—of course, a merger or a deal do not represent a threat to competition when they involve only the followers of the dominant company, as for the initially proposed aquisition of Sun by IBM or for the agreement between Microsoft and Yahoo!

In our opinion, the main differences between U.S. and E.U. industrial policy in the last years emerge in the general approach to market dominance and in the antitrust treatment of abuse of dominance/monopolization issues, which are

[40] Sun has made available by far the best open source alternative, which has forced Oracle to invest heavily in R&D to innovate and maintain its lead. Moreover, MySQL has created a binding price constraint on Oracle, which has been unable to perpetuate a high mark up policy and has been forced to reduce its prices. For this competitive pressure to last, Oracle should remain constrained by a fringe of rivals and by the most efficient one in particular, exactly what Oracle is trying to avoid through the merger with Sun. It is important to notice that no other company could replace the strategic role of MySQL in the open source business (the reason being that Oracle, as the new copyright owner of its source code, could adopt the so-called "dual license," excluding commercial exploitation by other firms and at the same time enjoying any enhancement made by others under the open source GPL). Since the existing database vendors have been unable for years to became a substantial threat, this simple merger would allow Oracle to get rid of its main competitive stimulus and therefore to soften competition. See "When a Merger Softens Competition: the Oracle-Sun Case," by F. Etro (*Vox*, November 11, 2009).

extremely important not only for their impact on the effectiveness of competition, but also for their possible interference with aggressive competition (which is often borderline with abusive practices) and with innovation policy (which must protect some degree of market power to guarantee the proper incentives).[41] The different approaches are well illustrated by the Report issued by the U.S. Department of Justice in September 2008, "Competition and Monopoly: Single-Firm Conduct under Section 2 of the Sherman Act,"[42] and by the "Guidance on the Commission's Enforcement Priorities in Applying Article 82 to Abusive Exclusionary Conduct," issued by the European Commission three months later. These documents contain the general principles that guide the two authorities in deciding which cases to pursue and how to deal with specific types of conducts.

The American approach emerging from the Report is aimed at the defense of the competitive process both in principle and in practice, reflecting "a national commitment to the use of free markets to allocate resources efficiently and to spur the innovation that is the principal source of economic growth." The analysis of dominance pays a lot of attention on the limits imposed by endogenous entry, emphasizing the role of entry pressure in disciplining market leaders in spite of their large market shares.[43] More in general, the Report recognizes the poor correlation that can exist between market share and market power, especially in high-tech sectors: "in markets characterized by rapid technological change, for example, a high market share of current sales or production may be consistent with the presence of robust competition over time rather than a sign of monopoly power. In those situations, any power a firm may have may be both temporary and essential to the competitive process."

As a consequence the U.S. Department of Justice adopts a non-intrusive role for antitrust policy in the competition in and for the markets. For instance, predatory pricing can be established only when recoupment is likely, that is only when entry is difficult once the market is monopolized. Moreover, the efficiency role of tying is recognized as a primary role (against a long-lasting hostility), especially for technological tying, "an area where enforcement intervention poses a particular risk of harming consumers more than it helps them in the long run. Technological tying often efficiently gives consumers features they want and judicial control of product design risks chilling innovation."

Finally, the Report marginalizes also the need for intervention in case of a refusal to supply, because "forcing a competitor with monopoly power to deal with rivals can undermine the incentives of either or both to innovate" and because "judges and

[41] See Vickers (2009) for an interesting comparison focused on "refusal to deal" issues.

[42] The Report largely reflects the Chicago approach to antitrust that was prevailing during the Bush Administration, on which we focus in what follows. The Obama Administration has announced a change of approach (with the DoJ withdrawing the above Report), but it is not clear yet how wide will be this change.

[43] The Report provides an enlightening example which is in perfect accordance with the implications of the EMSs approach: "Suppose a large firm competes with a fringe of small rivals, all producing a homogenous product. In this situation, the large firm's market share is only one determinant of its market power over price ... if the fringe firms can readily and substantially increase production at their existing plants in response to a small increase in the large firm's price (that is if the fringe supply is highly elastic), a decision by the large firm to restrict output may have no effect on market prices."

enforcement agencies are ill-equipped to set and supervise the terms on which inputs, property rights, or resources are provided." In our reading of the U.S. approach over the last years, this is based on the belief that competitive entry forces are the main constraints on the exercise of market power and when they are present antitrust intervention should be a marginal or residual necessity.[44]

In contrast with this, we believe that the European approach is still associated with a more interventionist and discretionary approach, inspite of recent progress. The cited Guidance of the European Commission states the adoption of an "effect-based" approach that is aimed at maximizing consumer welfare and protecting an effective competitive process, and not simply competitors. There is an important new aspect in the Guidance, the emphasis given to the role of entry in determining whether a dominant position exists or not. The key element in the Guidance definition of dominance is the extent to which the firm can behave independently of its competitors, customers and consumers, which relates to the degree of competitive constraints exerted on this firm by the supply of actual competitors, by the threat of expansion of competitors and potential entrants and by the bargaining power of customers. Therefore, entry plays a crucial role and dominance should be incompatible with the presence of a threat of endogenous entry. In particular, a leader "can be deterred from increasing prices if expansion or entry is likely, timely and sufficient," but in our view it would be also important to recognize that the same entry can induce the leader to decrease its prices below those of the rivals, or to adopt other aggressive strategies, without any anti-competitive purpose, as the endogenous market structures approach has made it clear.

In spite of this, we have a strong concern on the way the positive premises of the Guidance are carried through its details. The defense of consumers is strongly emphasized in theory but not in practice: most of the focus of the Guidance is on the foreclosure of competitors and not on the relation between this and the harm to consumers, which is what should matter.

A related concern is about the nature of the foreclosure effects under the "effects-based" approach. The Guidance indicates that a key element of abuse is anti-competitive foreclosure, defined as "a situation where effective access of actual or potential competitors to supplies or markets is hampered or eliminated as a result of the conduct of the dominant undertaking" which is likely to profitably increase its prices with harm for the consumers. However, it is not entirely clear which facts are going to prove foreclosure and which not. For instance, consider a situation in which new competitors enter in the market and some competitors increase their market share to a significant extent: one would expect that this proves that the dominant company's practice is not abusive, but not even this can be taken for granted on the basis of the E.U. Guidance, as suggested by the investigation on the bundling of Microsoft Windows with Internet Explorer, a browser losing market shares on rivals and new entrants.[45]

[44] For a related point by a moderate leader of the so-called Harvard approach to antitrust, see Hovenkamp (2005).

[45] However, the European Commission has recently taken important steps towards turning the page on the long-running Microsoft competition case. Over the summer 2009, the Commission issued a tentative welcome to proposals the company had made to address the EU's concerns regarding the integration of IE

Another issue is about the standard of undistorted competition. As regards pricing abuses, the European approach introduces the "as efficient competitor" test: "the Commission will normally intervene where the conduct concerned has already been or is capable of hampering competition from competitors which are considered to be as efficient as the dominant undertaking." However, the document introduces several exceptions to this principle (for instance, a dynamic view for which less efficient competitors may become as efficient in the future through network or learning effects), and the test does not apply to non-pricing abuses. This means that companies are left without a clear standard.

As a last issue, we welcome the confirmation in the Guidance of an efficiency defense: a dominant firm may justify a conduct leading to foreclosure on the ground that efficiencies are sufficient to guarantee that consumers are not penalized. Now, while the consideration of efficiencies generated by a conduct is extremely important to re-direct antitrust policy toward the maximization of consumer welfare, in our view the Guidance appears to adopt a too vague approach and to make it hard, if not impossible, for dominant companies actually to avail themselves of the efficiency defense. The main reason is that their verification appears to be postponed after the establishment of an anti-competitive foreclosure that harms consumers, and not during the decision on whether the same foreclosure harms consumers. Moreover, there appears to be a bias against the possibility that efficiencies can occur: for instance, technological tying is not even mentioned as a source of efficiency in tying cases, but it is actually considered a source of greater risk of anticompetitive foreclosure (because more costly to reverse).

Finally, the new guidelines do not seem to reduce the amount of uncertainty that is associated with the move toward the rule of reason approach. For instance, the potential conflicts between IPRs protection and antitrust policy remain entirely unsolved: while the U.S. have taken a clear position against the possibility of compulsory licensing of IPRs, the E.U. approach still contemplates this possibility under vague conditions. This kind of uncertainty can be a source of inefficiency and distorted behavior, especially when decision rules are imperfect and subject to errors.[46] More in general, antitrust uncertainty on exclusionary strategies may deter genuinely competitive or innovative strategies to be adopted by leading firms, and therefore it may exert negative consequences on consumer welfare. As O'Donoghue

Footnote 45 continued
in Windows. Microsoft's proposed solution would allow computer manufacturers and individual consumers to easily install their favourite web browser as the default and, if they wish, disable IE. In October, the Commission announced the opening of a formal market test, inviting comments from consumers, software companies, computer manufacturers, and other interested parties over a one-month period. In December 2009, while we write, the parties have finally reached an agreement for which Microsoft will distribute its operating systems with a "Choice Screen" for the selection of the web browser. Consumers will be able to install immediately their favourite browser as the default one between the twelve most widely used browsers, rather than downloading it from the Internet through the pre-installed browser Internet Explorer as until now. See "Beyond browsers: Moving on from the EU vs. IE case," by F. Etro (*Vox*, October 8, 2009).

[46] The lack of legal certainty is particularly regrettable in a context of increasing punitive fines and important efforts by the Commission to increase the scope for private enforcement to complement public enforcement of E.U. competition law.

and Padilla (2006, xi) have noticed, "the welfare cost of this lack of clarity and excessive caution must be enormous to the E.U. economy as a whole - something the E.U. can ill-afford given its lack of competitiveness relative to other international blocks and the stated objectives of the Lisbon Agenda in this regard."

In conclusion, the E.U. approach to abuse of dominance remains largely linked to a *naive* version of the post-Chicago approach which is biased against market leaders and in favor of their competitors in a way that is largely unrelated to the real protection of consumers. The U.S. approach, at least during the Bush Administration, has been closer to the principles of the Chicago school and of the endogenous market structures approach and, in our view, it has proved to be much more useful in promoting competition, business creation and innovation, especially in high-tech sectors.

## 7 Conclusion

In this article, I derived antitrust implications from the analysis of markets where entry of firms is endogenous rather than exogenous, contrary to most of the formal analysis within the post-Chicago tradition. Many applications were about the behavior of market leaders and, accordingly, issues of abuse of dominance. Endogenous entry requires a wide revision of our understanding of the role of incumbents in pricing, producing in the presence of network externalities and multi-sided markets, bundling products, price discriminating, and delegating to retailers through vertical restraints: when entry is endogenous, leaders adopt aggressive strategies without exclusionary purposes and without affecting welfare negatively. Endogenous entry has also implications for the analysis of mergers (that take place only if they create enough cost efficiencies and do not harm consumers) and for the evaluation of collusive cartels (that are unfeasible in markets where entry is endogenous). The spirit of the policy recommendation of the Chicago school is broadly supported by the endogenous market structures approach.

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