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Endogenous Entry and Antitrust Policy

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Abstract

This article derives antitrust implications for markets where entry can be regarded as endogenous (contrary to most analysis within the post-Chicago tradition). Many applications concern 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 create enough cost efficiencies and do not harm consumers), the evaluation of collusive cartels (that are unfeasible in markets where entry is endogenous) and state aids for exporting firms (which are always unilaterally optimal for international markets with free entry). The spirit of the policy recommendations of the Chicago school is broadly supported by our analysis in a solid game-theoretic framework.

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In this article I will propose a critical view of the post-Chicago approach to antitrust policy, emphasizing that this approach has often disregarded the consequences of the endogeneity of the market structure. Taking into account the endogeneity of entry in a market, standard results of the post-Chicago literature can be radically modified. The main implications concern the behavior of market leaders and, consequently, the antitrust approach to abuse of dominance (or monopolization), but I will also derive implications for the antitrust approach to mergers, collusion and state aids. The overall flavour of the endogenous entry approach is reminiscent of the Chicago school, but my analysis is based on solid game theoretic foundations in line with the post-Chicago tradition.

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, 2006a, 2008,a). 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. For instance, a firm competing with a single rival could engage in accommodating pricing to increase mark ups, or could engage in predatory pricing to induce the exit of the rival, but a firm facing endogenous entry of competitors will ordinarily engage in aggressive pricing strategies without exclusionary purposes. A monopolist in a primary market competing with a single rival on a secondary market may bundle its goods to monopolize the secondary market as well, but when the secondary market is characterized by endogenous entry the only purpose of bundling can be the strengthening of price competition. A firm facing a single rival could adopt vertical restraints on its retailers or price discrimination strategies to soften price competition, but when the same firm faces endogenous entry of rivals these anti-competitive practices will not be in its interest. Of course, notice that efficiency reasons can still motivate the adoption of bundling, vertical restraints, price discrimination or other strategies.

The theory of endogenous entry delivers a related and strong result 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 entity 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. In these cases, mergers are welfare improving. Simila results apply to cartels, that are ineffective whenever entry in the market is endogenous, unless the cartels act as a leaders. In this last case, the cartels coordinate aggressive strategies aimed at increasing the market shares of their members through low prices, and their implementation is always sustainable and it does

not harm consumers.

It is clear that the relevance of these results depends on the relevance of the hypothesis that entry is endogenous. One may argue that entry can be 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), then these results are potentially relevant.

The rest of the article is organized as follows. In Section 1 I will review the traditional approaches to antitrust and in Section 2 I will describe the endogenous entry approach. Section 3 summarizes the basic theoretical results. Section 4 applies the theory to abuse of dominance issues, including predatory pricing, bundling, price discrimination and vertical restraints. Section 5 is about mergers in markets with endogenous entry. Section 6 focuses on cartels. Section 7 explores aspects of the state aids policy. Section 8 concludes.

1 Chicago and post-Chicago views

The so-called pre-Chicago approach was mostly based on the simplistic insights of the early studies on imperfect competition, which associated monopolistic behavior and abusive conduct with firms having large market shares. Such a *naïve* view has been challenged since the 50s- 60s by what we now call the "Chicago school", led by Aaron Director and other exponents of the Law School of the University of Chicago, whose main merit has been to introduce a systematic economic approach to antitrust. While the Chicago school was seriously attacking collusive agreements as conducive to large welfare losses, it was less critical of mergers and exclusionary practices. Many scholars were (and still are) convinced that, 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 anticompetitive but may instead have a strong efficiency rationale behind them. For instance, bundling is typically used for price discrimination purposes and not for exclusionary purposes. Moreover, according to a widespread view in the Chicago school, there is no such a thing as predatory pricing, that is reducing prices below costs to induce exit by the competitors so as to compensate the initial losses with future monopolistic profits. The main reason is that, if the predator can sustain such initial losses, also any other pray can sustain the induced losses (which are smaller since its output is lower) as long as credit markets are properly working, therefore predatory pricing would not be effective to start with.[1]

More recently, Posner (2001) has taken a less extreme position, claiming that "there is an economic basis for concern with at least some exclusionary

[1] See McGee (1958).

practices, in at least some circumstances; and a few practices that are not exclusionary (though so classified in the law), like persistent price discrimination, may still be undesirable on strictly economic grounds" (Posner, 2001, p. 4). Accordingly, Posner proposes 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. 194-5). 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.

In the modern economic debate, the Chicago school has been criticized for failing to provide results that were robust enough to withstand full-fledged game-theoretic analysis of dynamic competition between incumbents and entrants. The so-called "post-Chicago" approach, has shown that in the presence of strategic asymmetries between incumbents and entrants and pervasive market imperfections, strategies as price-cuts, bundling or vertical restraints can be anti-competitive because they can successfully deter entry in the short run and protect monopolistic rents in the long run. I believe that 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.[2] 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.

In the 80s, while the Chicago school was succeeding in reducing the enforcement attitudes of US antitrust law, especially under the Reagan Administration, the 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, which represents one of the main contributions of this line of research. 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, of credit market imperfections or in the presence of limited forms of irrationality,

[2]Somewhat related with this literature is the theory of contestable markets by Baumol *et al.* (1982).

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. Analogously, many other strategies can have an exclusionary purpose.

One should keep in mind that many of the results of the post-Chicago approach (summarized in the early but still unsurpassed work of Tirole, 1988) are quite weak, and they 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 signalling models), which is what should matter in drawing antitrust implications. Nevertheless, the intellectual achievements of the post-Chicago approach, especially the introduction of game theory as the ultimate tool of industrial organization and the proof of the possibility of profitable exclusionary strategies, are remarkable.

My 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) and by Bulow *et al.* (1985) 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.[3] 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 duopolistic models, where the incumbent chooses its own strategies in competition with a single entrant. While this analysis simplifies the interaction between incumbents and competitors, it can be highly misleading, since it assumes away the possibility of endogenous entry, and hence limits its relevance to situations where the incumbent already has an exogenous amount of market power.

It is not surprising that the results of the post-Chicago approach are often biased toward an anti-competitive role of the incumbents: these engage in predatory pricing, threaten or undertake overinvestments in complementary markets and patent new technologies only to preempt entry, impose exclusive dealing contracts, or bundle their goods with the sole purpose of deterring the entry of the competitor. Otherwise they are accommodating, engaging in exces-

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

sive pricing or in anticompetitive mergers aimed at increasing prices, or stifling innovation to preserve their power. In such a simple scenario, what antitrust authorities should do is unambiguously fight against incumbents: punish their aggressive pricing strategies as predatory, and their accommodating pricing strategies as exploitative, punish investments in complementary markets as attempts to monopolize them, weaken their intellectual property rights, forbid bundling strategies, prohibit mergers and so on. The bottom line is that, according to this view, antitrust authorities should sanction virtually any behavior of the incumbents which does not conform to that of their competitors.

The fallacy of this line of thought, in my view, derives from a simple fact: it is based on a partial theory of oligopoly limited to the analysis of duopolies with an incumbent and an entrant which does not take into account that, at least in most cases, entry by competitors is not an exogenous fact, but an endogenous choice. Whether entry is more or less costly, it is typically the fruit of an endogenous decision by the potential competitors. 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 a subject of antitrust analysis, but of regulatory analysis. When entry can be regarded as an endogenous element which depends on the technological conditions that constraint the profitability of the firms, we need a complete understanding of the behavior of leaders facing endogenous entry.

2 The role of endogenous entry

The endogenous entry approach clarifies the role of market leaders and of the entry conditions in a game-theoretic framework that is more general than most analysis within the post-Chicago approach. In this section I will review its results and compare its implications for antitrust with those of the traditional approaches, but before doing that, I need to clarify a few concepts concerning the determinants of entry in a market.

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. 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 defined as competition between an exogenous number of firms: even if profits can be obtained 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 in-

cumbent). 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 *fixed costs of entry*: these are equally faced by 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.[4]

The main point emerging from our 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 market power of the leaders of a market, and may lead to misleading welfare comparisons.[5] In what follows, I will review the main applications for models of competition in quantities and in prices, and to models with strategic commitments. The reader interested in the theoretical results can skip to the next section.

2.1 Competition in quantities

The irrelevance of market shares for the evaluation of the market power of leaders emerges quite clearly in the simplest environment, that of competition in quantities with homogenous goods, 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 starting 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, lower concentration would be correctly associated with higher welfare.

Radical changes occur when entry in the market is endogenous, and is de-

[4]Another important aspect is about the source of these barriers and costs. As we noticed before, 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, it is hard to imagine how artificial barriers could be erected under normal circumstances. The Chicago school is quite clear on this point, 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."

[5]See also Etro (2006,c; 2007b,c).

termined by the existence of profitable opportunities in the same market. In such a case the leader would expand production until no one of the potential entrants has 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 for the market 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 output by the competitors: exploiting the economies of scale over the entire market allows the leader to enjoy positive profits even if no entrant could obtain positive profits in this 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, following traditional paradigms, we would associate this situation with a monopolistic environment, or at least with a dominant position derived by some barriers to entry. But this association is not correct, since entry is indeed free in this market: 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 firm can enter. And we are talking of firms that are as efficient as the leader (we assumed identical cost technologies). Finally, in Etro (2008,a) I noticed that this equilibrium with only the leader in the market is associated with a higher welfare than the free entry equilibrium without a leadership - the Marshall equilibrium, which would involve 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. When marginal costs are substantially increasing in the production level or, more generally, when the average costs have a U-shape, a market leader facing endogenous entry of competitors may not have incentives to deter entry, but would still behave in an aggressive way. In such a case, 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. Notice that 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 as much 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, in Etro (2008,a) I have shown 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 from indexes of concentration or from the market shares. Of course, an abusive behavior can be still associated with aggressive strategies aimed at foreclosure and with negative consequences on consumers. 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, and 2) when the same leader has built barriers to artificially constrain entry and without efficiency reasons. Finally, notice that 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, which is beyond the scope of this paper, but simple models are often able to say a lot. Our point here is simply to warn against the risk of directly associating aggressive price strategies that reduce entry with strategies that harm consumers.

2.2 Competition in prices

Another important implication of the theory of market leaders emerges quite clearly under competition in prices. In this typical situation, the traditional analysis of Stackelberg oligopolies 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.[6] Such an outcome 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. Again, in equilibrium with endogenous entry, leaders increase their market shares and obtain positive profits. Of course an aggressive pricing strategy will still reduce entry, even if it will not exclude all rivals. Nevertheless, we must be more careful in associating aggressive pricing with predatory purposes. The reason why predatory strategies are anti-competitive

[6] 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.

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 an aggressive pricing strategy is aimed at excluding some but not all competitors, this anti-competitive element is more limited.

Notice that competition in prices is quite typical of markets where product differentiation is relevant and firms have more autonomy in choosing their prices directly. The results are also relevant in oligopolistic markets in which prices determine the volume of business, as in the banking sector, where the interest rates on loans determine how much firms borrow from a bank, and the interest rates on deposits determine how much households lend to a bank.

2.3 Strategic commitments

In general, the spirit of our result on the aggressive behavior of leaders goes through when leaders cannot commit to output or price strategies, but can undertake preliminary investments that change their incentives in the market. 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, it is always optimal to adopt the strategy that allows one to be aggressive in the market: strategic overinvestment in cost reducing R&D is optimal independently from the form of competition, because it allows one to be aggressive against competitors.[7] A similar role is attached to investment in production capacity, to debt as a financing tool issued to commit management to produce higher output, and to many other strategic investments.

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. Finally, this point applies

[7] 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."

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.

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 paper, 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. Since a more aggressive strategy leads to lower prices for both firms as long as both are 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 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 market leaders 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), but it 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.

We will encounter a more complex situation when considering price discrimination versus uniform pricing, since they can both soften or strengthen price competition in different markets. However, we will show an example in which, when price discrimination emerges between two groups of customers, it is also likely to soften price competition compared to uniform pricing. If this is the case, price discrimination is adopted by a firm competing with an exogenous number of competitors, but not when entry is endogenous. Accordingly, when it takes place price discrimination is likely to harm at least some consumers.

The theory of endogenous entry will deliver a related and strong result 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 entity to increase prices or restrict production so as to enhance prof-

itability. 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. In these cases, mergers are welfare improving.

We will also develop some implications for the case in which collusive cartels are organized between a restricted number of firms. These cartels, as any price fixing agreements, always lead to higher prices and lower welfare when the number of firms in the market is exogenous. However, when entry in the market is endogenous collusive cartels are ineffective, unless they act as leaders. In this last case, the cartels coordinate aggressive strategies aimed at increasing the market shares of their members through low prices, and their implementation is always sustainable and it does not harm consumers.

Finally, our theory can be applied to standard problems of strategic policy to evaluate the role of state aids aimed at promoting exports. These are always optimal when the domestic firms export in markets where entry is endogenous, and they do not harm domestic or foreign consumers. Therefore, limitations to state aids and export subsidies should be exempted when they concern firms competing in international markets where entry is free.

3 Market leaders and endogenous entry

In this section I generalize the results derived in Etro (2006a, 2007a, 2008a) on the characterization of equilibria with endogenous entry.

Consider n firms choosing a strategic variable $x_i > 0$ with $i = 1, 2, ..., n$. They all compete in Nash strategies, that is taking as given the strategies of each other. These strategies deliver for each firm i the net profit function:

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

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

Most of the commonly used models of oligopolistic competition in quantities and in prices are nested in our general specification. For instance, consider a market with quantity competition so that the strategy x_i represents the quantity produced by firm i. The corresponding inverse demand for firm i is

$p_i = p\left[x_i, \sum_{j \neq i} h(x_j)\right]$ which is decreasing in both arguments (goods are substitutes). The cost function is $c(x_i)$ with $c'(\cdot) > 0$. It follows that gross profits for firm i are:

$$\Pi(x_i, \beta_i) = x_i p(x_i, \beta_i) - c(x_i) \tag{2}$$

Consider now models of price competition where p_i is the price of firm i. Any model with direct demand $D_i = D\left[p_i, \sum_{j=1, j \neq i}^{n} g(p_j)\right]$, where $D_1 < 0$, $D_2 < 0$, $g'(p) < 0$, is nested in our general framework after setting $x_i \equiv 1/p_i$ and $h(x_i) = g(1/x_i)$. This specification guarantees that goods are substitutes in a standard way since $\partial D_i / \partial p_j = D_2 g'(p_j) > 0$. Examples include models of price competition with Logit demand, isoelastic demand and constant expenditure demand and other demand functions as in the general class due to Dixit and Stiglitz (1977). Adopting, just for simplicity, a constant marginal cost c, we obtain the gross profits for firm i:

$$\Pi(x_i, \beta_i) = \left(\frac{1}{x_i} - c\right) D\left(\frac{1}{x_i}, \beta_i\right) = (p_i - c) D(p_i, \beta_i) \tag{3}$$

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

Our interest will be on the behavior of market leaders in these markets. Two situations are usually studied in the literature. The simplest one requires the 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 and aggressive under strategic substitutability. However, when entry is endogenous, we obtain the following result:

Proposition 1 (Etro, 2008,a). 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 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 $\pi_L = \Pi^L(x_i, \beta_i, k) - F$, 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: 1)

when the leader is tough ($\Pi_{13}^L > 0$), strategic over (under)-investment occurs under SS (SC), inducing a "top dog" ("puppy dog") strategy; 2) when the leader is soft ($\Pi_{13}^L < 0$), strategic under (over)-investment occurs under SS (SC), inducing a "lean and hungry" ("fat cat") strategy.

I will now follow Etro (2006a) and consider the case of endogenous entry assuming that the number of potential entrants is great enough that a zero profit condition pins down the number of active firms, n. The equilibrium conditions for a given preliminary investment k are the optimality conditions:

$$\Pi_1 \left[x, (n-2)h(x) + h(x_L) \right] = 0 \tag{4}$$

$$\Pi_1^L \left[x_L, (n-1)h(x), k \right] = 0 \tag{5}$$

plus the endogenous entry condition:

$$\Pi \left[x, (n-2)h(x) + h(x_L) \right] = F \tag{6}$$

One can now prove that a change in the strategic commitment by the leader does not affect the equilibrium strategies of the other firms x, or the spillovers from the strategies of the other firms β, but affects x_L according to a function $x_L'(k)$ which can be easily derived. Using such a function, the optimal choice of investment k for the leader in the first stage satisfies the optimality condition:

$$\Pi_3^L + \frac{h'(x_L)\Pi_2^L \Pi_{13}^L}{\Pi_{11}^L - h'(x_L)\Pi_{12}^L} = f'(k) \tag{7}$$

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

Comparing the optimality conditions of the leader and the followers, we have:

Proposition 2 (Etro, 2006a). UNDER NASH COMPETITION WITH ENDOGENOUS ENTRY, WHEN THE STRATEGIC INVESTMENT MAKES THE LEADER TOUGH (SOFT), OVER (UNDER)-INVESTMENT OCCURS, BUT THE LEADER IS ALWAYS MORE AGGRESSIVE THAN THE OTHER FIRMS.

Basically, under 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; 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.

In the rest of the paper, I will apply these 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. In conclusion I will deal with state aids, a topic occasionally included in antitrust discussions.

4 Abuse of Dominance

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 $p(X)$ which is decreasing in the total production X. For a general cost function, gross profits of firm i are:

$$\Pi\left(x_i, \beta_i\right) = x_i p\left(X\right) - c(x_i)$$

which are clearly nested in our framework. 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:

$$p(X) = \frac{c'(x)}{1 - 1/\epsilon} \tag{8}$$

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

$$p(X) = \frac{c(x) + F}{x} \tag{9}$$

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 $\pi_L = x_L p(X) - c(x_L) - F$ must satisfy the simple condition:

$$p(X) = c'(x_L) \tag{10}$$

which completes the characterization of the equilibrium in this case. Notice that the followers are producing below the optimal scale of production (which satisfies $c'(x) = \left(c(x) + F\right)/x$), while the leader is producing above it: according to Prop. 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 rule guarantees positive profits to the leader.

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 $p = a - X$, the equilibrium price is:

$$p = c + 2\sqrt{F}$$

The 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.[8] Of course, our theory has the advantage that it applies beyond the case of homogenous goods.

Summing up, market leaders facing endogenous entry 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 flat. In both cases, they obtain positive profits that are increasing in the fixed costs 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 Cost reductions and signaling

Our first application is about market pricing in standard markets and has implications for the main post-Chicago approaches to predatory pricing (Milgrom and Roberts, 1982). 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, we will assume for simplicity that marginal costs are constant. Here, the leader can invest k and reduce its marginal cost to $c(k) > 0$ with $c'(k) < 0$, while the marginal cost cannot be changed for all the other firms. One could think of the cost reducing investment as an investment in R&D to improve the production technology, but also in terms of learning by doing: past production reduces future costs.

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

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

Notice that in such a model, Π^L_{12} has an ambiguous sign, but we have:

$$\Pi^L_{13} = -c'(k) > 0 \tag{12}$$

[8] The contestable equilibrium requires a price of the incumbent equal to the average cost ($p = a - x = c + F/x$), therefore:

$$p = \frac{1}{2}\left(a + c - \sqrt{(a-c)^2 - 4F}\right)$$

which is always lower than the equilibrium price under Stackelberg competition in quantities with endogenous entry.

consequently the leader will overinvest in cost reductions when facing a fixed number of competitors (as long as SS holds), and will always overinvest and produce more than the other firms when entry is endogenous.

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

$$\Pi^L(x_L, \beta_L, k) = [p_L - c(k)]\, D(p_L, \beta_L) \quad \text{with } p_L = 1/x_L \tag{13}$$

Now we have:

$$\Pi^L_{13} = c'(k) D_1 p_L^2 > 0 \tag{14}$$

Accordingly, underinvestment in cost reductions emerges when entry is exogenous (since SC holds), 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.[9] 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).

The same result can also 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: since the study of informational asymmetries is beyond our current scope, we will just sketch their idea to emphasize the similarities with our approach. 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 to 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 our condition $\Pi^L_{13} > 0$: 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 overproducing enough to signal its efficiency and induce the follower

[9] A related point in a different framework was made in Etro (2004, 2008b).

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 (and SS), 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, we can point out that when entry is endogenous there can only be a gain from signaling efficiency for a low cost incumbent, since signaling a high cost would not soften price competition, but just induce further entry. In the spirit of our model, we can conclude by suggesting that 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 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 product 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 the simplest 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 $p(X)\phi(k)$, where 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:

$$\Pi^L(x_L, \beta_L, k) = kp(k) - ck + \delta\left[p(X)\phi(k)\, x_L - cx_L\right] \tag{15}$$

where $\delta \leq 1$ is the discount factor, while the net profit of the other firms is simply $\pi_i = x_i p(X) - cx_i - F$. Since the other firms do not enjoy network effects, one can easily show that in a free entry equilibrium the future production

$x_L(k)$ of the leader will be increasing in its initial production with $\partial x_L/\partial k = -c\phi'(k)/\phi(k)^2 p'(X) > 0$. Moreover, in equilibrium we have the cross effect:

$$\Pi_{13}^L = \frac{\delta c\phi'(k)}{\phi(k)} > 0 \tag{16}$$

which, according to our general principle, shows that the leader will always engage 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:

$$p(k) + kp'(k) = c - \delta p\,(X)\phi'(k)\,x_L(k) - \delta\frac{c\phi'(k)x_L(k)}{\phi(k)} \tag{17}$$

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 we have:

Proposition 4. In markets with network externalities an incumbent has an incentive to overproduce initially so as to be more aggressive when endogenous entry takes place in the future.

4.3 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) and Armstrong (2006), 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 many agents 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 we 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 the advertising).

One can verify that the same happens under price competition, which is the usual assumption in models of two-sided markets. However, under SC, 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.[10]

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,

[10]More formally, consider the simplest case of a monopolistic platform charging a group, say the buyers, a price p_B per interaction with the other group, say the sellers, and charging the sellers a price p_S per interaction with the buyers. If total demand of interactions is $D(p_B)$ for the buyers and $D(p_S)$ for the sellers, the number of interactions is $D(p_B)D(p_S)$. Given a marginal cost per interaction c the profits of the platform are:

$$\pi = (p_B + p_S - c)D(p_B)D(p_S)$$

whose maximization provides the following Rochet-Tirole (2003) rule $p_B + p_S - c = p_B/\epsilon_B = p_S/\epsilon_S$, where ϵ_i is the elasticity of demand for $i = B, S$. Strategic reasons may bias the pricing structure of platform leaders. In the example of the previous footnote, suppose product differentiation on one side occurs and, with the usual notation, profits of a representative firm are:

$$\pi = (p_B + p_S - c)D(p_B)D(p_S, \beta_S)$$

Suppose that the leader can commit to a price for the buyers, while, for simplicity, the others are given. Firms compete on the prices for the sellers. To verify the incentives of the leader, notice that (with $k = 1/p_B$ as preliminary commitment) we have:

$$\Pi_{13}^{L}(1/p_S, \beta_S, 1/p_B) = (p_S p_B)^2 D(p_B)D_1(p_S, \beta_S) < 0$$

Assuming that SC holds, this implies that when entry is not free the leader will tend to underprice buyers to be accomodating in the competition for the sellers. However, when entry in the platform competition is endogenous, the leader will tend to overprice buyers to be aggressive in the competition for the sellers.

and c is the marginal cost of an interaction, so that:

$$\Pi^L(x_L, \beta_L, k) = [p(k) + p(X) - c] \cdot k \cdot x_L \tag{18}$$

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

$$p(k) + p(x) - c = \frac{p(k) + p(x)}{\epsilon(k) + \epsilon(x)} = \frac{p(k)}{\epsilon(k)} = \frac{p(x)}{\epsilon(x)} \tag{19}$$

where $\epsilon(x) = -p(x)/xp'(x)$ 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. Since:

$$\Pi^L_{13} = p'(k)k < 0 \tag{20}$$

there is a strategic incentive to commit to underproduction to be more aggressive on the competitive side. 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).

4.4 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 the 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 entry emphasizes some limits of this way of thinking: pricing at or below marginal cost by the market leader does not need to exclude (equally 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 can not 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. 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."

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;*

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).[11] 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. We believe that 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 the chances that these followers have to exploit profitable opportunities in the market.

4.5 Tying

There has been a lot of attention in the economic literature on the rationale for tying (bundling) products rather than selling them separately. A fundamental reason for this is that many antitrust cases have focused on such a practice as an anti-competitive one.

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

[11] 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)

by the Chicago school because it would erroneously claim that a firm can artificially increase monopolistic profits from a competitive market. Bundling should have different motivations, as price discrimination or creation of joint economies, whose welfare consequences are ambiguous and sometimes even positive. Whinston (1990) has changed the terms of the discussion trying to verify how a monopolist can affect strategic interaction with competitors in another market by bundling. His main finding is that 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, here will we show that, when entry is endogenous, bundling may become the optimal "top dog" (aggressive) strategy.

Imagine that a monopolistic market is characterized by zero costs of production and unitary demand at price v, which corresponds to the valuation of the good alone. Another market is characterized by standard price competition, a fixed cost F and a constant marginal cost c. Gross profits for the monopolist without bundling are:

$$\pi_M = v + (p_M - c)\, D\left(p_M, \beta_M\right) - F \tag{21}$$

while profits for the other firms are $\pi_i = (p_i - c)\, D\left(p_i, \beta_i\right) - F$. In Bertrand equilibrium with endogenous entry the monopolist enjoys the profits $\pi_M = v$.

Under bundling, demand for the monopolist is constrained by demand for the other good, which is assumed less than unitary. 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:

$$\pi_{MB} = (P_M - c)\, D(P_M - v', \beta_M) - F = (p_M + v' - c)\, D\left(p_M, \beta_M\right) - F$$

while the other firms have the same objective function as before. In Bertrand equilibrium the monopolist chooses the price $P_M = p_M + v'$ satisfying:

$$(P_M - c) D_1\left[p_M, (n-1)g(p)\right] + D\left[p_M, (n-1)g(p)\right] = 0 \tag{22}$$

while each one of the other firms chooses p satisfying:

$$(p - c) D_1\left[p, g(p_M) + (n-2)g(p)\right] + D\left[p, g(p_M) + (n-2)g(p)\right] = 0 \tag{23}$$

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

$$(p - c) D\left[p, g(p_M) + (n-2)g(p)\right] = F \tag{24}$$

so that the profit of the monopolist becomes $\pi_{MB} = (P_M - c)\, D\left[p_M, (n-1)g(p)\right]$. Notice that if we define $\beta = g(p_M) + (n-2)g(p)$ the equilibrium spillovers received by the entrants as a consequence of the price chosen by their competitors,

the equilibrium conditions (23)-(24) jointly determine p and β independently from the price of the monopolist. Using $\beta_M = \beta + g(p) - g(p_M)$ we can rewrite the equilibrium first order condition of the monopolist as an implicit expression for $p_M = p_M(v')$, and immediately derive that the equilibrium price of the secondary good decided by the monopolist has to be decreasing in v'.[12]

Clearly, bundling is optimal if $\pi_{MB} > \pi_M$. We need to verify under which conditions this happens. Let us look at the way in which bundling changes the strategy of the monopolist. Since $\partial\pi_{MB}/\partial p_M - \partial\pi_M/\partial p_M = v' D_1 < 0$, bundling makes the monopolist tough. This implies that the monopolist is led to reduce the effective price in the other market by choosing a low price of the bundle. Since SC 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. In particular, bundling is optimal if the low price of the bundle increases profits in the competitive market more than it reduces them in the monopolistic one. It is easy to verify that bundling is optimal if:

$$[p_M(v') - c]\, D\left[p_M(v'), \beta_M\right] - F > v - v' D\left[p_M(v'), \beta_M\right]$$

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

Proposition 5. Under price competition with endogenous entry in a secondary market, a monopolist in a primary market can have an incentive to bundle both goods to be aggressive.

It is important to remark that, in this case, bundling does not need to have an exclusionary purpose as assumed by the leverage theory of tied good sales. The reduction in the price of the two bundled goods together can also benefit consumers. This is even more likely when they are complements, when there are network externalities between products, or when bundling creates efficiency effects.

Bundling is an example of a discrete strategy: a firm either bundles two goods or not. A similar story can be used to evaluate a related discrete strat-

[12] In particular we have:

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

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

egy, the choice of product compatibility and *system compatibility*, or interoperability: as Tirole (1988, p. 335) has correctly noticed, "a manufacturer that makes its system incompatible with other systems imposes a de facto *tie-in*." Typically, product compatibility softens price competition because consumers can mix and match products of different firms: these products endogenously become complements, while they would be substitutes in case of incompatibility. Since price cuts are more profitable when competing products are substitutes rather than complements, interoperability softens price competition (Matutes and Regibeau, 1988).

Therefore, according to the standard outcome under price competition with an exogenous number of competitors, the only reason why a leader would choose a low level of interoperability would be to induce their exit from the market. On the contrary, our results suggest that, when entry in the market is endogenous, a leader may favour a limited level of interoperability for a different purpose than entry deterrence: just because this strategy would strengthen price competition and enhance the gains from a low pricing strategy in the system competition, that is the competition between alternative systems.

4.6 Third degree price discrimination

Our results have also implications for price discrimination, and in particular third degree price discrimination (firms discriminate 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 $D^A(p_i, \beta_i)$ for each firm i, and the leader also serves a local market with demand $\tilde{D}^B(p_i)$ (we assume that 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:

$$\pi_L = p_L^A D^A(p_L^A, \beta_L) + p_L^B D^B(p_L^B) - c[D^B(p_L^B) + D^A(p_L^A, \beta_L)] - F \qquad (25)$$

while the profits of the other firms are simply:

$$\pi_i = \left(p_i^A - c\right) D^A(p_i^A, \beta_i) - F$$

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 SC 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 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.[13]

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 and vertical restraints

Vertical restraints are agreements or contracts between vertically related firms. When these restraints improve the coordination of a vertical chain, they are

[13]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.

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 downstream firm through a contract implying a fixed fee Υ and a wholesale price w for the good. The downstream firm sells this same good at the price p_D to maximize net profits:

$$\pi_D = (p_D - w)D(p_D, \beta_D) - \Upsilon \tag{26}$$

while the other firms, that are vertically integrated and face the same cost structure, have the standard profit function $\pi_i = (p_i - c)D(p_i, \beta_i) - F$. The upstream firm can preliminarily choose the optimal contract, meaning the wholesale price w and the fee Υ that maximize net profits:

$$\pi_U = (w - c)D(p_D, \beta_D) + \Upsilon - F \tag{27}$$

It is always optimal to choose w such that the profits 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. In particular, we know from our general results, that 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 β that are both independent from w, and $\beta_D(w) = \beta + g(p) - g(p_D(w))$. One can verify that the optimal contract solves the problem:

$$\begin{aligned} \max_{\{w,\Upsilon\}} \pi_U \quad &= \quad (w - c)D\left[p_D(w), \beta_D(w)\right] + \Upsilon - F \\ s.v. \quad &: \quad \pi_D = \left[p_D(w) - w\right] D\left[p_D(w), \beta_D(w)\right] - \Upsilon \geq 0 \end{aligned}$$

and requires a wholesale price for the retailer smaller than the marginal cost and implicitly given by:

$$w^* = c + \frac{(p_D - c)D_2 g'(p_D)}{D_1} < c \tag{28}$$

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:

Proposition 6. 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.[14] Therefore, also in the case of vertical restraints affecting interbrand competition, entry conditions are crucial to derive proper conclusions.

5 Mergers

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 preliminary merger with other firms and a subsequent cooperation in the strategic decisions may serve a similar role. When the number of firms in the market is given, this is typically the case. Moreover, a merger induces a more accommodating behavior which exerts an indirect effect on the other firms. When SS holds the other firms become more aggressive (Salant *et al.*, 1983), when SC 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 theory of mergers.[15] In our context, 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.[16]

[14] 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.

[15] An exception is in the independent work of Davidson and Mukherjee (2007), that extends the endogenous entry framework to the case of mergers between firms producing homogenous goods, and especially in the work of Erkal and Piccinin (2007,a), that extends the analysis to the case of product differentiation.

[16] 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 po-

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

$$\pi^{Merger} = \Pi\left(x_k, \beta_k\right) + \Pi\left(x_j, \beta_j\right) - \tilde{F}$$

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

$$\Pi_1(x_k, \beta_k) + \Pi_2(x_j, \beta_j)h'(x_k) = 0 \quad k, j = 1, 2 \tag{29}$$

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 β_M and β such that:

$$\Pi_1(x_M, \beta_M) + \Pi_2(x_M, \beta_M)h'(x_M) = \Pi_1(x, \beta) = 0, \;\; \Pi(x, \beta) = F$$

This implies $x_M < x$ and $\beta_M > \beta$: 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 independent firm. Nevertheless, the merger can still be profitable if $\pi^{Merger} > 0$, which requires $\tilde{F} < 2\Pi(x_M, \beta_M)$. In a market where entry is endogenous, the only way a merger can be profitable is by creating cost efficiencies.[17] This conclusion exactly matches the informal insights of the Chicago school on horizontal mergers, and can be summarized as follows:

Proposition 7. 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 models of competition in quantities and prices, 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. Since 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.[18]

tential 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).

[17] 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 $\tilde{F} < F$. In a model with imperfect substitutability and demand $p_i = a - x_i - b\beta_i$, a merger between two firms would lead them to produce $2 - b$ times as before and to reach the joint profits $\pi^{Merger} = (2 - b)(2 + b - b^2)F/2 - \tilde{F}$ which are positive if product differentiation is strong enough (b small).

[18] The Erkal-Piccinin model extends the analysis to more complex demand functions: under

6 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 SS or accommodating under SC, 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:

$$\pi^{Cartel} = \sum_{k=1}^{m} \Pi(x_k, \beta_k) - mF \tag{30}$$

while the other firms $i = m + 1, ..., n$, maximize their simple profits $\pi_i = \Pi(x_i, \beta_i) - F$ 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:

$$\Pi_1(x_k, \beta_k) + \sum_{q=1, q\neq k}^{m} \Pi_2(x_q, \beta_q) h'(x_k) = 0 \quad \text{for } k = 1, 2, ..., m$$

while the outsiders would stick to the usual optimality conditions $\Pi_1(x_i, \beta_i) = 0$. 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 Prop. 1, since the collusive commitment makes the members of the cartel more accommodating).[19]

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

competition in prices with a demand system derived from a quadratic utility function, 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).

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

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 β independently from the strategies of the cartel.[20] Therefore, taking into account that the expected spillover of a member of the cartel is $\beta_k = \sum_{j \neq k} h(x_j) = \beta + h(x) - h(x_k)$, the optimal strategies of the cartel solve the problem:

$$\max_{x_1,...,x_m} \pi^{Cartel} = \sum_{k=1}^{m} \Pi \left[x_k, \beta + h(x) - h(x_k) \right] - mF$$

The corresponding optimality conditions are:

$$\Pi_1(x_k, \beta_k) = \Pi_2(x_k, \beta_k) h'(x_k) \quad \text{for } k = 1, 2, ..., m$$

But these conditions exactly correspond to the condition defining the equilibrium strategy of a leader (or more leaders) in the Stackelberg equilibrium with endogenous entry. 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.[21] We can summarize our result as follows:

Proposition 8. In a market with endogenous entry, a collusive cartel is not effective unless it acts as a leader: in such a case, as long as there is endogenous entry of some followers, each member of the cartel is aggressive compared to each follower.

Paradoxically, collusion in markets where entry is endogenous turns out being profitable, sustainable[22] and also pro-competitive. This result should not be overemphasized from a policy point of view. It suggests that harmful collusion between a restricted number of firms of a market cannot occur when there is endogenous entry of other firms in the market, as already pointed out within the Chicago school. However, most of the time, collusive cartels involve all the firms of an oligopolistic market and are harmful to consumers: their avoidance should be the main focus of antitrust authorities.

[20] 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.

[21] 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.

[22] 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.

7 State Aids

Globalization leads to the intensification of competition on international markets and requires a deeper understanding of the effects of industrial policy at large in the international environment. In this section we present a discussion on the optimal state aid policy for exporting firms with particular reference to subsidies for exports, a topic on which there are contrasting views at both the policy and theoretical level - therefore we will not deal with other forms of state aids, for which our approach does not provide additional insights.

It is important to understand whether state aids to exporting firms and export subsidies are beneficial (as unilateral policies) and what are their consequences for international markets. Economic theory is largely ambiguous on this point. In the neoclassical trade theory with perfect competition, for instance, export subsidies are not optimal because they deteriorate the terms of trade. In case of imperfect competition, export promotion assumes a strategic dimension, so its main aim becomes shifting profits toward the domestic firms. A large body of literature has studied oligopolistic models with a fixed number of firms competing in a third market. In this case, the optimal unilateral policy is an export tax under price competition (or whenever SC holds; see Eaton and Grossman, 1986). Under quantity competition, an export subsidy can be optimal (Spencer and Brander, 1983), but only under restrictive conditions. The ambiguity of these results represents a major problem to derive policy implications.

When entry in the international market is free, however, the endogenous entry approach suggests that any commitment able to turn the strategy of the domestic firm into a more aggressive one is going to increase its profits. More precisely we can apply Prop. 2 and conclude that it is (unilaterally) optimal to implement any form of strategic export promotion that increases the marginal profitability of the domestic firms: this may include direct or indirect state aids for exporting firms, policies that boost demand or decrease transport costs, export subsidies, R&D subsidies for exporting firms or related strengthening of their IPRs. Here we will focus our attention on the optimal export subsidies following Etro (2003).[23] Adopting the usual notation, it is immediate to verify that a (specific) export subsidy s increases the marginal profitability of the domestic firm, say firm H. For instance, under competition in quantities we have:

$$\Pi(x_H, \beta_H, s) = [p(x_H, \beta_H) + s]\, x_H - c(x_H) \tag{31}$$

with:

$$\Pi_{13} = 1 \tag{32}$$

while under competition in prices we have:

$$\Pi(x_H, \beta_H, s) = (p_H + s - c)\, D\,(p_H, \beta_H) \quad \text{with } x_H = 1/p_H \tag{33}$$

[23] For an application to state aids to R&D investment see Etro (2008,b).

with:

$$\Pi_{13} = -D_1 p_H^2 > 0 \tag{34}$$

Now, the optimal unilateral policy does not maximize the total profits of the domestic firm, but these profits net of the subsidy (notice that prices affect only foreign consumers). Therefore, the optimal policy must simply maximize the strategic impact on the domestic profits: it follows that, as long as entry in the international market is free, an export subsidy is always optimal.

We can say something more than this: the optimal policy must implement nothing else than the Stackelberg equilibrium with endogenous entry in which the domestic firm is the leader, exactly the kind of equilibrium we have characterized in Prop. 1. Why this equilibrium? Simply because it is the best equilibrium that the domestic firm can aim for. It is now relatively simple to derive the subsidies that implement this equilibrium. For instance, with homogenous goods, increasing marginal costs and competition in quantities, the general expression for the optimal specific subsidy is (Etro, 2007):

$$s^* = p_H/\epsilon > 0$$

where p_H is the equilibrium price of the domestic firm and $\epsilon = -(p_H/x_H)(dx_H/dp_H)$ the corresponding elasticity of demand. It is important to notice that this optimal subsidy rate is exactly the opposite of the optimal export tax rate in the neoclassical theory of trade policy.

We can also derive the optimal specific subsidy under price competition. In our framework this is given by (Etro, 2007):

$$s^* = -(p_H - c)D_2 g'(p_H)/D_1 > 0$$

It is important to notice that the traditional optimal policy in the same model with exogenous entry would have required, according to the result of Eaton and Grossman (1986), a negative subsidy, that is an export tax.

At this point, the intuition for the general optimality of export promoting policies should be straightforward. While firms are playing some kind of Nash competition in the foreign market, a government can give a strategic advantage to its domestic firm with an appropriate trade policy. When entry is free, an incentive to be accommodating is always counterproductive, because it just promotes entry by other foreign firms and shifts profits away from the domestic firm. It is instead optimal to provide an incentive to be aggressive, to expand production or (equivalently) reduce the price, since this behavior limits entry increasing the market share of the domestic firm. This is only possible by subsidizing exports. Summing up:

Proposition 9. The optimal unilateral policies for domestic firms exporting in a market with endogenous entry are state aids or export subsidies which make these firms more aggressive.

Of course, we need to remind the reader that we are here referring to the optimal unilateral policy: as well known, if all countries were going to implement their optimal unilateral policies, an inefficient equilibrium would emerge. This may explain why international coordination tends to limit export subsidies.

If we interpret globalization as the opening up of new markets to international competition we can restate the main result as follows: in a globalized word, there are strong strategic incentives to conquer market shares abroad by promoting exports.

8 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 analysis within the post-Chicago approach. 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), for the evaluation of collusive cartels (that are unfeasible in markets where entry is endogenous) and for unilateral state aids (that always are optimal for firms exporting in markets where entry is free). The spirit of the policy recommendation of the Chicago school was broadly supported by our analysis in a solid game-theoretic framework.

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