Collective Dominance and the telecommunications industry¹

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Table of content

I. Introduction	3
II. Relevant factors for tacit collusion	4
1. The logic of tacit collusion.....	4
2. Relevant market characteristics	6
a. Necessary ingredients	6
b. Important factors	8
c. Other relevant factors	13
III. What can competition authorities do?	20
1. Merger control	22
2. Antitrust enforcement against collusion	23
IV. The telecommunications industry	26
1. Regulation, competition and collusion	26
2. Cooperation and collusion	28
3. A fast-growing industry	30
3. Network effects	31
4. E-commerce.....	32
References	34

¹ This note builds on joint work with many colleagues, and most particularly Bruno Jullien, Paul Seabright

and Jean Tirole. This note does not necessarily reflect their views, however, and all errors are mine.

I. Introduction

The development of the concept of collective dominance fills an important gap in European competition policy, since threats to competition can arise even in the absence of any single dominant firm. This is particularly the case when firms engage in what economists refer to as tacit collusion, since their behaviour may then approximate that of a single dominant firm.

While some practices can involve positive as well as negative aspects, thereby generating arguably difficult tradeoffs, there is instead a consensus – at least in practice – that collusion should be forbidden.² Unfortunately, it does not suffice to “forbid” collusion, which can be “implicit” as well as “explicit”. Explicit collusion, where firms engage in written or oral agreements, organise meetings to design and implement collusive conducts, and so forth, can be caught under Article 81 if the appropriate evidence is recovered. But implicit collusion does not require any explicit coordination and merely arises from the repetition of the same competitive situation. The concept of collective dominance provides a basis for antitrust intervention in such cases.

This note discusses the scope for antitrust intervention against tacit collusion. Section II first studies the circumstances in which such collusion can arise, and the forms it can take. Section III discusses the alternative courses of action available to competition authorities, while Section IV focuses on specific issues for the telecommunications industry.

² Selten (1984), among others, points out that tough price competition may discourage entry; fighting collusion may thus “backfire” by reducing the number of market participants – a similar observation applies to investments and other endogenous sunk costs, as emphasized by Sutton (1991, 1998). As noted by D’Aspremont and Motta (1994), intensifying competition however selects the most efficient competitors.

Using a panel of UK manufacturing industries, Symeonidis (1999) finds that the UK cartel laws from the late 50’s triggered tougher price competition and had a strong effect on the structure of previously cartelized markets, but little impact on firms’ profits.

II. Relevant factors for tacit collusion

1. *The logic of tacit collusion*

When the same firms repeatedly compete in the same markets, they may have an incentive to maintain high prices because they expect that if they do not do so, rivals will lower their own prices in the future. Whether firms can in fact maintain high prices depends mainly on four factors:

- *How much each firm gains from undercutting its rivals.*

Tacit collusion is easier to sustain when the gains from undercutting are low. This puts limits on the level of collusive prices that can be sustained, since the gains from undercutting depend among other things on the price-cost margin and the elasticity of the demand that each firm faces.³ The degree of product differentiation thus matters, as well as the nature of competition – while “undercutting” should be taken in the broad sense of competing more aggressively than expected, the associated benefits of such deviations from collusion are typically smaller when firms compete in quantities or capacities than when they compete in prices.

- *How much such a firm would lose in the future if its rivals retaliate*

The long-term loss of profit from a deviation is the difference between the long-run collusive profit that the firm would entertain by sticking to collusion, and the long-run profit it obtains under the market conditions that will prevail if undercutting occurs. The reaction of the rival firms to perceived deviations from the collusive conduct is often referred to as “retaliation”, although it needs not always take the form of aggressive actions against the firm.

Indeed, a simple form of retaliation consists in the mere breakdown of collusion and the restoration of “normal” competition and profits. Firms then anticipate that collusive prices will be maintained as long as none of them deviates, but if one attempts to reap short-term profits by undercutting prices, they will be no more collusion in the future, at least for some

³ At a given demand level, the benefits from a small price cut increase as the price-cost margin or the own-price elasticity of demand increase.

time. Firms may then abide to the current collusive prices in order to keep the collusion going, in which case collusion is self-sustaining. This form of collusion has a simple interpretation: firms trust each other to maintain collusive prices; but if one of them deviates, trust vanishes and all firms start acting in their short-term interest.

However, more sophisticated forms of retaliation may inflict tougher punishments and thereby allow sustaining higher collusive prices. For example, retaliation may include temporary price wars, leading to profits below “normal” levels for some period of time.⁴ It may also include actions that are specifically targeted at reducing the profits of the deviant firm⁵. Alternatively, firms may refuse to cooperate on other joint policies (such as joint ventures or joint distribution arrangements) or in standard setting processes. The retaliatory power of rivals thus depends on market specificity, and determines to a large extent the ability to maintain tacit collusion.

- *How likely is undercutting by the firm to lead to such retaliation*

Clearly, if there is little chance that undercutting triggers retaliation, the fear of losing the collusive profit will be an ineffective deterrent. The probability that undercutting by one firm triggers retaliation depends mostly on firms’ ability to monitor each other’s behaviour, and thus on market transparency.⁶ The extent of publicly available information on prices and quantities is thus highly relevant, but other dimensions such as market stability (demand and cost volatility, frequency of innovation and so forth) or the degree of similarity in cost and demand conditions matter as well.

- *How much the firm discounts future profit losses relative to today’s gains⁷*

If firms care mostly about current profits, they tend to focus on the short-term and therefore to “ignore” the consequences of retaliation. They thus have a strong incentive to undercut and collusion is not easy to sustain. The relative weight of current and future profits in the objectives of the firms depends among other things on the market real interest rate.

⁴ See for instance the work of Porter (1983) on the Joint Executive Committee for the rail-roads industry in the 1880s.

⁵ For example, in *Compagnie Maritime Belge* (case C-395/96P) shipping companies were alleged to charter “fighting ships” to compete head to head on specific routes against the ships of a targeted company.

⁶ The exact meaning of “market transparency” is a delicate issue that will be discussed below.

⁷ A discount rate R means that the firm weights the profits in period T with a multiplicative discount factor $\delta = 1/(1+R)^T$.

Future profits matter more with low interest rates,⁸ which facilitates collusion. Another key determinant is the delay before competitors react, which depends on the extent of monitoring and on structural factors such as adjustment costs, long-term contractual arrangements, and so forth.

2. Relevant market characteristics

The multiplicity of retaliation and collusive mechanisms creates a potential for collusion in many industries. The main issue is how large is this potential, that is, how credible and effective are the collusive mechanisms and to what extent is collusion likely to emerge.

Economic analysis allows a better understanding of the basic nature of retaliation mechanisms and their common features. It so provides key insights about the structural characteristics that affect the effectiveness of collusive and retaliatory conducts. I concentrate here on these aspects and discuss the factors that need to be considered when evaluating the potential for collusion.

The four factors described above determine the sustainability of tacit collusion. These factors in turn depend on market-specific characteristics, which can be grouped into three categories. The first category includes necessary ingredients for collusion. The second category covers important characteristics that determine whether collusion can be sustained. The last category corresponds to characteristics that are still relevant, although to a lesser extent or in a more ambiguous manner.

a. Necessary ingredients

The first characteristics are those that have a decisive impact on the firms' ability to sustain tacit collusion. These include *entry barriers*, the *frequency of interaction* and the role of *innovation*.

⁸ If the firm faces no risk and can freely access to the credit market, the discount rate corresponds to the market interest rate.

Entry barriers: collusion cannot be sustained in the absence of entry barriers and it is more difficult to sustain, the lower the entry barriers. In the absence of entry barriers any attempt to maintain supra-competitive prices would trigger entry (e.g., in the form of short-term or “hit-and-run” entry strategies), which would erode the profitability of collusion.

In addition, the prospect of future entry reduces the scope for retaliation, since firms have then less to lose from future retaliation if entry occurs anyway. That is, the prospect of future entry does not affect the short-run benefit that a firm can obtain from a deviation, but it reduces the potential cost of deviation: retaliation is less costly for deviating firms if they expect entry to occur and dissipate profits anyway, irrespectively of their past behaviour. Firms are therefore more tempted to undercut collusive prices and the ability to collude thus declines when the likelihood of entry increases.

The frequency of interaction: frequent interaction and frequent price adjustments facilitate collusion. As already noted, firms could not tacitly collude if they did not anticipate to interact again in the future. Similarly, collusion is unlikely when firms interact only infrequently, since the short-term gains from undercutting a collusive price can then be “punished” only in a far future.⁹ Collusion is conversely easier when firms interact more frequently, since they can then react more quickly to deviations and retaliation can thus come sooner.

A similar idea applies to the frequency of price adjustments. When prices adjust more frequently, retaliation can again come sooner; in addition, a cheating firm is unable to take advantage for as long a time as before of its cheating behaviour. Both factors contribute to hinder collusion. Thus, what matters is not whether the firms are “selling” in each period or only every now and then, but how frequently they can adjust their prices. The more frequent price adjustments are, the easier it is to sustain collusion.

Innovation: collusion is easier to sustain in mature markets where innovation plays little role than in innovation-driven markets. The reason is that innovations, and most particularly drastic ones, allow firms to gain a significant competitive advantage over their rivals. This

⁹ Of course, other industry characteristics such as market transparency, which is discussed below, also affect the length of time before retaliation effectively occurs. The point here is that retaliation will not even be feasible in the absence of frequent interaction.

prospect reduces both the value of future collusion and the amount of harm that rivals will be able to inflict if the need arises.

Consider for example an industry where, in the absence of any innovative activity, the incumbents would benefit from a secure, stable situation. These incumbents would hesitate before cheating on a collusive conduct, which would trigger a price war and dissipate their future rents. Suppose now instead that there is some probability that an incumbent makes a drastic innovation, driving all rivals out of the market. If the probability of such innovation is substantial, the incumbents then anticipate that their market position is short-lived (at least in expected terms); they thus put less emphasis on the cost of future retaliation and are more tempted to cheat on collusion. A similar reasoning applies to the case when the innovation comes from outsiders: retaliation is less effective when an innovator arrives, whether the innovator is an incumbent or an outsider.

Clearly, there is little scope of collusion in the absence of entry barriers, or if firms interact very infrequently, or else in innovation-driven markets. Therefore, whenever an industry presents one of these features, collusion is unlikely to constitute a significant concern.

b. Important factors

The second group of market characteristics includes key determinants of the scope for collusion. These factors include of course the *number of market participants*, but also the degree of *symmetry* among those participants, the existence of *maverick firms*, of *structural links* or of *cooperative agreements*.

Number of participants: Collusion is more difficult when there are more competitors. For one thing coordination is more difficult, the larger the number of parties involved – and particularly so when coordination is only based on a tacit common understanding of collusive market conducts. For example, identifying a “focal point” for prices and market shares becomes less and less obvious, particularly if firms are not symmetric.¹⁰

¹⁰ The idea that coordination is more difficult in larger groups is intuitive but there is little economic literature on this issue. See for example Compte and Jehiel (2001).

There is another reason that makes it difficult to collude with many competitors. Firms must share the collusive profit, and thus each firm gets a lower share of the pie as the number of firms increases. This has two implications. First, for each firm the gain from deviations increases since, by undercutting the collusive price, it can steal market shares from all its competitors; that is, since it has a smaller share each firm would gain more from capturing the entire market. Second, for each firm the long-term benefit of maintaining collusion is reduced, precisely because it gets a smaller share of the collusive profit. Thus the short-run gain from deviation increases, while at the same time the long-run benefit of maintaining collusion is reduced. It thus becomes more difficult to prevent firms from deviating.¹¹ This impact of the number of competitors is likely to be particularly important when there are few competitors.¹²

Symmetry: it is easier to collude among equals, that is, among firms that have similar cost structures, similar production capacities, or similar ranges of products. Suppose for example that firms have different marginal costs. Such cost asymmetry has several implications.¹³ First, firms may find it difficult to agree to a common pricing policy, since firms with a lower marginal cost will insist in lower prices than what the other firms would wish to sustain.¹⁴ More generally, the diversity of cost structures may rule out “focal points” for pricing policies and so exacerbate coordination problems. In addition, it would be efficient to allocate market share to low-cost firms, but this is clearly difficult to sustain in the absence of explicit agreements and side-transfers.¹⁵

¹¹ This insight is valid only when holding all other factors constant. The number of firms is however endogenous and reflects other structural factors such as barriers to entry and product differentiation.

¹² For example, in the case of an oligopolistic industry where n identical firms produce the same good, it can be shown that collusion is sustainable when the discount factor of the firms lies above a threshold, which is equal to $1 - 1/n$. This threshold increases by 33% (from $1/2$ to $2/3$) when adding a third competitor to a duopoly, but only by 12,5% (from $2/3$ to $3/4$) when adding a fourth competitor.

¹³ See Bain (1948) for an early discussion. Gertner (1994) validates this insight for environments with “immediate responses” where collusion is otherwise straightforward to achieve through simple price-matching strategies, even in the absence of repeated interaction.

¹⁴ It is for example well-known that the monopoly price is an increasing function of the industry’s marginal cost.

¹⁵ Side-transfers need not be monetary, however. They may for example consist of in-kind compensations or, when the same firms are active in several markets, of concessions made in another market. Still, such collusion schemes are not very plausible in the absence of any explicit agreement. For a discussion of these issues, see Osborne and Pitchik (1983) and Schmalensee (1987).

Second, even if firms agree on given collusive prices, low-cost firms will be more difficult to discipline, both because they might gain more from undercutting their rivals and because they have less to fear from retaliation by high-cost firms.¹⁶ Retaliation is indeed less effective when exerted by an inefficient firm against an efficient one, since the ability of the former to compete against the latter is more limited. In particular, the inefficient firm will not be able to induce a substantial profit loss on the efficient one without imposing on itself an even larger burden. This means that the retaliation that the inefficient firm will be rationally willing to undertake will impose little discipline on the efficient firm. Thus the low-cost firm's incentive to deviate from the collusive conduct will be larger than if it faced another low-cost firm.

A low-cost firm will be more willing to collude if it gets a larger share of the collusive profits. However, while this helps providing incentives for the low-cost firms, at the same time it affects the incentives of the high-cost firms. Thus there is a limit to the reallocation of market shares and, while it may help sustaining collusion, it cannot restore the same collusive possibilities as if the costs were similar: there is less scope for collusion with asymmetric cost structures.

A similar reasoning applies to markets where one firm has a superior product quality, since that firm has again less to fear from retaliation. The argument also extends to other types of cost differences, such as differences in production capacities. Capacity constraints potentially affect the sustainability of collusion in two ways. First, a capacity-constrained firm has less to gain from undercutting its rivals. Second, capacity-constraints limit firms' retaliatory power. At first glance, capacity constraints may appear to have an ambiguous effect on collusion, since they reduce both the incentives to deviate and the ability to punish such deviations. And indeed, studies that have focused on symmetric capacities¹⁷ have confirmed this apparent ambiguity.¹⁸ The impact of asymmetry in capacities is however less ambiguous. Compared with a situation where all firms have similar production capacities, increasing the capacity of one firm at the expense of the others both increases that firm's

¹⁶ Mason, Phillips and Nowell (1992) note in experimental duopoly games that cooperation is more likely when players face symmetric production costs.

¹⁷ See e.g. Abreu (1986) for a symmetric Cournot context and Brock and Scheinkman (1985) for a first analysis of a symmetric Bertrand context, later extended by Lambson (1987).

¹⁸ Brock and Scheinkman (1985) show for example in a linear model that, with exogenously given symmetric capacity constraints, the highest sustainable per capita profit varies non-monotonically with the number of firms.

incentive to undercut the others and limits the other firms' retaliatory power. Overall, therefore, asymmetry hinders collusion.

This insight has been hinted at by several studies¹⁹ and recently explored in more detail by Compte *et al.* (2002), who show that asymmetric capacities make indeed collusion more difficult to sustain when the aggregate capacity is itself quite limited. As for asymmetric costs, giving larger shares of the collusive profits to the bigger firms alleviates somewhat the tension generated by asymmetric capacities, but it does not evacuate it entirely, and the scope for collusion is nonetheless reduced.

The fact that the most effective collusive conducts involve asymmetric market shares, reflecting firms' costs or capacities, has an interesting implication: while market shares are highly endogenous variables, *market share asymmetry* can nevertheless provide indirect evidence of more profound asymmetry that tends to hinder collusion.

The intuition that "it is easier to collude among equals" can also explain the role of so-called "*mavericks*." A maverick firm can be interpreted as a firm with a drastically different cost structure, thus unwilling to participate in collusive conducts.²⁰ Consider for example a firm that has a drastically different cost structure or production capacity, or that is affected by different factors than the other market participants.²¹ Very often such a firm will exhibit a market conduct that differs from others, reflecting its distinct supply conditions. That firm may then be unwilling to be part to a collusive conduct – put another way, it would do so only under terms that would not be acceptable or sustainable for the other firms.

¹⁹ Lambson (1994) provides a first partial characterisation of optimal collusion schemes in this context. Lambson (1996) shows further that introducing a slight asymmetry in capacities hinders tacit collusion; and Davidson and Deneckere (1984), (1990) and Pénard (1997) show that asymmetric capacities make collusion more difficult in duopolies, using particular forms of collusive strategies.

²⁰ A new entrant can also appear to destabilize a pre-entry collusive during a transition period, until a new collusive situation is reached. This is a rather different scenario, where the temporary absence of collusion simply reflects a tâtonnement process for reaching a new focal point.

²¹ A firm that uses a different production technique than others will be affected by the price of different inputs, or the labour cost may fluctuate in a different manner.

Of course, the “asymmetry” can be along other dimensions. For example, a firm may have a stronger preference for the short-term and be therefore more tempted to undercut the rivals.²²

The existence of a “maverick” clearly tends to make collusion difficult if not impossible to sustain. It is however necessary to identify carefully the origin of the “maverick” character, in order to determine whether it is an inherent, long-lasting characteristic, or only reflects a transitory situation.

Structural links can facilitate collusion among firms. For example, cross-ownership reduces the gains derived from undercutting the other firm. Joint venture agreements can also enlarge the scope for retaliation – a firm can then for example punish a deviating partner by investing less in the venture.²³ For these reasons, collusion is more likely to appear in markets where competitors are tied through structural links.

In the absence of structural links, *cooperation agreements* can also contribute to foster collusion. As in the case of joint ventures, cooperation agreements can for example enlarge the scope for retaliation, thereby enhancing the ability to punish deviating partners. This may be particularly relevant for industries such as the telecommunications industry, where competitors need to reach interconnection agreements in order to offer their services. These agreements not only enlarge the scope for retaliation, they also have a direct impact on the operators’ pricing strategies. The operators may then design these interconnection agreements so as to facilitate collusion.

More generally, firms may alter their contractual agreements, either between themselves or with third parties, so as to facilitate collusion. Marketing agreements can constitute good tools to that effect. Jullien and Rey (2002) show for example that producers of consumer goods can resort to Resale Price Maintenance to impose more uniform prices across local retail markets, thereby making it easier to detect deviations from a collusive price. Record companies have similarly been accused to market their disks according to simple pricing grids (with only a few categories, instead of personalised prices for each author or composition) for a similar purpose.

²² See Harrington (1989) for an analysis of collusion between firms that have different discount factors.

²³ Martin (1995) provides a detailed analysis of this issue.

c. Other relevant factors

Other factors can have an influence on the sustainability of collusion, although possibly to a lesser extent or in a more ambiguous way. Among these, *market transparency* appears as a key factor. Other factors include *product differentiation*, the characteristics of demand (*demand trend and fluctuations*, as well as *demand elasticity* and *buying power*), *multi-market contact*, *club effects* or the organisation of particular markets such as *bidding markets*. These dimensions are relevant to assess the plausibility of collusion, particularly when the previous factors do not suffice to send a clear signal.

Market transparency: collusion is easier when firms observe each other's prices and quantities. Frequent price adjustments give firms the physical possibility to quickly retaliate when one market participant undercuts the others, but such deviation must first be identified by the other participants. As a result, collusion is more difficult to sustain when individual prices are not readily observable and cannot be easily inferred from readily available market data. This, in turn, supposes that some uncertainty affects the market: otherwise any deviation would be detected by the rivals, who would perceive a reduction in their market share.

This observability problem has first been stressed by Stigler (1964)'s classic paper, and formally analysed by Green and Porter (1984) and Abreu, Pearce and Stachetti (1985); the lack of transparency on prices and sales does not necessarily prevent collusion completely, but makes it both more difficult to sustain and more limited in scope.

We can illustrate this idea with Tirole (1988)'s version of Green-Porter's model. Starting with the base duopoly model, suppose now that: (i) each firm only observes its own price and sales, but not the others'; and (ii) with some probability, demand vanishes. Therefore, when a firm is unable to sell in a given period, it can either be because of "bad luck" (adverse shock on demand), or because another market participant has "cheated" (undercut the collusive price). As a consequence, perfect collusion is no longer possible: perfect collusion would require firms to go on with the monopoly price, even after a shock on demand; but then, each firm would have an incentive to undercut the others – and blame the fact that the others did not sell on bad luck.

In this context, the best collusive conduct is as follows: (i) start with the monopoly price, and maintain this price as long firms get their market shares; (ii) whenever a firm is unable to sell, launch a price war for some time before reverting to the monopoly price. The price war is needed and must be sufficiently lengthy (and thus costly) to deter potential

cheaters. But this price war can be triggered by pure bad luck – that is, because of an adverse shock on demand; firms have thus an incentive to limit the duration of the price wars to what is just sufficient to discipline the tacit conduct.

This admittedly simplistic example suffices to show that what matters is not what is directly observed by the firms, but what information firms can *infer* from the available market data. For example, inferring deviations from collusive conduct is easier and requires less market data²⁴ when the market is stable rather than unstable. Moreover the delay necessary to obtain reliable data on prices and quantities matters, as well as their nature. For example, professional associations sometimes publish information on prices, productions or capacity utilisation rates. It first matters whether this information is about aggregate or individual data, since in the latter case it is easier to identify deviant firms.²⁵ The time lag elapsed between the pricing period and the publication period is also important. Even detailed information may not help much to sustain collusion if it is available only after a long delay.

Demand growth: collusion is easier to sustain in growing markets, where today's profits are small compared with tomorrow's ones. Conversely, collusion is more difficult to sustain in declining markets, where tomorrow's profits (with or without retaliation) will be small anyway – in the limiting case where the market is on the verge of collapsing, there is almost no "future" and therefore no possibility to induce firms to abide today to a collusive conduct.

Business cycles and demand fluctuations hinder collusion. This is a corollary of the above analysis of demand growth or decline. The idea, formally captured by Rotemberg and Saloner (1986) and Haltiwanger and Harrington (1991), is that when the market is at a peak, short-term gains from a deviation are maximal while the potential cost of retaliation is at a minimum. Collusion is therefore more difficult to sustain in those times.

To see this, suppose that demand fluctuates from one period to another and, to fix ideas, assume for the moment that demand shocks are independent and identically distributed across periods. In this hypothetical scenario, firms know that they face an uncertain future, but in each period the prospects are the same; the probability of benefiting from a good shock is for example the same in each future period, and likewise for the probability of bad shocks. This

²⁴ For example, in the above hypothetical industry, in the absence of any demand shock firms could perfectly detect any deviation by their rivals by simply looking at their own sales.

²⁵ See for example Kühn (2001).

in turn implies that the amount of future retaliation to which a firm exposes itself in each period, remains the same over time. However, in periods where demand is higher than average, the short-term benefits from a deviation are themselves higher than average. Therefore, in such a period, firms must trade-off higher-than-average gains from deviations against a constant (and thus “average”) level of punishment. Clearly, deviations are more tempting in such period; by the same token, collusion is more difficult to sustain than in the absence of demand fluctuations, where both the short-term gains from deviations and retaliation possibility would always remain at an average level.

As fluctuations gain in scale, collusion becomes more and more difficult to sustain, at least in those states where demand is especially high. Firms are then obliged to collude “less” (by lowering the collusive price) or even abandon any collusion when demand is high. A similar analysis applies to more deterministic fluctuations, as for example in the case of seasonal or business cycles. There again, undercutting rivals is more tempting when demand is high, and the perceived cost of future price wars is lower when the cycle is currently at its top, since retaliation will only occur later, thus in periods of lower demand.

Product differentiation: this factor can have a more ambiguous impact on collusion, since it affects both the incentives to undercut the rivals and their ability to retaliate. This is particularly the case when product differentiation consists of offering different combinations of characteristics, possibly at comparable prices but targeted at different types of customers; this corresponds to what economists refer to as “horizontal differentiation”. Such differentiation aims at segmenting customers, in order to gaining market power over specific segments by creating customer loyalty: a customer may then be reluctant to switch away from a favourite brand, even if s/he would benefit from a small price reduction by turning to an alternative brand. This segmentation strategy affects the scope for collusion in two ways. First, it limits the short-term gains from undercutting rivals, since it becomes more difficult to attract their customers. Second, it also limits the severity of price wars and thus the firms’ ability to punish a potential deviation. Overall, therefore, the impact of horizontal differentiation appears quite ambiguous.

Indeed, the economic work on this issue has shown that collusion may become easier or more difficult, depending on the exact nature of the competitive situation (e.g., competition in prices versus competition in quantity).²⁶ Raith (1996) notes however that *product*

²⁶ See for example Ross (1992) and Martin (1993).

differentiation may exacerbate informational problems in non-transparent markets. That is, even if firms do not observe their rivals' prices or quantities, they may still be able to infer the relevant information from their own prices and quantities. But such inference may be easier to achieve when all firms offer the same goods than when they offer highly differentiated products. This may be one reason why antitrust authorities usually interpret product homogeneity as facilitating collusion.

Product differentiation has a less ambiguous impact on collusion, however, when one firm has a “better product” than the others (what economists refer to as “vertical differentiation”). In essence, firms are then in an asymmetric situation and the analysis is then similar to that of asymmetric costs. A firm that has a better quality (possibly adjusted for the cost) is in a situation somewhat similar to that of a firm that would offer the same quality as the others, but at a lower cost. This firm would have more to gain from cheating on a collusive path (this may amount to setting a price that does not fully reflect the increase in quality), and it has less to fear from a possible retaliation from the other firms.

To see this more precisely, consider a duopoly with an inelastic demand where one firm offers a better quality (at the same cost c , for the sake of presentation), which translates into a monetary bonus b for its customers. That is, consumers are willing to pay r for the lower quality and $r+b$ for the higher quality. Collusive conducts must then maintain a price differential of b between the two firms (otherwise, one firm would take over the entire market). For example, the firms could try to maintain a price of r for the low quality good and of $r+b$ for the high quality good, whereas price competition would have the high-quality firm sell the entire market but at a lower price $c+b$.

This situation is formally equivalent to the one, already discussed, where the two firms offer the same quality but face different costs.²⁷ The conclusions of the previous discussion thus readily apply. The high quality firm is more tempted to cut prices, because it enjoys a higher margin and thus gains more from stealing any additional customer away from its rival. To ease that firm's incentive constraint, collusive conducts can give a bigger market share to the high-quality firm, but collusion will nevertheless remain more difficult to sustain: when firms offer different cost-adjusted qualities, collusion is more difficult, the larger the competitive advantage of the high-quality firm.

²⁷ More precisely, the situation is formally the same as if consumers were willing to pay r for any of the products, but one firm faces a high cost $c_H = c$ whereas the other faces a low cost $c_L = c-b$.

It is often perceived that low *demand elasticity* should exacerbate collusion concerns. The elasticity of the demand has in fact no clear impact on the *sustainability* of collusive prices. For example, in the case of an oligopolistic industry where n identical firms produce the same good at the same cost c and repeatedly face the same demand, it can be shown that collusion is sustainable when the discount factor of the firms lies above a threshold equal to $1 - 1/n$; this threshold does not depend on the shape of the demand, which is therefore irrelevant in this case for assessing the sustainability of collusion: if the firms have a discount factor lower than this threshold, no collusion is sustainable and, whatever the shape of the demand, the only equilibrium yields the competitive price $p^c = c$. Conversely, if the discount factor of the firm exceeds the threshold, the firms can sustain any collusive price, even the monopoly price, whatever the shape of this demand function. Thus, demand elasticity has indeed no impact here on the sustainability of collusion. This comes from the fact that demand elasticity (and more generally, the shape of consumer demand) affects in the same way both the short-term gains from undercutting rivals and the long-term cost of foregoing future collusion.

Collusion is however more profitable when demand elasticity is low. When picking a collusive price, the firms must trade-off the increased margins generated by higher prices with the reduction in sales that these higher prices would trigger. The industry's ideal collusive price is the monopoly price, p^M , which maximises the joint profit of the firms, $\pi^{joint} = (p - c)D(p)$. It is well-known that this price is higher when the demand elasticity is lower.²⁸ This reflects the fact that, when demand is highly elastic, firms would lose too many sales if they tried to impose high prices. Conversely, if demand is low, then the firms can afford to maintain high prices without losing too many customers; the trade-off between sales and margins is then best solved for relatively high prices. *Therefore, for a given market size, the firms have more to gain from sustaining the monopoly price when demand elasticity is low.* In that sense, demand elasticity may constitute a relevant factor, although of a different nature than the factors listed above.²⁹ In addition, collusion is a larger concern for consumers when demand is inelastic than when it is elastic. This is both because the potential for large

²⁸ More precisely, the monopoly price is such that the Lerner index is inversely proportional to the demand elasticity: $L = (p - c)/p = 1/\varepsilon(p)$, where the elasticity is given by $\varepsilon(p) = pD'(p)/D(p)$.

²⁹ The profitability of collusion can in turn influence the firms' willingness to design and implement practices that facilitate the implementation of a collusive action. It can also induce firms to engage in more explicit collusion, at the risk of being caught by antitrust enforcement.

profitable increases in prices above the “normal” level increases when demand becomes less elastic, and because consumers are hurt more by a given price increase when they have little alternatives.³⁰

A related factor concerns the countervailing *buying power* of the customers. If buyers are powerful, even a complete monopolist may find it difficult to impose high prices. The profitability of collusion is similarly reduced. In addition, Snyder (1996) note that large buyers can successfully break collusion by concentrating their orders, in order to make firms’ interaction less frequent and to increase the short-term gains from undercutting rivals; more generally, large buyers can develop procurement schemes that reduce the scope for collusion.

Multi-market contact: it is well recognised that firms can sustain collusion more easily when they are present on several markets.³¹ First, multi-market contact increases the frequency of the interaction between the firms. Second, it may allow softening asymmetries that arise in individual markets. For example, one firm may have a competitive advantage in one market and its rival can have its own competitive advantage in another market. While a market-level analysis may then suggest that collusion is difficult to sustain, multi-market contact restores in such a case an overall symmetry that facilitates collusion. Third, multi-market contact may allow the firms to sustain collusion in markets where the industry characteristics alone would not allow such collusion.

For example, recall that for in a symmetric oligopoly with n firms, collusion is sustainable when the discount factor of the firms is larger than $1 - 1/n$. Suppose that two firms are in a duopoly situation in one market and face one more competitor in another market. The firms could sustain collusion in the first market if their discount factor is higher than $1/2$, but could not a priori collude in the second market if their discount factor is below $2/3$. Yet, they can actually sustain collusion in both markets. The idea is that they can give a higher market share to the competitor in the second market, in order to induce it to collude, and rely on their

³⁰ The potential harm to consumers is thus the larger, the less elastic is the demand. The impact on total welfare, however, is more ambiguous. The reason is that price increases generate less distortions when demand is inelastic (see e.g. Tirole (1988) for a discussion of this issue).

³¹ The classic reference is Bernheim and Whinston (1990). See also Parker and Röller (1997) and Evans and Kessides (1994) for empirical evidence ;

interaction in the first market to discipline them. Overall, therefore, multi-market contact facilitates collusion.

The principles reviewed above apply as well to *bidding markets*. For example, collusion is easier when there are fewer bidders that repeatedly participate in the same bidding markets, when the frequency of these markets is high (e.g., daily markets), and so forth. In addition, however, bidding markets can be designed in ways that either hinder or facilitate collusion. For example, sealed bid auctions generate less information (that is, except if the auctioneer reveals the details of all the bids afterwards) than public descending procurement auctions, where sellers observe at each moment who is still bidding at the current price. Therefore, a close look at the organisation of the bidding markets may be necessary to assess the likelihood of collusion.³²

Some markets are subject to *club or network effects*, where consumers benefit from being in the same “club” by using the same software or the same keyboard layout, subscribing to the same operator, and so forth.³³ Club effects have several implications. They tilt the market in favour of a single participant, thereby creating a “winner-take-all” type of competition which is not prone to collusion. In addition, club effects create lock-ins effects that reinforce the position of the market leader and thus increase the benefits derived from such a position. By undercutting its rivals a firm can trigger snow-balling effects that could easily tilt the market in its favour and thus obtain a durable leadership position. Club effects therefore exacerbate the gains from undercutting the rivals and, at the same time, lock-in effects limit retaliation possibilities. Both factors contribute to make collusion less likely.

Remark: Collusion in other dimensions than prices. The above discussion applies as well to other forms of competition. Where for example firms compete in quantity or production capacity, collusion consists in reducing the production levels below competitive

³² See e.g. Klemperer (2001).

³³ One important issue concerns the « compatibility » of rival clubs or networks. Club effects are fully internalised – and thus become irrelevant – when rival networks are fully compatible. This is for example the case in the telecommunications industry, where all operators are interconnected, so that subscribing to one or the other network does not affect who someone can communicate with. However, compatibility can be imperfect (e.g., some services can be proprietary) and pricing policies can also induce indirect club effects (for example, when it is cheaper to call subscribers of the same operator).

levels and retaliation can either take the simple form of reverting to “normal” competition, with higher output levels, or involve temporary large increases of competitors’ outputs, in order to further depress prices punish the deviating firm. While the nature of competition is different and often less intense under quantity competition than under price competition, it does not follow that the scope for collusion is larger or smaller, since retaliation possibilities are affected as well as the short-run gains of deviations from collusion: increasing one’s production level is less profitable, since prices will adjust to sell out the competitors’ output, but at the same time, retaliation is somewhat more difficult since the firm can always adapt its output level.

III. What can competition authorities do?

Assessing the scope for collusion is a difficult issue. While the above analysis emphasises relevant factors, it does not allow a definite conclusion as to whether collusion takes place or occurs or not. For one thing, tacit collusion relies to a large extent on firms’ conjectures about the future reactions of their competitors to their pricing or production decisions. For this reason there is not one but many potential forms that collusion may take for a given market structure, defined in terms of firms, products, costs and demand.³⁴ Whether a particular form of coordination occurs or not depends on managers’ perception of the industry, which can be to some extent subjective or manipulated by specific participants. Thus, even in situations where collusion is indeed sustainable, firms may still end-up “competing” in each and every period if they expect their rivals to do so: the fact that firms *could* sustain collusion does not mean that they actually succeed in doing it; firms may well compete in each period as if it were the last one, even if there exists another equilibrium in which they could maintain monopoly pricing forever.³⁵ And while there is a good

³⁴ This translates formally into the multiplicity of possible equilibria. Game theorists have long recognised that repeated games (so-called “super-games”) easily generate many equilibria – infinitely many, actually. Theory identifies the possible equilibria, including collusive ones, but so far it does not predict which of these equilibria will emerge.

³⁵ That is, the mere repetition of the “static” or “non-collusive” equilibrium of a competitive game is always a possible equilibrium outcome when this competitive game is repeated over and over (it even constitutes

understanding of the mechanisms underlying tacit collusion in general, as well as of many of the factors that hinder or enhance the ability to collude, this is not so for the conditions under which any particular form of tacit collusion emerges at a specific point in time.

Even assessing the likelihood of collusion is a tricky issue. We have seen that the sustainability of tacit collusion depends on many factors – and only some of them can be quantified with a reasonable degree of precision. In addition, it is rarely the case that all factors push in the same direction in a given industry. Evaluating the likelihood of collusion thus often involves a delicate assessment of the net result of conflicting effects. The exercise is made all the more difficult in that we do not have good models that incorporate the various effects; incorporating all the relevant dimensions into an integrated model would in most cases be unmanageable and unlikely to yield clear-cut predictions.

That being said, how what can antitrust fight collusion? There are two possible courses of action:

- *Ex ante*, competition authorities can prevent the emergence of an industry structure that is prone to collusion, by taking into account this concern when examining proposed mergers or joint venture agreements. They can also ban facilitating practices.
- *Ex post*, competition authorities can take steps to fight collusion *per se*, e.g., by uncovering evidence of explicit coordination or by attacking specific agreements that again facilitate collusion.

I discuss these approaches below, focussing first on merger control and then on the alternative actions.

a « subgame-perfect » equilibrium, which thus satisfies an additional credibility criterion); therefore, any collusive pricing equilibrium comes *in addition* to the standard static equilibrium.

1. Merger control

As just mentioned, a same market situation can give rise to many alternative equilibria. It is thus impossible to rely on theoretical analysis alone to determine whether collusion is *actually* taking place. And while the history of the industry may help determine whether collusion occurred in the past, it provides limited help for evaluating whether it will occur in the future – even more so if meanwhile a merger takes place.³⁶

Thus, it will not be possible to reach a definite conclusion from available market data as to whether tacit collusion will actually occur as a consequence of the merger. The merger control office can however address a different and yet relevant question: will the merger create a situation where collusion becomes more “likely”, that is, will collusion significantly be easier to sustain in the post-merger situation? I should stress the quotes on the word “likely”, however. As already mentioned, the market outcome can be perfectly competitive even when collusion is feasible. In addition, alternatively, firms may collude on prices that are only half-way to the monopoly level, either because higher prices could not be sustained or because they happen to be in such a half-collusive equilibrium. Whether collusion takes effectively place, and “how much” collusion takes place, depend among other things on subjective aspects that are difficult to quantify, and over which it is almost impossible to put a probability distribution.

This has two implications. First, the merger control office might be in a position to assess the future *feasibility* or *sustainability* of collusion rather than its “likelihood”, in the sense that it may not be realistically able to provide a probability figure. Second, the fact that firms collude does not imply that they behave as a single entity. They may be able to sustain prices that are above the competitive level but still short of the monopoly one – and even if the monopoly price could be sustained, they may happen to collude at a lower level.

A merger often affects many of the factors that are relevant for the sustainability of collusion and it can affect them in ways that tend to off-set each other. The impact of the merger on collusion can thus again involve conflicting effects. Ideally, the assessment could

³⁶ Past behaviour can however provide some information about specific characteristics of the market participants, which can for example be useful to identify whether firms are prone to collusion or of a “maverick” type.

be done by building a “meta-model” encompassing all relevant characteristics, but as mentioned such a “global model” would probably be intractable and thus quite useless.

The above discussion provides a basis for a structural analysis that may help the assessment. Rather than a pure “check-list” of relevant factors, it seems indeed more appropriate to develop a clear understanding of why each dimension is relevant, as well as of how it affects collusion – and is affected by a merger. This helps prioritising the relevant factors, by singling out the necessary ingredients (high entry barriers, frequent interactions and little role for innovation) and on the most important factors (number of market participants, their degree of symmetry, and so forth). The structural analysis makes it also easier to build an overall assessment when several factors have a role and push in different directions.

For example, a merger reduces the number of competitors, which tends to facilitate collusion, but it can make the remaining competitors more asymmetric, which tends to hinder collusion. Economic modelling of these two aspects provides an analytical framework for assessing how they affect the effectiveness of retaliation conducts, and thus how these retaliation possibilities are modified by a merger. This, in turn, helps assessing the net impact of the merger on the sustainability of collusion.

We should keep in mind however that evaluating the impact of a merger on collusion is by nature more difficult than the analysis of single dominance. This increased difficulty is also reflected in the more limited help offered by quantitative or econometric approaches. In particular, while some successful efforts have been made to evaluate *ex post* the likelihood of collusion in a particular industry, predicting the impact of a merger on the *future* likelihood of collusion appears substantially more challenging. If firms were not tacitly colluding in the pre-merger phase, past market data and econometric studies can help in assessing key structural parameters but will not provide direct information on potential collusive behaviour. And even if there is some evidence on past collusive conducts, one has to account for the fact that firms will adapt their conduct to accommodate the new environment created by the merger, which again requires some prospective analysis.

2. Antitrust enforcement against collusion

Antitrust authorities can first attack explicit forms of collusion where, say, managers meet, exchange information and conclude agreements on prices or market shares. These

explicit agreements can be fought in the EU under Article 81 and in the US under Section 1 of the Sherman Act. The main difficulty in that case is to establish the existence of such explicit agreements and get hard evidence that would stand in court. Antitrust enforcement can launch detailed investigations and down-raids – and rely on indirect or informal evidence to target likely suspects.

Another possibility is to encourage informed parties to come and provide the needed evidence. The interest of this approach is exemplified by the development of leniency programs which have already encountered substantial successes, first in the US and then in Europe.³⁷ Leniency programs vary in their design and scope: some apply to companies and others to individuals; some provide full protection while other only offer limited leniency; some apply only to first informants while some also apply as well, to a lesser extent, to later informants; and so forth. The performance of these leniency programs also varies,³⁸ which provides some ground for enhancing and fine-tuning their design.³⁹

In the absence of any hard evidence of explicit agreements, it is difficult if not impossible to directly fight collusion *per se*. There might actually be a debate as to whether antitrust authorities should take actions against purely tacit collusion, where by definition firms set prices non-cooperatively. In the end, the best way to determine whether collusion took place would be to contrast profit margins with cost and demand conditions. Such actions, however, would come close to regulating prices, something that competition authorities and courts are generally reluctant to do. In the US, Section 2 of the Sherman Act condemns for example monopolization but not the exploitation of market power through high prices. In the

³⁷ In the US, firms bringing information before an investigation is opened benefit from such a leniency program since 1978. The EU has adopted a leniency program in 1996, which allows firms that bring information to benefit from reduced fines. The Office of Fair Trading in the UK and the recent competition bill in France have also introduced leniency programs.

³⁸ In the US for example the leniency programs became really effective only after the reform of 1993, which extended leniency to firms bringing information after the opening of the investigation – as long as the Department of Justice has not yet been able to prove collusion. Thanks to this reform, on average 2 cartels are now disclosed every month, and the fines often exceed 100 million \$, not to mention jail for some managers. In 1999 only the Antitrust Division secured more than 1 billion \$ in fines, which is more than the total sum of fines imposed under the Sherman Act since its adoption more than a century ago. The EU has also recently amended its leniency program to improve its performance.

³⁹ These programs have also triggered a body of theoretical work. See e.g. Spagnolo (2000a,b) and Motta-Polo (2000).

European Union, charging an excessive price can however constitute an abuse of dominant position and Article 82 thus provides a basis under which tacit collusion could be attacked. However, building a case on the abuse of a dominant position requires establishing dominance, which in this case would amount to prove that collusion indeed occurred. This raises large difficulties both on legal and economic grounds.

First recall that the above discussion only provides an analytical framework for assessing the sustainability of collusion; it does not allow to conclude whether collusion effectively occurs. Of course, the past history of prices and market shares does bring additional information, which can reinforce the suspicion of collusion, but it will not in general provide a definite conclusion. Even the most advanced econometric models, assuming that the required data is available, typically provide only probability estimates. Second, from a legal perspective, establishing collusion would involve a standard of proof similar to the high standard established by the European Court for Article 81 cases.⁴⁰ Overall, it is unlikely that an abuse of collective dominance case could rely solely on the past realisation of prices or market shares.⁴¹

Competition authorities can still use the past history of prices, say, to alert industry “supervisors” about abnormally high prices. They can for example provide such information to consumer associations, in order to increase customers’ awareness of the problem. In regulated industries, competition authorities can also alert regulators or point to deficiencies in the regulatory environment.

Short of fighting collusion directly, competition authorities can attack those practices that facilitate collusion. Thus, for example, antitrust authorities may want to block *Resale Price Maintenance* when it facilitates collusion by generating more uniform prices. In the same vein, competition agencies may want to have a close look at marketing practices that tend to make the market more “transparent”, in the sense that they allow the market participants to infer more easily the pricing strategies of their competitors.

⁴⁰ See the *Woodpulp* Judgement of March 31, 1993. The Court basically required to prove that no other behaviour than collusion could explain the observed realisation of prices, a rather insurmountable task.

⁴¹ This suggests that it would be difficult to build a « pure » Article 82 case for collective dominance. However, cases have already been built –see e.g. *Compagnie Maritime Belge* – on both Articles 81 and 82.

IV. The telecommunications industry

The general principles discussed above apply to the telecommunications industry. Several specific aspects deserve however some comments. These concern the role of regulators, the need for cooperation in interconnection agreements and the importance of innovation and growth. I also briefly discuss some issues associated with the development of e-commerce.

1. Regulation, competition and collusion

Since fighting collusion *per se* comes close to price control, regulators can complement here the action of competition agencies. While antitrust authorities generally assess the lawfulness of conducts, regulators have more extensive powers. They can set constraints on wholesale and retail prices, either directly or through cost-of-service regulation schemes. Also, regulators can operate *ex ante* and not only *ex post*; while antitrust authorities assess conduct after the fact, regulators define pricing rules *ex ante*. Concomitantly, the regulatory process must be more expedient. The necessity not to halt productive decisions puts pressure on regulators to take rapid decisions. In contrast, the *ex post* nature of antitrust intervention does not call for a similar expediency. As a result, regulators are in practice in a better position to adopt corrective measures when needed. Another advantage is that regulators often have superior expertise. They are involved in a long-term relationship with the industry and have larger staffs for monitoring firms' accounts on a continuous basis; they also can insist on specific accounting principles (such as accounting separation) and disclosure rules.

To be sure, regulatory environments have their own caveats. *Ex ante* intervention and on-going relationships may foster collusion between the industry and the supervisor. The need for expertise also exacerbates revolving doors problems: it constrains recruitment and, at the same time, because of their deeper knowledge of a particular industry, regulators' natural career evolution is more likely to involve close links with this industry. Superior expertise may also exacerbate the ratchet effects that arise from limited commitment powers, when regulators (or politicians) are tempted to confiscate the efficiency gains that firms try to realise. Similarly, excessive attention may inhibit firms' initiative and distort technology

choices.⁴² Regulators are also constrained by their institutional environment. They may lack accountability and follow their own agenda, and they can face constraints – partly motivated by this accountability problem – on their means and powers. They are also subject to industry lobbying and political pressures, which can reflect various interest group pressures and be sensitive to alternative motivations (such as favouring domestic or public operators). Last, national regulators they have limited incentive and opportunity to develop inter-industry or international benchmarking.

For all these reasons, there are natural complementarities between the role of national regulators and that of community-wide antitrust supervision. First, having multiple instances reduces the scope for capture.⁴³ For example, the antitrust process provides a forum for incumbents and entrants if the regulator is perceived to be excessively lenient with one or the other side. Second, the separation of tasks may allow a more focused mission to each overseer.⁴⁴ Third, the ex ante nature of regulation and the ex post nature of antitrust creates a natural division of labour between decision-maker and assessor and reduces incentives for cover-ups. Overall, antitrust authorities thus have an important watchdog role. Last, the community dimension of antitrust supervision facilitates the development of international comparisons, which can take advantage of the substantial heterogeneity observed in national environments and promote “best practices”.

Collective dominance and tacit collusion may play an increasingly important role in that respect. Historically, the industry was dominated by a monopolistic operator. Accordingly, in the first phase of liberalisation the main concern was to strike an appropriate balance between promoting the entry of efficient competitors and protecting the incumbent’s incentive to maintain and develop its own infrastructure – which in many cases was the only infrastructure used by all operators. We are now in a second phase, at least in some sectors (e.g., mobile telecommunications and of internet backbones), where several operators can compete head-to-head; it may well be the case that no operator enjoys a dominant position anymore, and even when one operator is still dominant, abuses of this single dominance may no longer be only the only concerns or even the main ones. The prior experience of the Commission with collective dominance further contributes to give it a natural role to play. The Commission can

⁴² See, e.g., Crémer (1995) and Aghion-Tirole (1997).

⁴³ This benefit from having multiple “principals” has been extensively studied in the contract theory literature. See e.g. Laffont-Martimort (1999).

⁴⁴ On the desirability of “advocates”, see Dewatripont-Tirole (1999).

take advantage of this experience and help regulators adapt to the new issues arising in the second phase of liberalisation; the above discussion may also help identify situations in which operators may be particularly tempted and able to maintain cosy relationships and soften competition.

2. Cooperation and collusion

An important characteristic of the telecommunications industry is that operators often need to cooperate in order to provide service and compete in an effective manner. Telecom customers want “universal connectivity”, which requires interconnection agreements, the setting of standards, and so forth.

This need for connectivity is of course exemplified by hot disputes between incumbents and new entrants, such as the famous Clear-Telecom battle in New-Zealand. In the absence of regulation, incumbents can threaten the successful development of new competitors by refusing to interconnect, by insisting in high interconnection charges or by offering *de facto* degraded connectivity; conversely, entrants can take advantage of asymmetric regulatory environments to impose costly demands on the incumbents.

However, the need for mutual interconnection among competitors and the required cooperation that these interconnection agreements involve also creates some danger for the effectiveness of competition between mature operators. First, they provide one more way in which competitors interact, thereby creating more scope for retaliation and thus for collusion. Second, incumbents may collude in the terms they propose to new entrants, in order to protect their incumbency advantages. In addition, incumbents that collude – or take advantage of their own bilateral agreements to maintain soft competition, as stressed below – have actually higher incentives to keep entrants out, since their arrival could endanger collusion and restore more effective competition. Third, and perhaps more importantly, interconnection agreements have a direct impact on the operators’ perceived costs, and thus exert a direct influence on their pricing decisions, as well as on their decisions concerning new capacity investments, technological choices, and so forth. But then, operators can design the agreements so as to soften competition.

This point can be illustrated in a simple way in the context of bilateral interconnection agreements between two operators that, at the same time, compete in (linear) prices for

subscribers.⁴⁵ Suppose to fix ideas that two operators negotiate a bilateral access charge for terminating each other's calls. Whenever one operator's subscriber calls one of the other operator's subscribers, the operator that originates the call must pay that access charge to the other one. Thus, if in equilibrium each operator gets half of the market, and assuming that calling patterns are similar across on-net and off-net calls, each operator will have to pay the termination charge for about half of its subscribers' calls. Therefore, if c denotes the actual cost of communication and m denotes the termination mark-up that the access charge adds to the actual cost of termination, each operator's *perceived* marginal cost of communications is equal to

$$c + m/2.$$

That is, an increase in the access mark-up m will inflate the cost of all off-net calls, and thus inflate in turn the opportunity cost of attracting of stealing one more subscriber, as well as the marginal cost of inducing subscribers to call more often.⁴⁶ Both factors contribute to discourage the operators from pricing aggressively and give them instead an incentive to maintain high prices. Note that the termination charge affects operators' marginal cost, and thus their prices, even if in equilibrium the traffic is balanced and payments thus offset each other. Operators can take advantage of this feature and agree to set the access charge at a level that eliminates *de facto* any effective competition between them.⁴⁷

To be sure, the extent to which operators can manipulate these interconnection agreements so as to soften competition depends largely on the exact nature of retail competition as well as on the regulatory supervision.⁴⁸ The point remains, however, that the

⁴⁵ See Armstrong (1998) and Laffont *et al.* (1998a).

⁴⁶ The reasoning assumes here that operators cannot engage in termination-based price discrimination. If instead they can charge higher prices for off-net calls, the access charge would not affect their incentives to induce more on-net calls. Termination-based price discrimination however creates indirect forms of externalities (friends and relatives, for example, are then induced to subscribe to the same network), and are the source of other problems. See Laffont *et al.* (1998b) and Jeon *et al.* (2001).

⁴⁷ That is, the equilibrium price is increasing with the level of the reciprocal access charge. In particular, there exists a level of this access charge for which the "normal" competition between the operators lead them to charge retail prices at the monopoly level, even in the absence of any "repeated interaction," simply because they perceive a high cost for each additional traffic they generate.

⁴⁸ If for example the operators compete in "two-part tariffs" (subscription fees plus usage prices), the termination charge still affects their incentives with respect to usage prices but has less direct impact on the

negotiation of interconnection agreements gives the operators a natural avenue for altering the incentives to compete and thus deserves particular attention from regulators and antitrust authorities.

A similar remark applies to infrastructure sharing agreements, a particularly relevant issue for the development of third-generation mobile communications networks. There again, such agreements have an impact on the effectiveness of competition, by enlarging the scope for retaliation but also by directly affecting the operators' pricing and other strategic decisions. This potential impact on competition is however smaller when operators simply share towers (and the associated fixed costs), which leaves many technology options open, than when they also cooperate on network design and on technological choices that condition the nature of services that can be offered.

3. A fast-growing industry

Despite the troubles associated with the UMTS technology and the financial market bubbles, the telecommunications industry is and remains a fast-growing industry. As we have seen, market growth is a relevant factor when assessing the likelihood or sustainability of collusion. Let me however emphasize again here that, as such, demand growth tends to facilitate collusion. More precisely, *for a fixed number of market participants*, collusion is easier to sustain in growing markets: collusion is easier to sustain when the short-term gains from a deviation are small compared with the cost of future retaliation, and this is indeed more likely to be the case in growing markets, where today's profits are small compared with tomorrow's ones.⁴⁹

This conclusion appears somewhat at odds with some case courts and opinions expressed by the European Commission in guidelines.⁵⁰ Indeed demand growth is in practice

competition in subscription prices, which are not usage-sensitive. In addition, termination mark-ups introduce pricing distortions that hurt the operators' profitability, by reducing the net "quality" of the services they offer (high usage prices means that subscribers call less often than what would be efficient).

⁴⁹ If for example demand grows steadily at a constant rate g , the situation is analogous to that of a stagnating market where firms' discount factors is multiplied by the same constant g , since future periods weigh more when the market grows. Thus, in a growing market collusion can be sustained for lower values of the firms' actual discount factor.

⁵⁰ See for instance the recent guidelines for market definition in ...electronic communication markets.

often interpreted as a factor hindering collusion. One possible reason for this apparent discrepancy is that the above reasoning assumes that the number of market participants remains fixed despite market growth, while in practice, entry may be easier in growing markets.⁵¹ It is the prospect of future entry that then hinders the ability to collude.

However, it may be useful to disentangle the intrinsic effect of market growth discussed above from the impact of entry and other factors, so as to assess their relative strengths. In markets with low entry barriers, market growth is indeed likely to generate entry, and the overall impact may well be detrimental to collusion. However, in those markets where entry barriers are high (e.g., because of spectrum scarcity, as in the mobile telecommunications), the intrinsic impact of market growth may prevail and facilitate collusion. This is not to say that collusion is necessarily likely, since other factors – and notably the role of innovation – also play an important role. But again, distinguishing the role of each factor contributes to provide a more accurate overall assessment of the scope for collusion.

3. Network effects

As already mentioned, club effects tend to destabilise collusion; this is because they generate tipping effects that both exacerbate the gains from undercutting the rivals and limit retaliation possibilities. Is it not clear, however, whether such club effects are relevant in “network” industries such as the telecommunications industry, where all networks are interconnected. Because of universal connectivity, a subscriber from one network can communicate with subscribers from any other network, which evacuates the scope for club effects.

Club effects may however become again relevant when networks develop proprietary standards and offer network-specific services; indirect club effects can also arise from network-base price discrimination. Both types of practices may generate problems. For example, proprietary standards degrade the quality of the “connectivity” that is *de facto* offered to subscribers, while termination-based discrimination can be used strategically to exacerbate installed base advantages. Still, both types of practices may also contribute to make collusion less likely.

⁵¹ Market growth may also be the sign of a lack of maturity, or of a highly innovative market.

4. E-commerce

Let me conclude with a digression on the impact of e-commerce on collusion in various goods and services markets. Of course, at this stage many uncertainties remain about the development of electronic wholesale and retail trade; the remarks that follow are thus highly speculative.

A first source of concern relates to the development of electronic procurement platforms. These platforms can involve close cooperation between competitors and they may also enhance the information that each of them will have about rivals' production and development plans. "Cooperation" on the buying side may thus have some adverse consequences on the "competition" on the selling side.

At the retail level, many observers predict instead that the development of electronic commerce will foster competition and contribute to lower prices. Setting-up a website certainly involves much lower fixed costs than in the case of traditional brick-and-mortar retail outlets. In addition, regulations that limit the development of large stores are likely to have little bite on electronic commerce. Furthermore, producers may themselves decide to bypass distributors and sell directly "on-line." Last, consumers can more easily compare prices – by "surfing" on the net, or by using "shop bots" that do the research for them.

The reduction in search costs and the increase in the overall number of (electronic or traditional) retailers suggest that indeed, prices will fall, particularly for homogenous goods for which price comparisons are the most effective, as well as for those goods that do not require inspection or trial prior to purchase.⁵²

It can however be stressed that electronic commerce also facilitates price-matching strategies. For example, Barnes & Noble.com can react within a couple of hours to a change in the prices that Amazon.com charges for best sellers – even though its traditional bookstores do not change their prices. The possibility of such quasi-instantaneous price matching (thanks to the sellers' own search engines) can foster collusion.

⁵² Brynjolfsson-Smith (1999) found that books were 9 % to 16 % cheaper on the net, shipping costs included. Prior studies had however found lower differences – and even sometimes, higher prices on the Net. Brokerage commissions for stock exchanges or plane tickets are also cheaper online, even if traditional brokers and travel agencies have started to align their own tariffs.

Electronic trade makes also new strategies available to retailers. For example, Books.com offers a “Price Compare” option which looks for the prices of Amazon.com, Barnes & Noble.com and Borders.com, and aligns its own price on the cheapest one. Such “automatic” price-matching service resembles “most-favoured nations” clauses and a commitment power whose anticompetitive effects have long been recognised.⁵³

There again, it is premature to predict the future evolution of these strategies. This will for example depend on suppliers’ ability to control the electronic commerce of their product – and in particular, to protect their traditional retailers – as well as on distributors’ ability to refuse access to these “shopbots” – as some have tried against Bargain Finder.

⁵³ The commitment to match any price cut reduces the competitors’ incentives to price aggressively.

References

- Abreu, D. (1986), "Extremal Equilibria of Oligopolistic Supergames," *Journal of Economic Theory*, 39:191-223.
- Abreu, D., D. Pearce and E. Stachetti (1985), "Optimal Cartel Equilibria with Imperfect Monitoring," *Journal of Economic Theory*, 39:251-269.
- Aghion, P. and J. Tirole (1997) "Formal and Real Authority in Organizations," *Journal of Political Economy*, 105:1-29.
- Armstrong, M. (1998), "Network Interconnection," *Economic Journal*, 108:545-564.
- Crmer, J. (1995) "Arm's-length Relationships," *Quarterly Journal of Economics*, 2:275-295.
- Bain, J. (1948), "Output Quotas in Imperfect Cartels," *Quarterly Journal of Economics*, 62:617-622.
- Bernheim, D. and M. Whinston (1990), "Multimarket Contact and Collusive Behavior," *Rand Journal of Economics*, 21.
- Brock, W.A. and J. Scheinkman (1985), "Price Setting Supergames with Capacity Constraints," *Review of Economic Studies*, 52:371-382.
- Brynjolfsson, E. and M. Smith (1999), "Frictionless Commerce? A Comparison of Internet and Conventional Retailers," MIT Sloan School of Management.
- Davidson, C. and R.J. Deneckere (1984), "Horizontal Mergers and Collusive Behavior," *International Journal of Industrial Organization*, 2:117-132.
- D'Aspremont, C. and M. Motta (1994), "Tougher Price Competition or Lower Concentration: A Trade-off for Antitrust Authorities," Universit Catholique de Louvain, Discussion Paper n 9415.
- Davidson, C. and R.J. Deneckere (1990), "Excess Capacity and Collusion," *International Economic Review*, 31:521-541.
- Dewatripont, M., and J. Tirole (1999) "Advocates," *Journal of Political Economy*, 107(1):1-39.
- Evans, W.N. and I.N. Kessides (1994), "Living by the 'Golden Rule': Multimarket Contact in the U.S. Airline Industry," *Quarterly Journal of Economics*, 109:341-366.

- Gertner, R. (1994), "Tacit Collusion with Immediate Responses: The Role of Asymmetries," mimeo, University of Chicago.
- Green, E. and R. Porter (1984), "Non-Cooperative Collusion under Imperfect Price Information," *Econometrica*, 52:87-100.
- Haltiwanger, J. and J. Harrington (1991), "The impact of cyclical demand movements on collusive behavior," *Rand Journal of Economics*, 22:89-106.
- Jeon, D.-S., J.-J. Laffont, and J. Tirole (2001), "On the Receiver Pays Principle," mimeo, University of Toulouse.
- Laffont, J.-J. and D. Martimort (1999) "Separation of Regulators against Collusive Behavior," *Rand Journal of Economics*, Vol. 30, n° 2, 232-262.
- Laffont, J.-J., P. Rey and J. Tirole (1998a), "Network Competition: I. Overview and Nondiscriminatory pricing," *Rand Journal of Economics*, 29(1):1-37.
- Laffont, J.-J., P. Rey and J. Tirole (1998b), " Network Competition: II. Price Discrimination" (with Jean-Jacques Laffont and Jean Tirole)," *Rand Journal of Economics*, 29(1):37-56.
- Lambson, V.E. (1987), "Optimal Penal Codes in Price-Setting Supergames with Capacity Constraints," *Review of Economic Studies*, 54:385-397.
- Lambson, V.E. (1994), "Some Results on Optimal Penal Codes in Asymmetric Bertrand Supergames," *Journal of Economic Theory*, 62:444-468.
- Lambson, V.E. (1996), "Optimal Penal Codes in Nearly Symmetric Bertrand Supergames with Capacity Constraints," *Journal of Mathematical Economy*, forthcoming.
- Martin, S. (1993), "Endogenous Firm Efficiency in a Cournot Principal-Agent Model", *Journal of Economic Theory*, 59:445-50.
- Martin, S. (1995), "R&D Joint Ventures and Tacit Product Market Collusion," *European Journal of Political Economy*, 24:357-379.
- Mason, C.F., O.R. Phillips and C. Nowell (1992), "Duopoly Behavior in Asymmetric Markets: an Experimental Evaluation," *Review of Economics and Statistics*, 662-670.
- Motta, M. and M. Polo (2000), "Leniency Programs and Cartel Prosecution," mimeo, available at <http://www.iue.it/Personal/Motta/>.
- Osborne, M., and C. Pitchik (1983), "Price Competition in a Capacity-Constrained Duopoly," *Journal of Economic Theory*, 38:238-260.

- Parker, P.M. and L.-H. Röller (1997), "Oligopoly and the Incentive for Horizontal Merger," *American Economic Review*, 75:219-227.
- Pénard, T. (1997), "Choix de Capacités et Comportements Stratégiques : une Approche par les Jeux Répétés," *Annales d'Economie et de Statistique*, 46:203-224.
- Porter, R. (1983), "A Study of Cartel Stability: The Joint Executive Committee, 1880-1886," *Bell Journal of Economics*, 14:301-314.
- Raith, M. (1996), "Product Differentiation, Uncertainty and the Stability of Collusion," London School of Economics-STICERD Discussion Paper Series EI/16:49.
- Ross, T. W. (1992), "Cartel Stability and Product Differentiation," *International Journal of Industrial Organization*, 10:1-13.
- Rotemberg, J., and G. Saloner (1986), "A Supergame-Theoretic Model of Business Cycles and Price Wars during Booms," *American Economic Review*, 76:390-407.
- Selten, R. (1984), "Are Cartel Laws Bad for Business?," in *Operations Research and Economic Theory*, Hauptmann, Krelle and Mosler eds, Berlin/Heidelberg: Springer-Verlag.
- Schmalensee, R. (1987), "Competitive Advantage and Collusive Optima," *International Journal of Industrial Organization*, 5:351-368.
- Snyder, (1996), "A Dynamic Theory of Countervailing Power," *Rand Journal of Economics*, 27:747-769.
- Spagnolo, G. (2000a), "Optimal Leniency Programs," mimeo, Stockholm School of Economics.
- Spagnolo, G. (2000b), "Self-Defeating Antitrust Laws: How Leniency Programs Solve Bertrand's Paradox and Enforce Collusion in Auctions," mimeo, Stockholm School of Economics.
- Staiger R. and F. Wolak (1992), "Collusive Pricing with Capacity Constraints in the Presence of Demand Uncertainty," *Rand Journal of Economics*, 23:203-220.
- Stigler, G. (1964), "A Theory of Oligopoly," *Journal of Political Economy*, 72:44-61.
- Sutton, J. (1991), *Sunk Cost and Market Structure*, Cambridge: MIT Press.
- Sutton, J. (1998), *Technology and Market Structure*, Cambridge: MIT Press.
- Symeonidis, G. (1999), "Are Cartel Laws bad for Business? Evidence from the UK," mimeo, University of Essex.